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Department of Transport, Tourism and Sport

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

N69 Listowel Bypass

Environmental Impact Statement

Volume 2 of 4: Main Report

May 2017

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Glossary

Below is provided a partial glossary of terms used in this environmental impact statement. The definitions therein are not to be taken as comprehensive but solely as an aid to the non-technical reader.

Term	Definition
AADT	Annual Average Daily Traffic (expressed in vehicles per day)
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.
AOD	Above Ordnance Datum
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.
Baseline survey	A description of the existing environment against which future changes can be measured.
BCI	Bat Conservation Ireland
BCT	Bat Conservation Trust
BEALAP	Blarney Electoral Area Local Area Plan
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)
CAFÉ	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.
Central Reserve	The area which separates the two carriageways of a dual carriageway road or a 2+1 road. Note that this includes any hard strips.
CFB	Central Fisheries Board
CFRAMS	Catchment Flood Risk Assessment and Management Study
CIRIA	Construction Industry Research and Information Association
CLEA	Contaminated Land Exposure Assessment
CMRC	Coastal Marine Resources Centre
CMS	Construction Method Statement
COD	Chemical Oxygen Demand
Cost Benefit Analysis	A comparison of the quantifiable economic benefits (savings in time and accident reduction) of a road scheme against the capital cost of constructing the scheme.
CRTN	Calculation of Road Traffic Noise
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(A)	The term used to express a level of sound or decibel level. The (A) denotes that levels are 'A'-weighted.
Design	Design proposals for the proposed road scheme as presented in the Environmental Impact Statement.
DED	District Electoral Division
DEFRA	Department for Environment, Food and Rural Affairs (UK)
DMRB	Design Manual for Roads and Bridges
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
EA	Environment Agency
EC	European Commission
EEV	Enhanced Environmentally-friendly Vehicle
Embankment	A bank or mound constructed to carry a roadway at a level higher than the original ground level.
EMCs	Even Mean Concentrations
EMSCs	Event Mean Sediment Concentrations
Environmental Impact Assessment- EIA	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.
Environmental Impact Statement- EIS	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.
EU	European Union
EUNIS	European Natura Information System
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
FTE	Full time equivalent (jobs)
g/m^3	Grams per metre cubed.
GAC	Generic Assessment Criteria
GDP	Gross Domestic Product
Geophysical Survey	A non-invasive survey method involving one or more of the following; earth electrical resistance, various types of magnetometry and ground penetrating radar.
GHG	Greenhouse Gases
GPA	Guidelines for Planning Authorities
Grade/Gradient	Slope along any length of road.
CRTN	Calculation of Road Traffic Noise
GSI	Geological Survey of Ireland
GSWR	Great Southern and Western Railway
GVA	Gross value added is the value of output less the value of intermediate consumption; it is a measure of the contribution to Gross Domestic Product (GDP) made by an individual producer, industry or sector
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
HMWB	Heavily Modified Water Bodies
Horizontal Alignment	Direction and course of the roadway on a plan.
HRA	Hot Rolled Asphalt
HWM	High Water Mark
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

Term	Definition
	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
ISO	International Standards Organisation
ITS	Intelligent Transport Systems
IUCN	International Union for Conservation of Nature and Natural Resources
IWeBS	Irish Wetland Bird Survey Data
KER's	Key Ecological Receptor's
l/s	Litres per second.
Landtake	Land required for the construction of the proposed new road. The area of land between the fence lines.
LAP	Local area plan
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.
Long-Term Impact	Impact lasting twenty to fifty years.
LUTS	Cork Land Use and Transportation Study
L_x	Sound that exceeds the level L for x% of the sampling duration.
m/s	Metres per second.
m^3/day	Metres cubed per day.
m^3/hr	Metres cubed per hour.
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
mg/kg	Milligrams per kilogramme.
mg/l	Milligrams per litre.
mg/m^2/day	Milligrams per metre squared per day.
mg/m^3	Milligrams per metre cubed.
MHWN	Mean High Water Neap tide
MHWS	Mean High Water Spring tide
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.
MLWN	Mean Low Water of Neap tides
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
MOVA	Microprocessor Optimised Vehicle Actuation
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.
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.
NIAH	National Inventory of Architectural Heritage
NIS	Natura Impact Statement
NOX	Oxides of Nitrogen.
NPWS	National Parks and Wildlife Service
NRA	National Roads Authority (Transport Infrastructure Ireland was established through a merger of the National Roads Authority and the Railway Procurement Agency in August 2015.)
NSS	National Spatial Strategy
NTM	National Traffic Model
NTS	Non-Technical Summary
NTS (in relation to drawings)	Not to scale
N	Nitrogen
Negative Impact	A change which reduces the quality of the environment (for example,

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	by lessening species diversity and the reproductive capacity of the ecosystem, by damaging health, property or by causing nuisance).
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NTS (in relation to drawings)	Not to scale
OD	Ordnance Datum
OPW	Office of Public Works
OS	Ordnance Survey
Overbridge	Bridge that carries another road/railway over the road under consideration.
P	Phosphorus
PAHs	Polycyclic Aromatic Hydrocarbons
Pavement	Road structure - includes the road surface and the underlying structural layers.
PCU	Passenger car units
Permanent Impact	Impact lasting over fifty years.
pNHA	Proposed Natural Heritage Area
POC	Point of Compliance
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.
QNHS	Quarterly National Household Survey
RBMPs	River Basin Management Plans
Receptor	Any element in the environment which is subject to impacts.
Recharge	The addition of water to the zone of saturation; also, the amount of water added.
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.
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 Construction Details (RCD)	NRA detailed design documents from the NRA publication Manual of Contract Documents for Road Works, Volume 4.
Road Network	Description (often in diagrammatic form) of a system of roadways.
Route	The chosen route for which this EIS 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
SATURN (Traffic Model)	Simulation and Assignment of Traffic to Urban Road Networks
SAC	Special Area of Conservation
Scope / Scoping	The process of identifying the significant issues (scope) which should be addressed by a particular Environmental Impact Statement.
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.
SGVs	Soil Guideline Values
Short-Term Impact	Impact lasting one to seven years.
SI	Statutory Instruments (SIs) are an order, regulation, rule, scheme or bye-law made in exercise of a power conferred by statute.
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

Term	Definition
	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.
SWCH	Surface water channels
SWRBDMP	South West River Basin District Management Plan
SWRFB	South Western Regional Fisheries Board
SWRPG	South West Regional Planning Guidelines
Temporary Impact	An impact which is not permanent or lasting.
TII	Transport Infrasturture Ireland – formerly the National Roads Authority – was established through a merger of the National Roads Authority and the Railway Procurement Agency in August 2015.
TRL	UK Transport Research Laboratory
TSAS	Trophic Status Assessment Scheme
TSS	Total Suspended Solids
UAA	**Utilisable Agricultural Area**
Underbridge	Bridge that carries the road under consideration above another road or railway.
Underpass	A way or passage below another road or structure to facilitate traffic flow.
Underpass (Pedestrian)	A way or passage below another road or structure to facilitate pedestrians or cyclists.
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.
V/C	Volume to Capacity ratio
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.
VID	Visual Impact Drawing
VIS	Visual Impact Schedule
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.
WFD	Water Framework Directive
WHO	World Health Organisation
WMU	Water Management Unit
ZoI	Zone of Influence
95^{th} 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 95% of the time.

1 Introduction & Need for the Proposed Development

1.1 Introduction

The Kerry National Road Design Office (NRDO) of Kerry County Council has developed proposals for a bypass of Listowel Town in County Kerry. Listowel is situated in North Kerry on the N69 Tralee to Limerick National Secondary Route.

The design of the 'N69 Listowel Bypass', hereinafter also referred to as 'the proposed development', has been developed in the preparation of the Environmental Impact Statement (EIS) of the proposed development and to establish land take requirements. This EIS has been prepared on behalf of Kerry County Council by Jacobs Engineering Ireland Ltd, including specialist input from sub-consultants and individuals for the aspects outlined in Table 1-1.

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

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

The location of the proposed development is shown in Figure 1.1.1 in Volume 3 of this EIS. Figure 1.1.1 also identifies the boundary of Listowel Town, as identified in the Listowel Town Development Plan, 2009 - 2015.

The remainder of this chapter is subdivided into the following elements;

- *Listowel;*
- *Integration with Policy Objectives;*
- *Traffic Specific Need;*
- *Proposed Development Objectives;*
- *Non Statutory Public Consultation & Display; and*
- *Legislative Requirement for an EIS.*

A full description of the proposed development is provided in Chapter 2 of this EIS.

Table 1-1 Specialist Sub-Consultant Inputs

Aspect	Sub-Consultant	Further Sub-Consultant	Details
Flora and Fauna and Natural Impact Statement	**Scott Cawley Ltd** Aebhin Cawley and Andrew Speer	Dr Evelyn Moorkens – Independent Consultant Myles Nolan – Independent Consultant	Freshwater Pearl Mussel Invertebrate Survey at River Feale (Spider)
Air Quality & Climate	**AWN Consulting** Sean McMahon	-	-
Noise & Vibration	**AWN Consulting** Stephen Smith	-	-
Landscape & Visual	**Brady Shipman Martin (BSM)** David Bosonnett	-	-

1.2 Listowel

The name Listowel derives from the Irish 'Lios Tuathaill' which means 'Tuathal's Ringfort'. Built adjacent to the River Feale around the middle of the 17th century, the Town developed around Listowel Castle, which was positioned at a strategic river crossing and became an important trading and market town whose relative affluence derived mainly from trade in butter and grain. In that context, it is interesting to note that an eight acre field adjacent to the Town, purchased by a number of enterprising local farmers, was the birthplace of Kerry Group Plc in 1972, one of the world's leading international food production companies.

As the foremost market town in North Kerry, it was and to some extent still is the focal point and main shopping town north of Tralee, with an extensive catchment extending from Tarbert to the east, Ballybunion to the west, Ballylongford to the north and Kilflynn to the south. It could also be considered the 'Hub Town' for villages such as Asdee, Moyvane, Knockanure, Duagh, Lixnaw and Ballyduff.

The layout of the town centre is particularly attractive with a Town Square which is the cultural and commercial focal point of the Town. The Square was set out around the year 1855 and has changed little since that time. In the centre of the Square is St. John's Church which was built as a Protestant Church in 1819 and is now an Arts & Heritage Centre.

The John B. Keane Road is relevant given its importance in completing the bypass of Listowel. Its location is shown in Figure 1.1.1 of Volume 3, with further detail provided in Chapter 2 of this volume of the EIS. It extends from the R553 (Ballybunion Road) to the Caherdown Roundabout on the N69 National Secondary Road, a distance of approximately 2 km.

Construction of the John B. Keane Road commenced in 1996 when the section from the Ballybunion Road to the Ballylongford Road was constructed, with the remainder of the road from the Ballylongford Road (R552) to the Caherdown Roundabout completed in 2000. In 1998 the section of the roadway from the Ballylongford Junction to the N69 was subject to a public consultation process under the Part X planning procedure and was advertised as the 'Proposed Listowel Northern Relief Road'. The report to the Elected Members of Kerry County Council, dated July 1998, refers to the nature and extent of that development as the construction of a 'Northern Relief Road'. On the basis that the road was constructed primarily as a 'Relief Road' for the Town, a limited number of accesses have been permitted onto the road, with no individual access, for example for private dwelling houses, as would usually pertain in an urban street context.

Image 1-1: Photo along the John B. Keane Road between Ballygologue Road and the R552 Junction, looking east

1.3 Integration with Policy Objectives

The provision of an N69 Bypass for Listowel Town is a stated objective of national, regional and local policy documents. This reflects the key role played by the N69 in linking Listowel with the Tralee/Killarney Hub, the Tarbert Industrial Landbank, the Port of Foynes, the Limerick/Shannon Gateway and the wider region. The proposed development is in compliance with the various development plan policies at national, regional, county and local level.

The applicable policy is set out in the following policy documents:

- *National Spatial Strategy for Ireland, 2002-2020;*
- *Smarter Travel, 2009;*
- *South West Regional Authority - Regional Planning Guidelines, 2010-2022;*
- *Kerry County Development Plan, 2015-2021;*
- *Listowel Town Development Plan, 2009-2015; and*
- *Listowel/Ballybunnion Functional Areas Local Area Plan 2013 – 2019.*

Relevant details in relation to each of these documents are provided hereunder which confirm that the proposed development is consistent with National, Regional and Local policy.

1.3.1 National Spatial Strategy for Ireland, 2002-2020

This National Spatial Strategy for Ireland 2002 – 2020 (NSS) is a twenty year planning framework designed to achieve a better balance of social, economic, physical development and population growth between regions. Its focus is on people, on places and on building communities. It considers that through closer matching of where people live with where they work, different parts of Ireland will for the future be able to sustain a better quality of life for people, a strong, competitive economic position and an environment of the highest quality. The Strategy 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 3.3.4 of the National Spatial Strategy for Ireland, 2002-2020 (NSS) deals with revitalisation of the West and South West wherein it states that “the research carried out for the NSS into rural and urban trends and economic performance has identified certain areas – primarily along the coast in parts of Cork, Kerry, Clare and Galway – that have been experiencing economic growth and revitalisation based on the diversification of an economy previously centred on agriculture. To support the revitalisation of areas in the South West, Tralee and Killarney will act as linked hubs. This will capitalise on the combined capacities of both towns, such as those in third-level education, developing links between industry and centres of learning, surface and air transport links and key natural resources such as scenic landscape. For the linked hubs to function effectively, improved local linkages will be required through road network and bus-based public transport options, improved energy and telecommunications”.

Section 4.7 of the NSS states that in regard to county towns and towns over 5,000 populations in the South West Region, “Tralee, Killarney and Mallow, as hubs, will perform important roles with the national structure at the regional and county level. Improvements in regional accessibility through roads, advanced communications infrastructure and public transport links are key supporting factors”.

The NSS states the following in relation to Listowel: “Towns such as Listowel, Kanturk, Charleville, Mitchelstown and Fermoy have historically developed to serve strong rural and agricultural hinterlands. Capitalising on the location and attractions of such centres on or near important transport corridors will become an important part of diversifying these towns as their reliance on traditional economic activities lessens.” Therefore, given that the proposed development is predicted to reduce congestion within Listowel, and will improve the links between Listowel and adjacent towns, this will serve to capitalise on its location and attractiveness, which is consistent with the aspirations of the NSS.

1.3.2 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 choose 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 angles: it will lead to further congestion, further local air pollution, contribute to global warming, and result in negative impacts to health through promoting 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.*

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

1.3.3 South West Regional Authority - Regional Planning Guidelines, 2010-2022

The South West Regional Authority is the statutory authority for the South West Region of Ireland. The Planning and Development Act, 2000 requires Regional Authorities to make Regional Planning Guidelines in respect of their region and to review the Guidelines at intervals not exceeding six years. The Regional Planning Guidelines (RPGs) is a strategic policy document designed to steer the future growth of the region over the medium to long term and works to implement the strategic planning frameworks set out in the NSS. The RPG sets out high level strategies, in line with the NSS and promotes the overall sustainability and growth of the region.

Section 2.1 of the RPG states; ‘‘To give effect to this vision and in order to prepare an overall development strategy, it is necessary to identify specific planning areas that can assist in the formulation of strategic guidelines for the future development in the region. Within these planning areas, there are a number of strategic growth corridors that provide connectivity and linkages. The key corridors are:

- *Atlantic Corridor/Inter-regional corridors;*
- *Along the N21/N69 national road from Tralee to Limerick; and*
- *Intra–regional corridors–main national roads linking main towns of regional importance throughout Cork and Kerry.”*

Chapter 5 of the RPG sets out the key physical infrastructure needs for the region, providing an integrated framework for future land use and national investment in infrastructure. Within Chapter 5, the N69 (and N21, & N67) is identified as a significant strategic road investment in the region, linking the Tralee/Killarney linked Hub with the Tarbert/ Ballylongford deepwater port and landbank and Limerick through the Tarbert Ferry.’’ Therefore the need for the N69 Listowel Bypass is identified in the RPG.

1.3.4 Kerry County Development Plan, 2015-2021

The Kerry County Development Plan, 2015-2021 sets out the strategic aim of the Transport and Infrastructure Strategy of the overall Plan to maintain and provide additional key infrastructure and to work with other agencies in the sustainable provision of infrastructure to attract new business investment and people into the county through the implementation of policy and objectives stated within the Plan. Relevant Objectives of the Plan are listed in Table 1-2.

Table 1-2 **Kerry County Development Plan, 2015-2021, Policy Objectives for National Routes**

Objective	Stated Objective / N69 Listowel Bypass Compliance
Objectives RD-4 & RD-20	Seeks to provide or facilitate the sustainable provision of all infrastructure projects including road schemes and by-passes as outlined in Table 7.1a/b. The N69 Listowel by-pass is included.
Objective H-8	Seeks to support local Tidy Towns groups in their approach to the natural and built heritage. Tidy Towns groups can facilitate and promote the physical and visual enhancement of the town. In order for the town to develop and to maximize its potential it needs to be an attractive, easily accessible, relaxing, pedestrian friendly place to live and visit. The town needs to develop without the significant intrusion that comes with a continuous stream of through-traffic travelling through its core and along its main shopping streets.
Objective H-14	Seeks to promote and develop the arts, cultural and heritage attractions throughout County Kerry. Listowel is sometimes described as the "Literary Capital of Ireland" as it is the home of Ireland's biggest literary festival while it is also the joint longest racing festival in Ireland. The reduction in vehicular traffic through the town centre will facilitate the further development of these festivals.
Objective H-26	Seeks to secure the preservation of all sites, features and objects of archaeological interest within the County. Listowel Castle is of major archaeological interest. The reduction of traffic through the town adjacent to the Castle would further preserve the structure
Objective H-42	Seeks to promote the positive enhancement of existing Architectural Conservation Areas (ACA). There is an ACA designation within the Square and there are a large number of protected structures within the town centre. The reduction in vehicular traffic through the town centre will facilitate the further enhancement and protection of the ACA.
Objective H-49	Seeks to support the designation of Listowel as a Historic Town. Kerry County Council supports the designation of Listowel as a Historic Town in association with the Historic Towns Initiative from the Heritage Council. In this pilot scheme, the Heritage Council is seeking to combine the conservation and protection of the built and natural heritage. It is envisaged that the reduction in the flow of traffic through the narrow winding streets of the historic core of the town would protect the urban fabric of the town including the Square and Listowel Castle.

1.3.5 Listowel Town Development Plan, 2009-2015

The Listowel Town Development Plan 2009-2015 was adopted by Listowel Town Council in May 2009. It sets out a number of road policy objectives for the Town, as listed below in Table 1-3.

Table 1-3 **Listowel Town Development Plan, 2009-2015, Road Policy Objectives**

Objective	Stated Objective
MAC 31	Provide a bypass of the town of Listowel as indicated in Table 7.19 of the Kerry County Development Plan 2015 – 2021.
MAC 32	Reserve land for and co-operate with Kerry County Council and the NRA in order to provide the Listowel N69 Bypass and to protect the Route Option Corridor for the bypass from further development prior to the establishment of a final route.
MAC 35	Reserve part or all of the lands generally along the line of the Lartigue railway jointly in the ownership of Listowel T.C. and Kerry County Council for the continuation of an Inner Relief Road with footpaths and cycle ways with the cooperation. The route selection process optimised the use of existing infrastructure along the John B. Keane Road. This road was built in the 1990's with the specific aim of providing a relief road. The proposed development of the bypass along the John B. Keane road could promote the development of the industrial/business zoned lands in Clieveragh.

The provision of a bypass is also in accordance with the overall strategy and vision for Listowel as outlined in the Listowel Town Development Plan 2009-2015 that includes:

- *Improving the quality of life of all the citizens of the town;*
- *Providing for the development of the town in a manner that is sustainable and protects its social, cultural, environmental and economic assets;*
- *Ensuring the provision of adequate infrastructure and services to cater for the existing and future needs of the town;*
- *Protecting and enhancing the health of the town centre by facilitating and supporting measures which improve its vitality and viability;*
- *Promoting social inclusion and a more participative society by providing accessibility to public and social services and facilities;*
- *Providing a more pedestrian and cyclist friendly environment in the town;*
- *Promoting the concept of a walkable town centre which reduces conflict between the needs of pedestrians and motorists;*
- *Ensuring that the local road network provides ease of access to and between the various areas in the vicinity of the town;*
- *Seek to promote effective urban renewal within the town; it is considered that the reduction in vehicular traffic through the town would promote urban regeneration and renewal. This urban renewal would maximise the economic value of tourism and economic activity in the town and therefore the potential attractiveness of shopping and socialising in the town will be increased. This potential increase in economic activity could reduce the property vacancy rate;*
- *Seek to promote the protection and enhancement of the built heritage including ACAs. The reduction in vehicular traffic through the town centre will protect the built heritage; and*
- *Improving linkages between Listowel Town and the Tralee/Killarney development hub, the Limerick/Shannon gateway, the Tarbert Industrial Landbank and the Port of Foynes.*

1.3.6 Listowel/Ballybunnion Functional Areas Local Area Plan 2013 - 2019

The Listowel/Ballybunnion Functional Areas Local Area Plan was adopted by Kerry County Council in July 2013. Its purpose is to provide a comprehensive local planning framework for the development of the combined Listowel/Ballybunion Functional Area. When taken in conjunction with the Regional Planning Guidelines and the County Development plan, it completes the planning framework for the North Kerry area.

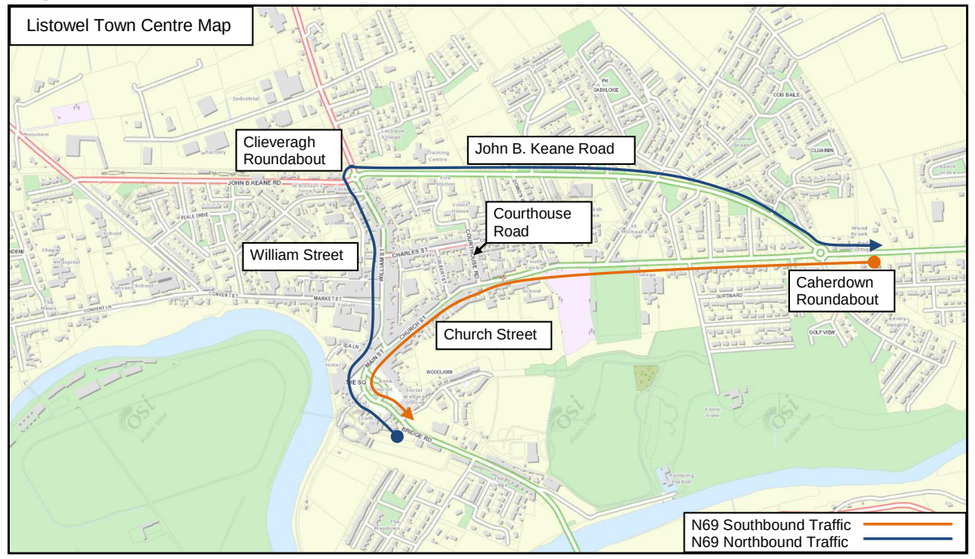
- *Objective NR-1 of the Local Area Plan identifies the following Objective: "Facilitate the sustainable development of the N69 Listowel Town Bypass Scheme subject to Environmental Impact Assessment and Article 6 Habitats Directive Assessment at project level stage." Therefore the Listowel/Ballybunnion Functional Areas Local Area Plan supports the development of the N69 Listowel bypass.*
- *Objective 5 of the Core Strategy; Seeks to provide for a more pedestrian and cyclist friendly environment in the town, promote the concept of a walkable town centre which reduces conflict between the needs of pedestrian and motorist and improve linkages between Listowel and the Hub towns, the Limerick/Shannon gateway, the Tarbert Industrial Landbank and the Port of Foynes. This objective will be facilitated by the development of the proposed Bypass.*

Therefore, as can be ascertained from the above referenced policy documents, there is strong National, Regional and Local Policy supporting the development of the N69 Listowel Bypass.

1.4 Traffic Specific Need

The cross-section of the existing N69 through Listowel Town Centre is a single carriageway road of varying width, with national traffic required to use the narrow road network in the town square and surrounding streets. A one way system is in operation within the centre of Listowel Town, which requires traffic travelling south through Listowel to use Church Street, whilst traffic travelling north is diverted north via William Street, onto the Clieveragh roundabout, and then east onto the John B. Keane Road to the Caherdown Roundabout to continue east along the N69. Traffic travelling south through Listowel has to give way to traffic joining the N69 from Courthhouse Road, turning west to travel along Church Street. The below image extract provides a graphical representation of the N69 network layout in Listowel Town centre, whilst Figure 1.1.1 in Volume 3 depicts the wider route of the N69 as it approaches and runs through Listowel.

Image 1-2: Listowel Town Centre



The N69 currently runs through a busy retail area, generally bounded by car parking on one or both sides of the road, with significant pedestrian activity in the area. All of these

factors contribute to slow moving traffic, having to yield or stop to accommodate parking cars, pedestrian activity, retail deliveries and other activities associated with a busy market town.

There are also over twenty access points, comprising side roads and local accesses along the existing N69 between its junction with the R557 and Caherdown Roundabout (refer to Figure 1.1.2), which equates on average to an access point every 200m. Turning vehicles associated with these access points also contribute to slow moving traffic. There are significant traffic volumes using the N69 as it travels through Listowel, notably at the following locations (figures are 2013 AADT (total 24 hour flow) traffic levels);

- Church Street: 8170 vehicles (note this is a one way flow);
- Bridge Road: 14950 vehicles (note this is a two way flow); and
- William Street: 9480 vehicles (note this is a one way flow).

These locations, including other notable locations and their corresponding traffic flows, are depicted in Figure 1.1.2, Volume 3. This figure shows the traffic flows in 2013, and also shows the modelled traffic volumes in 2017, and 2032, the Design Year associated with the proposed development, i.e. the year in which the proposed development is assessed in the context of its ability to accommodate future traffic growth. The route of the existing N69 through Listowel, northbound and southbound, is also depicted in Figure 1.1.2.

These significant flows, travelling through the narrow urban streets of Listowel, result in significant congestion within the town of Listowel, and also interrupts national traffic which is travelling through Listowel along this section of National Secondary Road. In addition to this, in the absence of any intervention, predicted increased traffic demand will result in further congestion . Note the following increases in traffic volumes, presented in Table 1-4, along these sections of the N69, predicted to occur in the years identified above as 2017 and 2032.

Table 1-4 Current and Projected Traffic Growth

Location	2013 AADT	2017 AADT	2032 AADT
N69 Church Street (1 way)	8170	8780	10160
N69 Bridge Road (2 way)	14950	16350	19170
N69 William Street (1 way)	9480	10020	11290

As can be seen from this table, significant increases in volumes are predicted to occur, notably on the N69 at Bridge Road, where an almost 30% increase in traffic is expected to occur between 2013 and 2032, which will lead to further congestion and delays. The above future traffic projections are derived from a traffic model prepared specifically to analyse the existing and future traffic patterns in the area, which was developed using a software package titled 'VISUM', a macroscopic travel-demand modelling software, which is appropriate for the level of analysis required. Full details on the software model development, its compliance in terms of its calibration and validation, and all the outputs derived from the model are presented in a separate report titled the 'N69 Listowel Bypass Traffic Modelling Report', which was completed in August 2015. Note that the software predicts traffic volumes and patterns based on three different growth scenarios, titled 'low', 'medium' and 'high'. The traffic associated with all three growth scenarios are presented in the Traffic Modelling Report, however only those figures associated with 'high' growth forecasts are presented in this EIS. The selection of the high growth forecast ensures that a conservative approach is taken in the context of any mitigation identified.

The congestion associated with the traffic volumes results in journey time delays for traffic travelling along the N69, with predicted increases in traffic flows further contributing to increased delays. In particular for example, traffic travelling northbound along the N69 through Listowel in the evening (between 5pm and 6pm), along the route and between the start and end points shown on Image 1-4, takes approximately 8 minutes to complete (in 2013), at an average speed of only 40 km/h, and at significantly slower speeds through the very centre of Listowel Town, along Bridge Road and William Street etc.

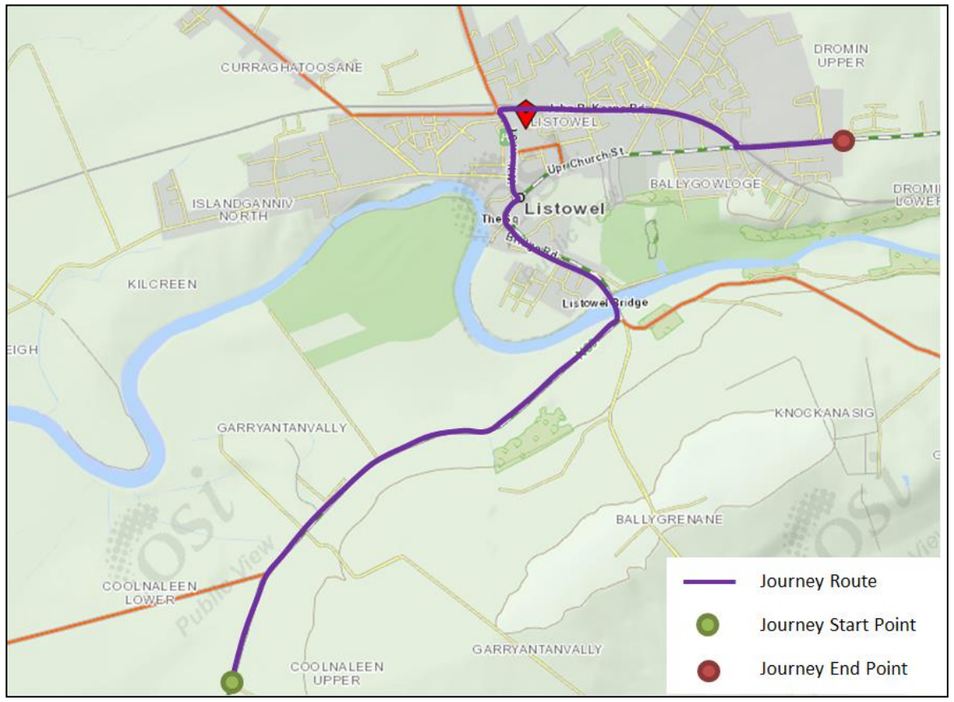


Image 1-3: Journey Time Route through Listowel (Northbound)

However, with increased levels of congestion expected due to increased traffic demand, traffic modelling predicts this same trip will increase to approximately 10 minutes in 2017, and further increase to 18 ½ minutes in 2032, over twice the length of time it currently takes, at an average approximate speed of only 18 km/h. This information is depicted graphically in Image 1-5 (with minutes depicted on the Y-Axis, and Years depicted on the X-Axis).

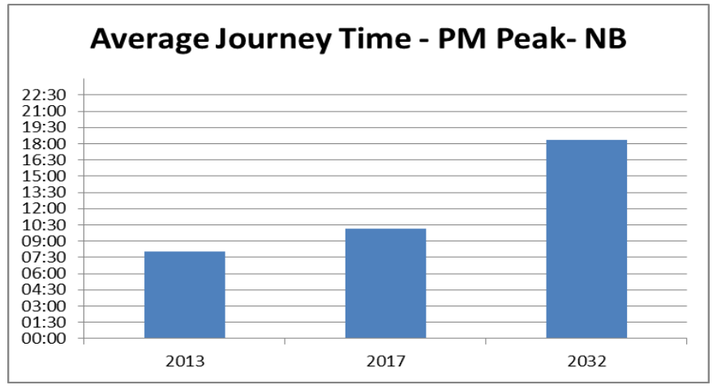


Image 1-4: Average Journey Time, Northbound.

Similarly for the reverse journey in the same evening period, albeit utilising the one-way element of the N69 via Church Street, see Image 1-6 below, the journey currently takes approximately 7 minutes to complete, at an average speed of approximately 42 km/h, again with a significantly slower speed through the very centre of Listowel.

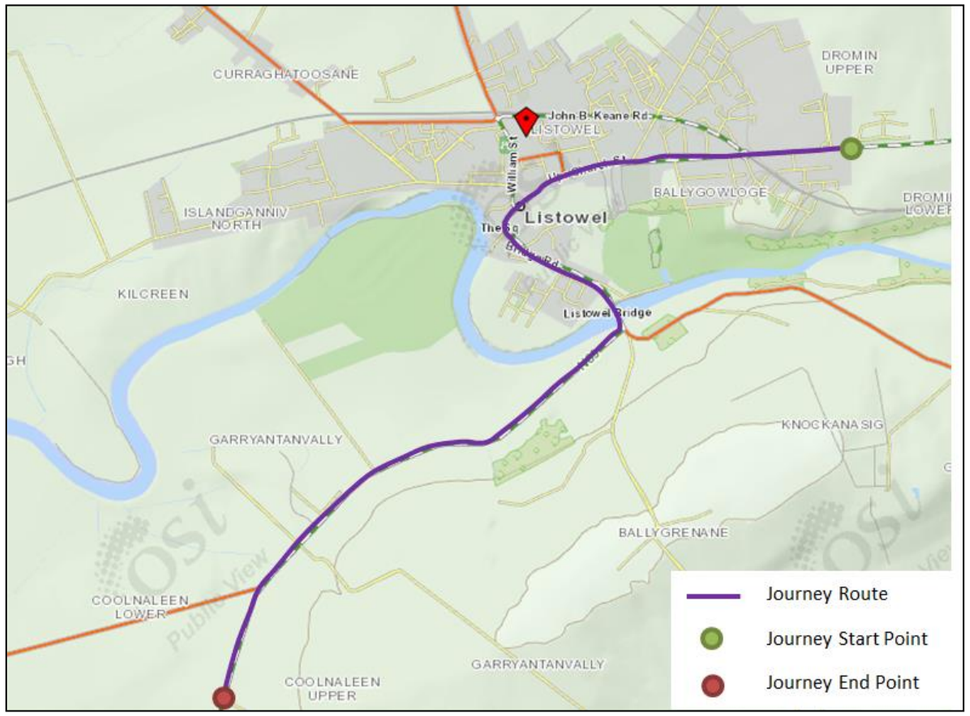


Image 1-5: Journey Time Route through Listowel (Northbound)

Again however, increased levels of congestion as a result of future traffic demand, means this journey will take over 8 minutes in 2017, and as much as approximately 15 minutes in 2032, at an average speed of just over 20 km/h. This information is depicted graphically in Image 1-6.

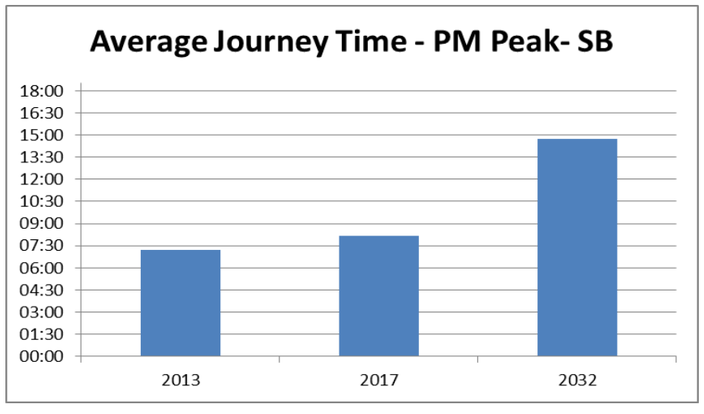


Image 1-6: Average Journey Time, Southbound.

Therefore, traffic travelling along the N69 through the town of Listowel is currently subjected to high levels of congestion, resulting in increased journey times, which will be exacerbated in the future such that journey times in the evening period will approximately double by 2032 (from 2013), in the absence of any form of intervention.

As can be noted from the above, there is insufficient capacity along the existing N69 to accommodate current traffic volumes utilising the N69 through the town of Listowel. This lack of capacity is resulting in delays, which will be significantly intensified by future traffic growth, as presented above for 2017 and 2032. Therefore there is a specific need to address this current congestion issue, which will be exacerbated in the future.

1.5 Proposed Development Objectives

The design brief for the proposed development can be summarised as follows: "To design the proposed route identified in The N69 Listowel Bypass Road Improvement Scheme, Phase 2 Route Selection Report, December 2012 in accordance with prescribed technical standards, statutory provisions and service requirements." Details in relation to the Route Selection process are provided in Chapter 3 of this EIS.

The overall approach to the proposed development is based on the following key operational goals/objectives:

- *Meet the objectives of National, Regional County and Local Policy Documents;*
- *Reduce journey times on the N69 through Listowel;*
- *Reduce congestion within Listowel Town Centre;*
- *Provide opportunity for the revitalisation of the town of Listowel;*
- *Support the sustainable development of Listowel Town;*
- *Reduce collisions and fatalities on this section of the N69;*
- *Provide opportunity for creating a safer environment for pedestrians by removing National Traffic from Listowel Town Centre;*
- *Provide an economically viable proposed development in line with Government public spending code directive. (one that provides a Benefit to Cost Ratio greater than 1 and a positive Net Present Value); and*
- *Provide a proposed development that will improve accessibility.*

Chapter 2 of this EIS identifies how the proposed development complies with the above referenced objectives.

1.6 Non Statutory Public Consultation & Display

A non-statutory public consultation (in relation to proposed route options under consideration), public display (in relation to the preferred option/route) and Public Information Day were undertaken in relation to the proposed development.

The N69 Listowel Bypass proposed Route Corridor Options were presented to the Listowel Electoral Area Meeting on Monday 26th September 2011, to the Kerry County Council Senior Management Team on Tuesday 27th September 2011 and to Listowel Town Council on Monday 3rd October 2011. A search of the Land Registry Database was undertaken for details of affected landowners and on Monday 3rd October 2011 each registered landowner was sent a questionnaire inviting submissions and a drawing showing the Study Area, Constraints and the proposed Route Corridor Options. The drawings were put on display for viewing by the public at Kerry NRDO, Kerry County Council County Buildings, Listowel Town Council and Listowel Town Library from Tuesday 4th October 2011 to Friday 28th October 2011. The closing date for receipt of submissions was Tuesday 1st November 2011. The Public Consultation was advertised in the Kerryman newspaper of Wednesday 28th September 2011 and on Radio Kerry on Tuesday 4th October 2011. On completion of the route selection process, a preferred route/option was identified.

The N69 Listowel Bypass Preferred Route was placed on display for public viewing from 7th November 2012 until 7th December 2012 in the following locations:

- *Kerry County Council, County Buildings, Ratass, Tralee, Co. Kerry;*
- *Kerry National Road Design Office, Kerry County Council, The Island Centre, Castleisland, Co. Kerry;*
- *Listowel Town Council, Áras and Phiarsaigh, Listowel, Co. Kerry; and*
- *Listowel Library, Civic Centre, Listowel, Co. Kerry.*

Advertisements detailing the public display were issued on 7th November 2012 in the Kerryman Newspaper and on Radio Kerry. These advertisements are shown in Image 1-7 and 1.8 respectively.

COMHAIRLE CONTAE CHIARRAÍ
KERRY COUNTY COUNCIL

N69 SEACHBHÓTHAR LIOS TUATHAIL
N69 LISTOWEL BYPASS [KY-06-290]
TAISPEÁINT POIBLÍ
PUBLIC DISPLAY

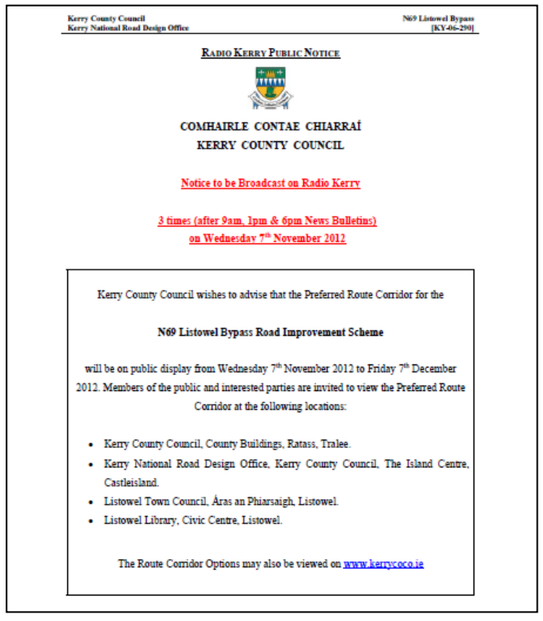
Kerry County Council's National Road Design Office has identified a Preferred Route Corridor for the above scheme. The Preferred Route Corridor will be on display from Wednesday 7th November 2012 to Friday 7th December 2012 at the following locations:

1) Kerry County Council, County Buildings, Rathass, Tralee.
2) Kerry National Road Design Office, Kerry County Council, The Island Centre, Castleisland.
3) Listowel Town Council, Áras an Phiarsaigh, Listowel.
4) Listowel Library, Civic Centre, Listowel.

The Preferred Route Corridor may also be viewed on **www.kerrycoco.ie.**

Sinlú: Gerard O'Brien/*Gearóid Ó Briain*
Acting SEO/*Feidhmeannach*
Sinsearach Gníomhach,
Corporate Affairs/*Gnóthaí Corparáideacha*

Image 1-7 : Public Display Advertisement



Kerry County Council
Kerry National Road Design Office

N69 Listowel Bypass
[KY-06-290]

RADIO KERRY PUBLIC NOTICE

COMHAIRLE CONTAE CHIARRAÍ
KERRY COUNTY COUNCIL

Notice to be Broadcast on Radio Kerry

3 times (after 9am, 1pm & 6pm News Bulletins)
on Wednesday 7th November 2012

Kerry County Council wishes to advise that the Preferred Route Corridor for the

N69 Listowel Bypass Road Improvement Scheme

will be on public display from Wednesday 7th November 2012 to Friday 7th December 2012. Members of the public and interested parties are invited to view the Preferred Route Corridor at the following locations:

- Kerry County Council, County Buildings, Ratass, Tralee.
- Kerry National Road Design Office, Kerry County Council, The Island Centre, Castleisland.
- Listowel Town Council, Áras an Phiarsaigh, Listowel.
- Listowel Library, Civic Centre, Listowel.

The Route Corridor Options may also be viewed on www.kerrycoco.ie

Image 1-8: Public Display Advertisement

In addition, a Public Information Day was held in the Listowel Arms Hotel on the 21st September 2016 between midday and 8pm. The information day was well attended by members of the public with a brisk stream of attendees across the day and large numbers between 5pm and 8pm in particular. A sign in sheet and comment sheets were available and attendees invited to register their attendance and submit comments. Almost 60 people registered their attendance however this represented a fraction of the large numbers that did attend, the majority of which attended for information or preferred to discuss their comments directly with Kerry County Council staff members. Attendees comprised Landowners, Town Traders, Kerry County Council Members and the general public including Local Interest Groups.

1.7 Legislative Requirement for EIA

An Environmental Impact Assessment Screening Report was prepared in April 2013. The purpose of this report was to identify the legal requirement or otherwise for an Environmental Impact Assessment (EIA) for the project. This EIA Screening Report documented the methodology applied during the screening of the proposed development, with reference to relevant legislation and guidance documents.

In summary, as the proposed development passes through the Lower Shannon Special Area of Conservation (SAC), and as the River Feale Bridge element of the proposed development was likely to be greater than 100m, an EIA was deemed necessary under two of the mandatory triggers. A copy of the EIA Screening Report is included in Appendix 1.1. Note this Screening Report was issued to An Bord Pleanala by Kerry County Council as part of a request for the Board to exercise its power under section 50(1)(b) of the Roads Act 1993, as amended, to direct the road authority to prepare an EIS in respect of the proposed development.

An Bord Pleanala subsequently directed Kerry County Council to prepare an EIS on the 12th July 2013. The following matters were considered by the Board in making its decision;

- *The nature of the proposed road development, which includes a bridge likely to be in excess of 100metres;*
- *The environmental sensitivity of the proposed route in that it passes through a Natura 2000 site – the Lower River Shannon Special Area of Conservation*
- *The environmental sensitivity of the proposed route in relation to the built-up urban and residential areas through which it passes*
- *The submissions made to the Board by the road authority; and*
- *The report and recommendation of the person appointed by the Board to make a report and recommendation on the matter.*

2 Description of the Proposed Development

2.1 Location of the Proposed Development

In the context of the national road network, Listowel is situated on the N69 Tralee – Limerick National Secondary Route. The existing N69 commences in Tralee and runs northwards through the heritage town of Listowel and the ferry port village of Tarbert. It then follows the mouth of the River Shannon through the industrial Port of Foynes before terminating at Limerick City. It is the main access route to Limerick/Galway/Dublin for residents in North Kerry and provides an alternative to the N21 National Primary Route between Tralee and Limerick. The N69 carries a high volume of Heavy Commercial Vehicles (HCV's) travelling through North Kerry and to/from the Port of Foynes. It is a popular route for tourists for accessing the Killimer-Tarbert ferry and also for its scenic views across the Shannon estuary. Refer to Figure 1.1.1 (Location Plan) contained in Volume 3, for the location of Listowel and the N69 in the context of the above references.

2.2 Description of the Proposed Development

Refer to Figures 2.1.1-2.1.13 in Volume 3 for the location and layout of the proposed development. The below description should be read in conjunction with these figures to aid understanding. The proposed development is a combination of new road construction and upgrades to existing roads. It includes new road construction through greenfield lands around the west of the town and the upgrade of the existing John B. Keane Road along the northern fringe of the town as well as side road realignments, junction upgrades and the provision of new pedestrian and cycle infrastructure.

The proposed development comprises approximately 7 km of construction between the existing N69 at Billeragh, south of Listowel Town and the existing N69 in Ballygowloge (refer to Figure 2.1.1 for the proposed development terminus locations). It consists of approximately 3.8 km of new greenfield road construction, 1.2 km upgrade/realignment of existing road, and 2 km of upgrade to the John B. Keane Road and provision of new shared cycle and pedestrian facilities.

The proposed development commences on the existing N69 in the townland of Billeragh approximately 0.7 km south of its junction with the R557 to Finuge and continues along the N69 for a distance of approximately 0.25 km. It then leaves the existing road alignment and proceeds north as greenfield construction through the townland of Coolnaleen and Garryantanvally, intersecting the R557 to Finuge at a new roundabout (Roundabout 1), then continuing north. It crosses two streams, the Ballygrenane Stream (WF4) and the Garryantanvally Stream (WF5), before crossing the River Feale by means of a river bridge. Continuing northwards, it crosses the Mill Stream Lower (WF1) and then intersects Local Road L1011, known locally as Greenville Road, at a new roundabout (Roundabout 2). The local road approaches to the roundabout will be realigned slightly to the north on either side to facilitate construction of the roundabout. The mainline then turns northeast, intersecting Local Road L10112, known locally as Forge Road. Access to the northern section of the L10112 will be provided by means of a 'T' junction (Side Road 6) onto the proposed development, while the section of the L10112 to the south of the proposed development will become a cul-de-sac, accessed via the Greenville Road. The proposed development continues northeast, crossing three small streams, and turns east following the line of the disused railway for approximately 0.6 km before turning northeast to avoid an existing cluster of dwellings. It also crosses the Mill Stream Upper (WF0) along this section.

The proposed development then intersects the R553 to Ballybunnion at a new roundabout (Roundabout 3) approximately 0.2 km north of the existing John B. Keane Road/L1050 Convent Street junction. Roundabout 3 will also provide access to the existing Side Road 8.

The existing junction of the R553 John B. Keane Road/L1050 Convent Street will be realigned to give priority to national road traffic. A right turn lane will be provided for traffic turning south onto Convent St (via Side Road 9).

The John B. Keane Road between the L1050 junction and the R552 Ballylongford Road Junction will be redesigned as N69 National Secondary Road. The John B. Keane Road is currently designated as N69 from the junction with the R552 Ballylongford Road. The existing junction with the R552 Ballylongford Road is a small urban roundabout. As part of the proposed development, this will be upgraded to include traffic signals, in place of the existing roundabout, incorporating pedestrian crossing facilities. The entire length of the John B. Keane Road, i.e. between Roundabout 3 (R553 Ballybunion Road) and Roundabout 4 (Caherdown Roundabout) will be upgraded to include a new shared pedestrian and cyclist facility on its northern side which will generally be constructed within the existing road boundary to minimise adverse impact. A short section of this new shared pedestrian and cyclist facility will be directed behind the John B. Keane Road onto a separate existing public road/laneway between the R552 Junction and the John B. Keane Road at chainage 5,670 m (refer to Figure 2.1.5) due to a lack of width along the existing John B. Keane Road at this location to accommodate the required 3 m width for a shared pedestrian/cycleway.

The proposed development comprises four sections, which have been designated Sections A to D as outlined hereunder:

- *Section A (Greenfield Section) – From the N69 Tralee Road tie in to the N69/R557 Roundabout (Roundabout 1);*
- *Section B (Greenfield Section) – From the N69/R557 Roundabout (Roundabout 1) to the N69/L1011 Road Roundabout (Roundabout 2);*
- *Section C (Greenfield Section) – From the N69/L1011 Road Roundabout (Roundabout 2) to the N69/R553 Roundabout (Roundabout 3); and*
- *Section D (Existing Road Upgrade and provision of shared pedestrian/cycleway path) – From the N69/R553 Roundabout (Roundabout 3) to the N69 in Ballygowloge at the existing N69/John B. Keane Roundabout (Roundabout 4).*

2.3 Mainline Carriageway Provision

A Type 1 Standard Single Carriageway (S2) will be adopted as the road cross-section on the greenfield sections of the proposed development (Sections A, B & C). The principal dimensions are shown in Table 2-1 below and shown in Figure 2.1.27. The S2 cross-section will require a minimum road corridor land-take of 30.3 m in width (fence to fence). The pavement will be 12.3 m wide and shall comprise 2 x 3.65 m carriageway and 2 x 2.5 m hard strips. There will be 2 x 3.0 m verges. There will be a 1.0 m offset from cutting and embankment side slopes to open drains which will be provided throughout. The open drains will be a minimum of 2.0 metres wide at ground level. Finally, 2 x 3.0 m strips will be provided between the edge of the open drains and the fence line, as a workspace for maintenance access. The Design Speed will be 100 km/hour and public lighting will be provided at all roundabout junctions.

Table 2-1 Mainline Cross-Sectional Dimensions – Type 1 Single Carriageway (S2)

Verge	Hard Shoulder	Carriageway	Hard Shoulder	Verge	Side Slopes*	Work Space**
3.0 m	2.5 m	2 x 3.65 m	2.5 m	3.0 m	2H : 1V	3.0 m

* Side Slopes of 3H:1V shall be provided at embankments to roundabouts
** Working space is measured from the edge of the open drain, which is 2 m wide and offset 1 m from the side slope

The existing John B. Keane Road is classed as Urban All Purpose Single Carriageway Relief Road and the proposed dimensions of this road type as a result of the proposed development are shown in Table 2-2 below.

Table 2-2 Mainline Cross-Sectional Dimensions – Urban All Purpose Single Carriageway Relief Road.

Offset	Shared Surface*	Segregation	Carriageway	Footpath**
0.65m	3.0m	0.5m	2 x 3.5 m	1.8 m

* Shared Surface Width reduced locally at pinch points.

** Minimum footpath width at pinch points. Footpath width is greater where space allows. Existing footpath kerb line on the southern side of John B. Keane Road will not be changed.

A total of three (3) roundabouts, one (1) river bridge, and one (1) at-grade junction will be constructed as part of the proposed development. Three (3) existing junctions will be realigned as part of the proposed development.

The junction layout at the R552 Ballylongford Road will be upgraded to include traffic signals.

2.4 Description of Proposed Junctions, Side Roads and Interchanges

There are a total of nine (9) side roads in the proposed development. In addition, there are a total of three (3) roundabouts proposed at junctions with existing roads. Six (6) of the proposed side roads are located at the tie-in of existing roads with the proposed roundabouts. Three of the proposed side roads form links with existing roads.

Table 2-3 below lists all roads impacted by the proposed development and the description of work needed to connect all roads. Locations of the roads listed within Table 2-3 are shown on Figures 2.1.14 - 2.1.26.

Table 2-3 Summary of Side Roads

Side Road	Location	Side Road No	Alteration/Modification
L10115	Section A, Chainage 100 m	1	Existing T Junction to mainline maintained. Setback to achieve proper sightlines
R557	Roundabout 1: Section A, Section B and R557	2 & 3	Roundabout 1 (50 m Diameter). SR2 Eastern Arm & SR3 Western Arm. Localised realigning of road to tie-in with roundabout
L1011 (Greenville Road)	Roundabout 2: Section B, Section C and L1011	4 & 5	Roundabout 2 (50 m Diameter). SR4 Eastern Arm & SR5 Western Arm, Localised realigning of road to the north to tie-in with roundabout
L10112 (Forge Road)	Section C, Chainage 3,310 m	6	SR6 - T Junction with mainline. No junction provided to the south. Turning head provided at cul-de-sac.
R553 (Ballybunnion Road) and Private Road	Roundabout 3: Section C, Section D and R553	7 & 8	Roundabout 3 (50 m diameter) SR7 - Northern Arm, Localised realignment of road to tie-in with roundabout. SR8 Eastern Arm realigned to provide access to private road and access to Famine Graveyard via SR8A
L1050 (Convent Street)	Section D, Chainage 5,190 m	9	Realigned as T Junction with Right Turn Lane. Also access to SR9A (Convent View) via T-Junction.

2.5 Description of Proposed Cycle and Pedestrian Facilities

The existing Sive Walk is a local amenity which runs from Listowel Town Square to Derra Bog, partly along existing roads and partly along the disused Great Southern and Western Railway route. The Sive Walk will be accommodated on a new pedestrian walkway to be constructed to the north of the proposed development (see Figure 2.1.4 in Volume 3).

The realigned Sive Walk will be approximately 900 m in length and 4 m wide with 1 m verges. The walk will be surface dressed improving the existing surface which comprises hard standing, approximately 5 m wide which in places becomes muddy in wet conditions. It will be separated from the proposed mainline with boundary screening comprising hedging and other planting.

The point from where it commences will be relocated north of the proposed development, slightly further out from the town, however the proposed development at this location (Section D) will have footpaths on both sides maintaining connectivity to the route. This is an improvement on the present situation.

New footpaths will also be constructed on the western side of the R553 to enhance connectivity to the realigned walk and the footpath on the eastern side will be retained.

In addition to the Sive Walk realignment, a new shared cyclist and pedestrian facility will be provided between Roundabout 3 and Roundabout 4 along the northern side of the existing and upgraded elements of the John B. Keane Road. This facility will be 3 m wide and will be segregated from the existing/upgraded road. Appropriate footpath and dropped kerb tie-ins will be provided to facilitate crossings at all roundabouts and junctions.

2.6 Flood Risk Assessment

A detailed Flood Risk Assessment (FRA) has been carried out in order to assess the potential flood impacts of the proposed development and identify any mitigation measures necessary to ensure that the proposed development is not at risk of flooding and does not cause any potential increase in flooding in the area. The FRA report can be found in Appendix 8.2 of Volume 4. The FRA concluded that the proposed development is at low risk of flooding and will not significantly increase the risk of flooding elsewhere.

The proposed mitigation measures generally include culverts passing under the proposed development at key locations. The culverts and structures vary in size and are used to prevent the build-up of flood waters that would otherwise be caused by the barrier created by the proposed development. The proposed flood relief culverts will be reinforced concrete pipes of dimensions detailed in Table 2-4 and Table 2-5.

Other mitigation measures include local re-profiling of the Mill Stream adjacent to Greenville Road and introducing a land drain in the vicinity of Forge Road and the proposed development (see Figure 2.1.33). The results of the modelling show that following the provision of mitigation measures, there is no increase in flood risk to receptors in the area.

2.7 Other Culverts

A number of 0.9 m diameter concrete pipe culverts are required to maintain connectivity of field drainage ditches that would be severed by the proposed development at locations detailed in Table 2-4.

Table 2-4 List of Culverts as part of the proposed development

Culvert Type	Structure / Culvert Number	Approximate Mainline Chainage (m)	Approximate Dimensions
Flood Relief	C15A-C15J (10 No)	1,410 – 1,580	0.9 m diameter
Flood Relief	C21, C21A & C21B	2,080 – 2,090	0.9 m diameter
Ditch	C33A	3,285	0.9 m diameter
Ditch	C33B*	3,285	0.9 m diameter
Ditch	C33C	3,010	0.9 m diameter
Flood Relief	C33D-C33I (6 No)	3,330 – 3,390	0.9 m diameter
Ditch	C42**	4,240	0.9 m diameter

* Culvert C33B off line adjacent to Culvert C33A
** Culvert C42 offline in 'Sive Walk' field drain adjacent to proposed development chainage of approximately 4,240 m

2.8 Description of Proposed Structures

Refer to Figures 2.1.1 – 2.1.5 in Volume 3 for the locations of the structures. Table 2-5 outlines the structures along the proposed development. A bridge will be provided to cross the River Feale and is discussed further in Section 2.9.

As part of the NRA Technical Acceptance criteria any bridge, tunnel, culvert etc. with a clear span or internal diameter greater than 2.0 m is required to be registered as a structure and undergo formal NRA Technical Acceptance procedure.

(i) Structure ST11 – Accommodation Underpass

Structure ST11 is shown in Figure 2.1.2 & 2.1.29 and is an accommodation underpass to provide access to the farmland severed as a result of the introduction of the proposed development. The proposed structure is a single span structure of a proprietary precast reinforced concrete box system with precast concrete wingwalls on the approaches.

(ii) Structure ST18 – Accommodation Underpass

Structure ST18 is shown in Figure 2.1.3 & 2.1.30 and is an accommodation underpass to allow machinery access to the farmland severed as a result of the introduction of the proposed development. The proposed structure is a single span structure of a proprietary opti-cadre precast concrete box system with reinforced earth wingwalls on the approaches. A kerbed footway will be incorporated to facilitate the safe movement of pedestrians in accordance with TII Standards.

(iii) Structure ST24 – Accommodation Underpass

Structure ST24 is shown in Figure 2.1.3 & 2.1.31 and is an accommodation underpass to provide access to the farmland severed as a result of the introduction of the proposed development. The proposed structure is a single span structure of a proprietary precast reinforced concrete box system with precast concrete wingwalls on the approaches.

(iv) Structure ST27 – Mill Stream Lower Culvert

Structure ST27 is shown in Figure 2.1.3 & 2.1.30 and is a box culvert to allow the existing Mill Stream Lower to flow under the proposed development. The proposed structure is a single span structure of a proprietary precast concrete box system with precast concrete wingwalls.

(v) Structures ST13, ST14, ST15 & ST39 – Watercourse Culverts

Structures ST13, ST14, ST15 and ST39 are 2.1 m internal diameter concrete pipes which prevent the respective watercourses from being severed by the proposed development.

(vi) Structures ST14A, ST15A-ST15C & ST27A-ST27F – Flood Relief Culverts

Structures ST14A, ST15A-ST15C and ST27A-ST27F are 2.1 m internal diameter concrete pipes which act as flood relieving measures. Structures ST27A-ST27F are shown in conjunction with Structure ST27 in Figure 2.1.30.

Table 2-5 List of Structures as part of the proposed development

Structure Purpose	Structure Number	Approximate Mainline Chainage (m)	Approximate Dimensions
Accommodation	ST11	1,095	3.5 m wide, 3.0 m high, 20.0 m long
Ballygrenane Stream	ST13	1,270	2.1 m diameter, 20.0 m long
Stream	ST14	1,390	2.1 m diameter, 25.0 m long
Flood Relief Culvert	ST14A	1,395	2.1 m diameter, 25.0 m long
Stream	ST15	1,525	2.1 m diameter, 50.0 m long
Flood Relief Culvert	ST15A	1,530	2.1 m diameter, 50.0 m long
Flood Relief Culvert	ST15B	1,535	2.1 m diameter, 50.0 m long
Flood Relief Culvert	ST15C	1,540	2.1 m diameter, 50.0 m long
River Feale	ST17	1,650	Width of deck = 16.3 m Main span = 69.0 m Back span = 45.0 m
Accommodation	ST18	1,820	4.5 m wide, 4.5 m high (min), 20.0 m long
Accommodation	ST24	2,440	3 m wide, 2.1 m high, 22.5 m long
Flood Relief Culvert	ST27A	2,660	2.1 m diameter, 22.5 m long
Flood Relief Culvert	ST27B	2,663	2.1 m diameter, 22.5 m long
Flood Relief Culvert	ST27C	2,668	2.1 m diameter, 22.5 m long
Mill Stream Lower	ST27	2,670	3.0 m wide, 2.8 m high, 22.5 m long
Flood Relief Culvert	ST27D	2,672	2.1 m diameter, 22.5 m long
Flood Relief Culvert	ST27E	2,677	2.1 m diameter, 22.5 m long
Flood Relief Culvert	ST27F	2,680	2.1 m diameter, 22.5 m long
Mill Stream Upper*	ST39	3,880	2.1 m diameter, 35.0 m long

* Mill Stream Upper also passes under the realignment of proposed Sive Walk

2.9 Description of the River Feale Crossing (ST 17)

The proposed River Feale Bridge (ST17) spans the river and is located within the townland of Garryantanvally. The structure crosses perpendicular to the river and is a two span arrangement with an intermediate support located within the Lower River Shannon SAC, but outside of the high water channel. The south abutment is set-back, with the intermediate pier set-back from the northern edge of the high water channel. The pier set-back allows for a natural bank path to be maintained for future access for maintenance and fishing and includes an allowance for the curvature of the river. The northern back span has been sized to minimise the overall length of the structure while preventing uplift at the abutment bearings. The length of the main span is approximately 69 m with a back span of 45 m. The general arrangement of the River Feale Bridge is shown Figure 2.1.28 in Volume 3.

Consultation has been undertaken with the Office of Public Works (OPW), the National Parks and Wildlife Service (NPWS) and Inland Fisheries Ireland (IFI) with regard to the appropriate design criteria required for width and freeboard above the design level.

Meetings were held with the NPWS in May 2013 and October 2016 to discuss the ecological assessment for the N69 Listowel Bypass and River Feale crossing options. A meeting was held with the IFI in August 2013 to discuss the proposed development and the River Feale bridge crossing.

2.10 Drainage and Attenuation

There are a number of different types of drainage system adopted for the carriageway drainage system:

- *Sealed Drainage: This drainage system collects, conveys and discharges carriageway runoff via sealed (impervious) conduits. An example of this type of drainage system is the kerb and gully drain. Typically, this type of drainage system is used where footways are provided or on high embankments (> 6 metres).*
- *Grassed Surface Water Channels: Grassed Surface Water Channels are a development of swales for use as road edge channels. The function of the channel is to collect and convey rainwater runoff from the road surface. At suitable points along the channel, water is discharged into a separate carrier pipe or carrier drain. Where Grassed Surface Water Channels are used a Fin Drain should be provided to ensure any percolation through the channel is intercepted before reaching the unbound pavement layers.*
- *Over the Edge Drainage (Open Channels): These drains are used to drain over the edge carriageway runoff on smaller embankments (<6 metres high) and to act as interceptor drains for water from adjoining properties at the top of cut slopes and at the toe of embankments. They are generally trapezoidal in shape, 1 metre wide at the base with 1:1 side slopes. They can be unlined or concrete lined, depending on ground conditions.*

Table 2-6 provides a summary of the drainage methods proposed along the proposed development.

Table 2-6 Summary of Drainage Methods Proposed

Section	Drainage Type	Chainage Left (m)	Chainage Right (m)
Section A	Existing Drainage Maintained	0m-230m	0m-230m
	Grass Surface Water Channel	230m-510m	
	Sealed Drainage System	510m-565m	510m-565m
Section B	Sealed Drainage System	1,000m – 1,050m	1,000m – 1,050m
	Grass Surface Water Channel	1,050m – 1,290m	1,050m – 1,290m
	Surface Water Channel	1,290m – 1,340m	1,290m – 1,340m
	Surface Water Channel	1,340m – 1,590m	1,340m – 1,590m
	Sealed Drainage System	1,590m – 1,725m	1,590m – 1,725m
	Surface Water Channel	1,725m – 1,810m	1,725m – 1,810m
	Surface Water Channel		1,725m – 2,390m
	Surface Water Channel	2,390m – 2,610m	2,390m – 2,610m
	Sealed Drainage System	2,610m – 2,710m	2,610m – 2,710m
Section C	Sealed Drainage System	3,000m – 3,060m	3,000m – 3,060m
	Surface Water Channel	3,060m – 3,290m	3,060m – 3,290m
	Surface Water Channel		3,290m – 3,420m
	Grass Surface Water Channel		3,420m – 3,770m
	Surface Water Channel	3,770m – 4,200m	3,770m – 4,200m
	Surface Water Channel	4,200m – 4,370m	
	Sealed Drainage System	4,370m – 4,480m	4,370m – 4,480m
Section D	Existing Drainage Maintained	5,000m – 7,057m	5,000m – 7,057m

It is proposed, as part of the drainage design for the proposed development, to construct retention ponds (also known as attenuation ponds) which will reduce the likelihood of flooding in the catchment.

The locations, volume and outfall reference of proposed attenuation ponds are shown in Table 2-7. See Figures 2.1.2 – 2.1.5 for the location of these outfalls.

Table 2-7 Attenuation Details.

Attenuation Pond & Outfall Reference	Location	Attenuation Volumes (m^3)
A1	Section B, Ch 1,160 m – 1,240 m, RHS	763.641
A2	Section B, Ch 1,490 m – 1,540 m, LHS	431.117
A3	Section B, Ch 1,760 m – 1,840 m, RHS	586.002
A4	Section B, Ch 2,670 m – 2,710 m, LHS	1028.135
A5	Section C, Ch 3,460 m – 3,560 m, RHS	390.346
A6	Section C, Ch 3,870 m – 3,970 m, RHS	651.422

Pollution Control measures from the proposed development are designed in accordance with HD 33/06, HA 103/06, HA 216/06 of the DMRB.

The proposed road drainage system will primarily incorporate grassed surface water channels, kerb and gully, over the edge drainage, sealed pipes, carrier drains, interceptor ditches, culverts, attenuation areas and pollution control as required in accordance with the above design standards.

Pollution control will be achieved during the conveyance of the road runoff to the attenuation features. Specific features incorporated into the proposed development design include a forebay and wetlands at each outfall location. Grassed surface water channels within the intermediate verges and over-the-edge drainage to grassed swales/carrier drains will allow the runoff to filter through the vegetation.

2.11 Material Requirements

As is typical with any new road construction, various earthworks will be required to construct the proposed development. The approximate earthwork volumes for the proposed development are shown in Table 2-8.

Table 2-8 Material Balance

Section	Cut (000m^3)	Fill (000m^3)	Net (000m^3)
Section A	1.75	1.00	-0.75
Section B	2.28	160.34	158.05
Section C	0.09	41.38	41.29
Section D	0.68	NA	-0.59
Total	**4.81**	**202.81**	**198.00**

From the above table, it can be seen that there is a requirement for some 198,000 m^3 of fill material to construct the proposed development. In order to move the required fill material that cannot be sourced within the road corridor to on-site locations, assuming an 8 month period will return approximately 170 working days. 10 m^3 per truck for 198,000 m^3 over this period returns 117 truck movements per day.

The volumes split south and north of the River Feale are 48,562 m^3 south of the Feale and 150,229 m^3 north of the River Feale. Over eight months this will result in 29 truck movements per day south of the Feale and 88 per day north of the Feale.

Any materials deposited on site not forming part of the permanent works are subject to the Waste Management Act 1996. It should also be noted that not all areas may be suitable for disposal of unacceptable material arising from the site, but nevertheless it may be possible to dispose of all such material in situ. However the nature of materials sourced from cut must be audited to determine its suitability for deposition on site, with particular attention given to possible leachate from wet / peaty material near watercourses, stability of peat spoil and suitability / compatibility with landscaping proposals and planting requirements. Any remaining unsuitable soil may be used as fill to landscape areas and any surplus will require removal to an appropriately licensed receptor site.

2.12 Traffic

Chapter 1 of this EIS identified the traffic need associated with the proposed development, i.e. it highlighted the capacity issues and other constraints which limit the existing N69 in properly performing its function as a National Secondary Route. It highlighted that the existing traffic congestion will significantly worsen between now and 2032, resulting in a doubling of certain travel times through Listowel. In this section 2.12, the general traffic impacts associated with the proposed development are examined, including the predicted future traffic levels along the proposed development and the specific traffic impact within Listowel Town.

The introduction of the proposed development provides an alternative means for traffic to travel along the N69 without having to drive through the centre of Listowel Town, along busy retail streets such as William Street, Church Street, Charles Street and Bridge Road. It also provides an alternative means to access Listowel Town from the east and south, without having to use Bridge Road and Upper Church Street. The proposed development attracts significant volumes of traffic: approximately 6,500 vehicles are predicted to use the proposed development in the present year (2017). Forecast traffic growth will see an increase in traffic on the proposed development to approximately 9,500 vehicles per day by 2032. Traffic volumes on the proposed development, and in and around the general area as a result of the proposed development, are depicted in Figure 2.1.40 of Volume 3.

The traffic volumes shown are those volumes modelled for 2017 and 2032 with the proposed development in place (identified as Do Something traffic volumes). It also includes current and forecast traffic volumes in the situation without the proposed development in place (identified as the Do Minimum traffic volumes); these were previously presented in Figure 1.1.2, which is referenced in Chapter 1, but are also included in this figure for ease of reference and comparison.

Traffic modelling indicates that traffic will transfer to the proposed development from other routes within the general area, including some roads within the town centre that were previously assessed as being inadequate to accommodate the traffic volumes associated with the N69 National Secondary Road. The impact on three of the key streets within the town centre is depicted in Table 2.9 below (these are the same locations previously identified in Table 1-4 in Chapter 1).

Table 2.9 Projected Traffic Volumes (with and without Proposed Development)

Location	2017 AADT		2032 AADT	
	Do Min	Do Something	Do Min	Do Something
N69 Church Street (1 way)	8780	6640	10160	8530
N69 Bridge Road (2 way)	16350	9860	19170	12250
N69 William Street (1 way)	10020	7940	11290	9720

As can be seen from the above table, although there are significant volumes of traffic still using the above town centre roads, they are markedly reduced from the volumes predicted without the proposed development in place. Notably, the traffic volumes on Bridge Road are reduced by approximately 40% with the proposed development in place by the year 2032.

Journey times along the N69, which were significantly hampered by the constraints involved in having to navigate through the narrow, slow moving streets in the town centre, are significantly improved as a result of the proposed development. In re-examining the same journey routes previously considered in Chapter 1, the positive effect of the proposed development on the town centre can be seen.

Image 2-1 below depicts the route between start and end points, travelling north along the N69. These are the same start and end points previously considered in Chapter 1, when assessing journey times along the existing N69. The existing N69 route is again shown and defined as the Do Min Journey Route. The proposed development is also depicted and the Journey Route between the same start and end points, using the proposed development, defined as the Do Something Journey Route.

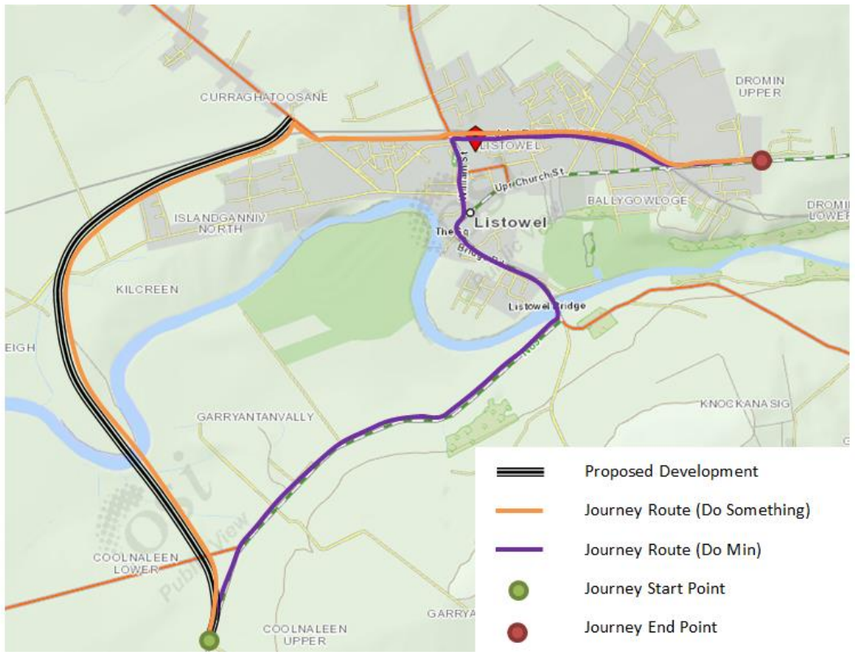


Image 2-1: Journey Time Route, Northbound, with and without Proposed Development

Based on the traffic modelling undertaken, traffic travelling northbound in the evening peak period during 2017, using the proposed development will be able to make this journey in approximately 7 minutes, this compares favourably with the same journey in the absence of the proposed development, which as outlined in Chapter 1 would take over 10 minutes. The benefit associated with the proposed development is again even more pronounced as a result of increased traffic growth up to 2032. In 2032, the journey depicted in Figure 2.1, using the proposed development, would take approximately 7.5 minutes, whereas in the absence of the proposed development, this same journey would take almost 18.5 minutes. This is depicted graphically in Image 2-2 below.

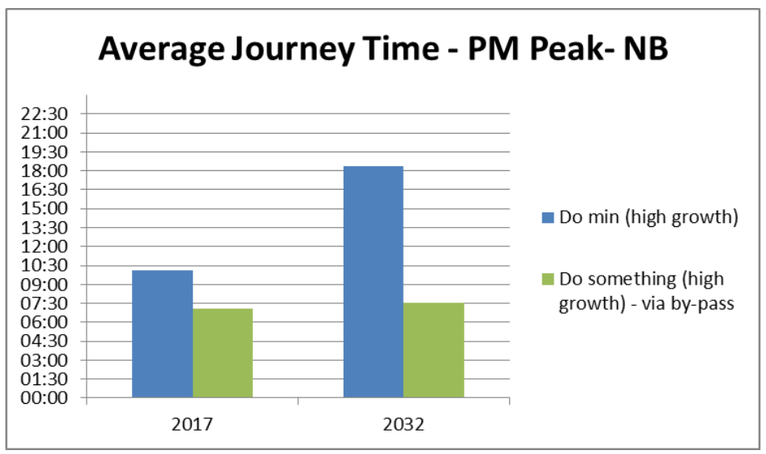


Image 2-2: Average Journey Time, Northbound.

If we analyse the same route in the reverse direction, southbound, as shown in Image 2-3, the benefits are also significant.

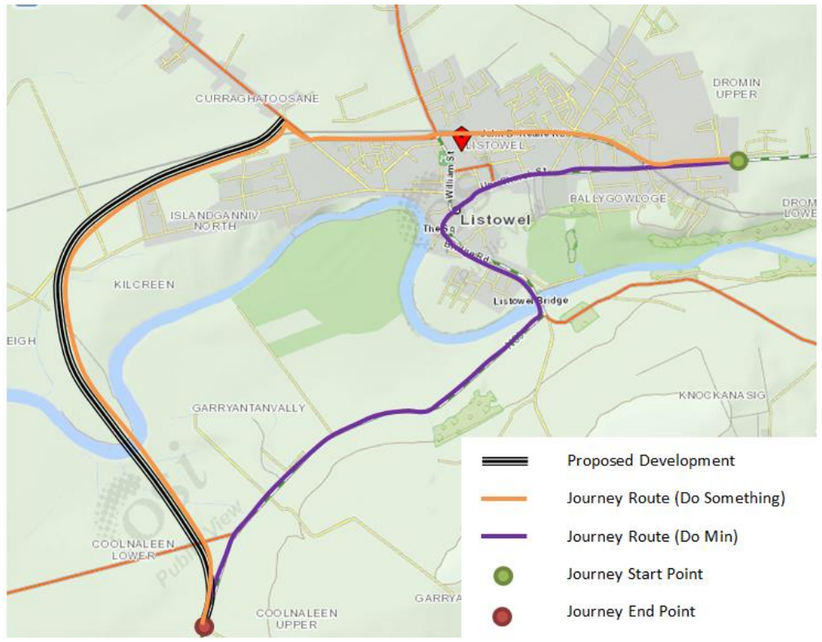


Image 2-3: Journey Time Route, Southbound, with and without Proposed Development

Based on the traffic modelling undertaken, traffic travelling southbound between the start and end points depicted in 2017, which has the option of using the proposed development, will be able to make this journey in approximately 6.5 minutes during the evening peak period; this compares with over 8 minutes in the absence of the proposed development. By 2032, it is predicted that traffic travelling along the same route, using the proposed development, will be able to undertake this same journey in just over 7 minutes, despite the increase in traffic demand over this 15 year period. In the absence of the proposed development, this same journey would take almost 15 minutes to complete in 2032, travelling along the existing N69. Therefore the introduction of the proposed development approximately halves the time necessary to undertake this journey. This is depicted graphically in Image 2-4.

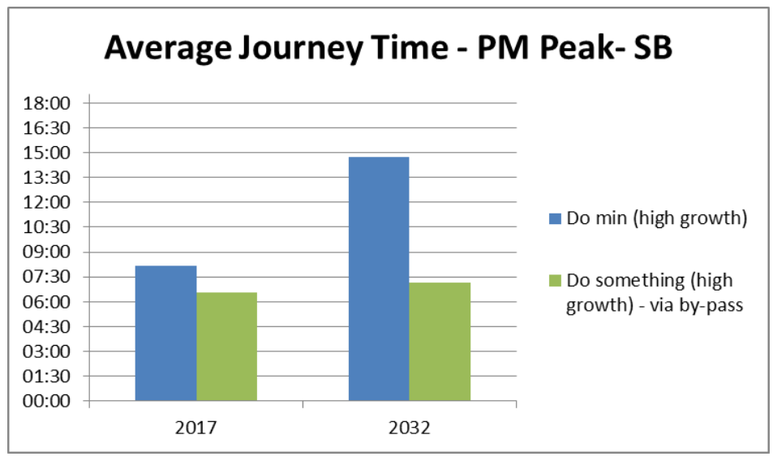


Image 2-4: Average Journey Time, Southbound.

The above results highlight the benefits of the proposed development, not only in removing significant volumes of traffic from the centre of Listowel, but also in reducing the current journey times associated with the N69, and also significantly reducing the future journey times for traffic travelling along the proposed development.

The proposed development incorporates the existing John B. Keane Road to complete the 'bypass' of Listowel, between the L1050 (Side Road 9 Junction) and the existing N69 at the Caherdown roundabout (Roundabout 4). This results in an increase in traffic on this section of the John B. Keane Road. This impact has been examined in detail as part of the traffic modelling process undertaken and reported in the 'N69 Listowel Bypass Traffic Modelling Report'. The impact on traffic volumes in terms of the Do-Minimum and Do-Something scenarios are presented in Figure 2.1.40, with traffic volume details provided east and west of the John B. Keane roads junction with the R552 to Ballylongford. It should be noted that the section of the John B. Keane Road east of its junction with the R552 is currently designated as the N69, and caters for N69 traffic traveling south to north through Listowel Town (with southbound traffic using Upper Church Street). However, the section of the existing John B. Keane Road to the west of this junction, will be reclassified as the N69, up to its tie in with the proposed development, upon the introduction of the proposed development. This section therefore experiences the greatest impact in terms of increased traffic volumes. The traffic volumes are presented in Table 2-9.

Table 2-9 John B. Keane Road Traffic Volumes

Location	2017 AADT		2032 AADT	
	Do Min	Do Something	Do Min	Do Something
John B. Keane Rd (west of R552)	6710	8860	10080	11870
% increase	**-**	**32%**	**-**	**17%**
John B. Keane Rd (east of R552)	7520	7700	10510	10000
% increase	**-**	**2.4%**	**-**	**-0.9%**

As can be seen from Table 2-9, there is limited impact on the John B. Keane Road east of the R552 junction, however there is a significant increase in traffic on its section west of the R552, however, this increase over the Do-Minimum actually decreases with future traffic growth. Detailed junction operational assessments were undertaken at each of the junctions along the John B. Keane Road, which are presented in a separate traffic modelling report titled the 'N69 Listowel Bypass Junction Traffic Modelling Assessment' report. This report outlines the junction modelling undertaken, using three separate pieces of software employed subject to the nature of the junction being assessed as follows:

- *Arcady, for the assessment of roundabout junctions;*
- *Picady, for the assessment of priority junctions; and*
- *Linsig, for the assessment of signalised junctions.*

The analysis determined that following the introduction of the proposed development, the junctions along the John B. Keane road continue to operate within capacity, even under future high growth forecast traffic rates. This includes its junction with the R552, which is being improved as part of this development to include traffic signals to provide priority for future N69 traffic and also to provide safe crossing facilities for pedestrians. Further details in relation to this element of the proposed development are provided in Section 2.2 of this Chapter 2.

The proposed development will remove significant volumes of traffic from some of the most congested elements of the road network within Listowel Town, which are not adequate to deal with current traffic volumes. It will also lead to reduced journey times for traffic travelling along the N69 through Listowel, notably in the evening period, where by 2032 journey times will, as a result of the introduction of the proposed development, be less than half what they would otherwise be.

2.13 Compliance with Objectives

Chapter 1 set out the objectives associated with the proposed development. Table 2-10 below examines these objectives and identifies how the proposed development, as outlined in this chapter, meets same.

Table 2-10 Objectives Compliance

No	Objective	Compliance Consideration	Compliance
1	Meet the objectives of National, Regional County and Local Policy Documents.	The proposed development meets the objectives of National, Regional and Local Policy Documents as set out in Section 1.3.	Yes
2	Reduce journey times on the N69 through Listowel.	As identified in Section 2.12, the proposed development reduces journey times on the N69.	Yes
3	Reduce congestion within Listowel Town Centre.	As identified in Section 2.12, the proposed development reduces congestion within Listowel Town Centre.	Yes
4	Provide opportunity for the revitalisation of the town of Listowel.	Reduced congestion will create a better environment for the revitalisation of Listowel.	Yes
5	Support the sustainable development of Listowel Town.	The proposed development is in compliance with the objectives of National, Regional and Local Policy documents, it will inevitably support the development of Listowel Town in a sustainable manner consistent with the planning documents listed. Much of the lands proposed for retail development are to the north of Listowel Town which is also consistent with the northern bypass proposed.	Yes
6	Reduce collisions and fatalities on this section of the N69.	High quality alternative provided to the existing N69.	Yes
7	Provide opportunity for creating a safer environment for pedestrians by removing National Traffic from Listowel Town Centre.	As identified in Section 2.12, the reduced congestion in Listowel Town combined with the improved pedestrian facilities along the John B. Keane Road will improve the environment for pedestrians.	Yes
8	Provide an economically viable proposed development in line with Government public spending code directive (one that provides a Benefit to Cost Ratio greater than 1 and a positive Net Present Value).	The proposed development demonstrates a positive Net Present Value and a Benefit to Cost Ratio ranging between 2.1 and 3.1 subject to the level of anticipated traffic growth.	Yes
9	Provide a proposed development that will improve accessibility.	The proposed development improves accessibility by providing alternative access routes into and out of different parts of Listowel Town and also includes improved pedestrian and cyclist provision.	Yes

3 Outline of Alternatives

3.1 Introduction

Various alternative solutions were considered to address the scheme objectives as part of the EIA process. This comprised Do Nothing/Do Minimum options, traffic management alternatives and six different infrastructure type options, i.e. options which included civil engineering works to bypass Listowel Town, thereby reducing congestion in the town centre itself.

A route selection process was undertaken in 2011 and 2012 by Kerry NRDO which culminated in the production of a Route Selection Report. The Route Selection Report was prepared in accordance with the NRA Project Management Guidelines and the assessment was undertaken in accordance with these guidelines and the NRA Environmental Appraisal and Construction Guidelines.

3.1.1 Assessment Process

A Route Selection Report was prepared to identify a suitable Study Area for the examination of alternative solutions to address the scheme objectives, to identify key constraints within that Study Area, to develop feasible options and to carry out a systematic assessment of the options leading to the selection of a preferred alternative, or option.

As stated above, three types of alternatives were considered which can be grouped as follows;

- *Do-Nothing/Do-Minimum Alternatives;*
- *Traffic Management Alternative;*
- *Infrastructure Alternatives.*

The consideration of the above alternative types is discussed below.

3.2 'Do Minimum' / 'Do Nothing' / Traffic Management Alternatives

Prior to developing Route Corridor Options, the NRA Project Appraisal Guidelines 2011 require the consideration of Do-Nothing, Do-Minimum and Traffic Management alternatives. This assessment is detailed in the N69 Listowel Bypass Road Improvement Scheme Route Selection Report 2012. It was concluded that the Do-Nothing, Do-Minimum and Traffic Management Alternatives would not alleviate the traffic congestion, accident patterns and environmental concerns as the road geometry of the Town Square and existing River Feale Bridge allow for only limited improvements, which would not change the traffic patterns. The report further notes that these options are not compatible with national and local policy documents.

3.3 Infrastructure Alternatives

Infrastructure alternatives or options comprise solutions which involve new civil engineering infrastructure such as roads, bridges, roundabouts etc. In the context of the proposed development, they comprise the addition of a new Route Corridor to allow traffic to bypass Listowel Town in such a manner so as to reduce congestion in the Town in so far as practicable.

3.3.1 Route Corridor Option A (Red)

Route Corridor Option A (Red), shown in Figure 3.1.1, measures approximately 5.80 km in length between the start and end points and consists of approximately 5.24 km of new road and 0.56 km of existing road.

Route Corridor Option A commences on the existing N69 in the townland of Billeragh approximately 1.15 km south of junction R557 to Finuge, and continues along the existing N69 for a distance of approximately 0.4 km. It then leaves the existing road and proceeds north-eastwards as greenfield construction intersecting Local Roads L10115, L10114, L6051 and Regional Road R555 to Duagh, before crossing the River Feale and turning in a more northerly direction to meet the N69 at Bolton's Cross.

This Route Corridor Option continues via the existing N69 until it terminates in the townland of Skehanierin approximately 0.37 km northeast of Bolton's Cross.

3.3.2 Route Corridor Option B (Cyan)

Route Corridor Option B (Cyan), shown in Figure 3.1.1, measures approximately 6.02 km in length between the start and end points and consists of approximately 3.72 km of new road and 2.30 km of existing road.

Route Corridor Option B commences on the existing N69 in the townland of Billeragh approximately 1.15 km south of junction R557 to Finuge, and continues along the existing N69 for a distance of approximately 2.54 km. It then leaves the existing N69 and proceeds in an easterly direction as greenfield construction through the townland of Ballygrenane, and intersects the R555 Regional Road to Duagh with a proposed roundabout south of the existing River Feale Bridge and proceeds northeast across the River Feale at a new bridging point before turning east to meet the N69 at Bolton's Cross.

This Route Corridor Option continues via the existing N69 until it terminates in the townland of Skehanierin approximately 0.37 km northeast of Bolton's Cross.

3.3.3 Route Corridor Option B1 (Blue)

Route Corridor Option B1 (Blue), shown in Figure 3.1.1, measures approximately 6.06 km in length between the start and end points and consists of approximately 3.76 km of new road and 2.30 km of existing road.

Route Corridor Option B1 commences on the existing N69 in the townland of Billeragh approximately 1.15 km south of junction R557 to Finuge, and continues east along the existing N69 for a distance of approximately 2.54 km. It then leaves the existing N69 and proceeds in an easterly direction as greenfield construction through the townland of Ballygrenane and intersects the R555 Regional Road to Duagh with a proposed roundabout south of the existing River Feale Bridge. Route Corridor Option B1 continues east and crosses over the R555 Duagh Road before turning north east, crossing the River Feale and meeting the N69 at Bolton's Cross.

This Route Corridor Option continues via the existing N69 until it terminates in the townland of Skehanierin approximately 0.37 km northeast of Bolton's Cross.

3.3.4 Route Corridor Option C (Green)

Route Corridor Option C (Green), shown in Figure 3.1.1, measures approximately 8.29 km in length between the start and end points and consists of approximately 4.6 km of new road and 3.69 km of existing road.

Route Corridor Option C commences on the existing N69 in the townland of Billeragh approximately 1.15 km south of junction R557 to Finuge, and continues along the existing N69 for a distance of approximately 0.17 km. It then leaves the existing road and proceeds north as greenfield construction through the townlands of Coolnaleen, and Garryantanvally, intersecting the R557 to Finuge, before crossing the River Feale and intersecting Local Road L1011, before turning east, intersecting Local Road L10112, and following the line of the disused railway for 600 m before turning northeast to avoid a cluster of dwellings. This Route Corridor Option intersects the R553 to Ballybunnion, with an at grade junction approximately 200 m north of the existing John B. Keane Road/L1050 junction.

This Route Corridor Option continues via the existing John B. Keane Road to Caherdown Roundabout (Tim Kennelly Roundabout) and along the existing N69 until it terminates in the townland of Skehanierin approximately 0.37 km northeast of Bolton's Cross.

3.3.5 Route Corridor Option D (Orange)

Route Corridor Option D (Orange), shown in Figure 3.1.1, measures approximately 9.56 km in length between the start and end points and consists of approximately 8.90 km of new road and 0.66 km of existing road.

Route Corridor Option DB commences on the existing N69 in the townland of Billeragh approximately 1.15 km south of junction R557 to Finuge and continues along the existing N69 for a distance of approximately 0.87 km. It then leaves the existing road and proceeds north as green field construction through the townland of Garryantanvally, intersecting the R557 to Finuge, before crossing the River Feale and intersecting Local Road L1011 and the disused railway. It then turns north east and intersects the R553 to Ballybunion at an at-grade junction, and then turns east, intersecting the R552 to Ballylongford Road approximately 120 m south of Burntwood Crossroads and the Local Road L1018 at Coolatoosane, before turning south east, and meeting the existing N69 approximately 0.37 km northeast of Bolton's Cross.

3.3.6 Route Corridor Option C/D (Dark Green)

Route Corridor Option C/D (Dark Green), shown in Figure 3.1.1 is approximately 8.48 km in length between start and end points and consists of approximately 4.3 km of new road and 4.18 km of existing road.

Route Corridor Option C/D is an amalgamation of Route Corridor Options C and D. Route Corridor Option C/D commences on the existing N69 in the townland of Billeragh approximately 1.15 km south of junction R557 to Finuge and continues along the N69 for a distance of approximately 0.80 km. It then leaves the existing road and proceeds north as greenfield construction through the townland of Garryantanvally, intersecting the R557 to Finuge, before crossing the River Feale and intersecting Local Road L1011, before turning east, crossing Local Road L10112 and following the line of the disused railway for approximately 600 m before turning northeast to avoid a cluster of dwellings. The Route Corridor Option intersects the R553 to Ballybunion, with an at-grade junction approximately 200 m north of the existing John B. Keane Road/L1050 Road junction.

This Route Corridor Option continues via the existing John B. Keane Road to Caherdown Roundabout (Tim Kennelly Roundabout) and along the existing N69 until it terminates in the townland of Skehanierin approximately 0.37 km northeast of Bolton's Cross.

3.4 Infrastructural Alternatives Appraisal

3.4.1 Preliminary Options Assessment

Initially, preliminary option assessments were carried out on Route Options A, B, B1, C and D to determine the feasibility of each option. A preliminary assessment of the alternatives on the basis of three assessment criteria was undertaken. These criteria are as follows;

- *Environment;*
- *Engineering; and*
- *Economy.*

These criteria and how the infrastructure alternatives were considered in the context of same are explained further below.

a. Environment

The Environment Assessment was conducted based on the consideration and assessment of each of the infrastructural alternatives in regards to the following criteria;

- *Terrestrial Ecology;*
- *Aquatic Ecology and Fisheries;*
- *Water Quality;*
- *Air Quality;*
- *Noise and Vibration;*
- *Landscape and Visual;*
- *Human Beings;*
- *Geology;*
- *Hydrogeology;*
- *Material Assets;*
- *Archaeology and Cultural Heritage; and*
- *Agriculture.*

b. Engineering

The Engineering Assessment was conducted based on the consideration and assessment of each of the infrastructural alternatives in regards to the following criteria;

- *Traffic Assessment and Road Cross Section;*
- *Technical Standards;*
- *Junctions, Access and Interaction with Existing Network;*
- *Structures;*
- *Geology;*
- *Groundwater;*
- *Earthworks;*
- *Road Safety Impact Assessment;*
- *Drainage;*
- *Construction;*
- *Service Conflicts; and*
- *Land and Property.*

c. Economy

A Level 2 Option Comparison Estimate was conducted in accordance with the NRA Project Management Guidelines (2010) and the NRA Cost Management Manual (2010).

Following the preliminary assessment of the infrastructure alternatives, the preferences for each alternative under the above sub-categories were combined into the overall Preliminary Assessment Framework Matrix as shown in Table 3-1.

Table 3-1 Preliminary Assessment Framework Matrix

Evaluation Criteria	Option A	Option B	Option B1	Option C	Option D
Environment	Low Preference	Low Preference	Low Preference	High Preference	High Preference
Engineering	Low Preference	Medium Preference	Low Preference	High Preference	High Preference
Economy	Low Preference	Medium Preference	Medium Preference	High Preference	Low Preference
Progress to Stage 2	**No**	**No**	**No**	**Yes**	**Yes**

The Preliminary Assessment Framework Matrix divided the Route Corridor Options into two broad groups, Route Corridor Option A, B and B1 which go to the east and south of Listowel, and Route Corridor Options C and D which go to the West and North. The Route Corridor Options to the east and south encounter significant difficulties in terms of the River Feale cSAC, the associated structures, difficult topography and safety concerns associated with the junctions.

The Route Corridor Options progressed to Stage 2 Project Appraisal are Route Corridor Option C and Route Corridor Option D along with an Option amalgamating Options C and D. Full details in relation to this assessment is available in the Route Selection Report identified in Section 3.1.

3.4.2 Project Appraisal

Further to the identification and refinement of the various infrastructure alternatives, an appraisal of the alternatives on the basis of the five Common Appraisal Criteria was undertaken. These criteria are as follows:

- *Environment;*
- *Accessibility and Social Inclusion; and*
- *Safety;*
- *Economy;*
- *Integration.*

These criteria and how the infrastructure alternatives were considered in the context of same are explained as follows:

a. Environment

The environmental appraisal was conducted based on the consideration and assessment of each of the infrastructure alternatives in regards to the following criteria:

- *Archaeology and Cultural Heritage;*
- *Ecology;*
- *Hydrology;*
- *Geology and Hydrogeology;*
- *Air Quality;*
- *Noise and Vibration;*
- *Agriculture;*
- *Landscape and Visual Assessment; and*
- *Human Beings and Material Assets (Socio Economics).*

b. Accessibility & Social Inclusion

The Accessibility and Social Inclusion Appraisal was undertaken in accordance with the NRA Project Appraisal Guidelines 2011 Unit 7.0 Project Appraisal Balance Sheet and as such comprised assessments on Deprived Geographic Areas and Vulnerable Groups.

c. Safety

The Safety Appraisal was based upon an independent Road Safety Audit Stage F (Part 1) carried out for each infrastructure alternative in accordance with NRA HD 19 Road Safety Audit. The Road Safety Audit Stage F (Part 1) Report compared the alternatives in terms of Road Safety. In addition, the accident benefits derived from the Cost Benefit Analysis were included in this assessment.

d. Economy

A Cost Benefit Analysis (COBA) was undertaken which compared the overall cost of the alternative with the benefits expected to be derived from the alternative.

e. Integration

The Integration Appraisal was undertaken in accordance with the NRA Project Appraisal Guidelines 2011 Unit 7.0 Project Appraisal Balance Sheet and comprised the consideration of integration of the various alternatives with other elements of Government policy and infrastructure investment. Four types of transport integration were appraised to ensure that investment across the transportation portfolio was integrated towards achieving a common goal, namely:

- *Transport integration;*
- *Land use integration;*
- *Geographical integration;*
- *Integration with other Government policies.*

Following the appraisal of the infrastructure alternatives, the preferences for each alternative under the sub-categories were combined into the overall Project Appraisal Framework Matrix as shown in Table 3-2.

Table 3-2 Project Appraisal Framework Matrix

Evaluation Criteria	Option C	Option D	Option C/D
Environment	Intermediate	Least Preferred	Preferred
Accessibility & Social Inclusion	**Similar**	**Similar**	**Similar**
Safety	Preferred	Least Preferred	Intermediate
Economy	Intermediate	Least Preferred	Preferred
Integration	**Similar**	**Similar**	**Similar**
Overall	**Intermediate**	**Least Preferred**	**Preferred**

Route Corridor Option C/D emerged as the Preferred Corridor Option from the Project Appraisal Matrix.

- *It ranked 'Preferred' in the Environmental Evaluation.*
- *All three options are ranked as 'Similar' under the headings of Accessibility & Social Inclusion and Integration.*
- *It ranked as 'Intermediate' in the Safety Assessment. It ranked 2nd using the headings of the Stage F (Part 1) Road Safety Audit and predicted Fatal and Serious Casualties and ranked 3rd for predicted accidents. Route Corridor Option C will result in marginally fewer total accidents and casualty rates over the 30 year appraisal period using values output by the COBA programme.*
- *It ranked 'Preferred' in the Economic Evaluation with a higher benefit to cost ratio for High, Medium and Low Growth than Options C and D. It was also the least expensive option.*

3.5 Preferred Alternative

Based on the Project Appraisal Framework Matrix prepared, Option C/D was determined as the Preferred Alternative (or Route Corridor). Option C/D was therefore taken forward and refined and improved to reflect the current proposed development as presented in this EIS. Note that full details in relation to the Route Selection Process are presented in the Route Selection Report identified in Section 3.1.

4 Human Beings & Socio Economics

4.1 Introduction

This chapter considers the impacts on human beings that 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.

It also seeks to identify the land use changes and changes in economic activities directly attributable or attributable in part to the proposed development and the resulting impacts. These changes may result from direct physical impacts through construction work, or impacts realised in the wider economy.

In addition, impacts on tourism, recreation and amenity arising from the proposed development are discussed in this chapter.

Impacts on human-related environmental aspects, such as traffic, agronomy, air, noise and landscape and visual effects, and are considered in Chapters 1, 5, 9, 10, and 11 respectively.

4.2 Description of the Existing Environment

4.2.1 The Study Area

The N69 links Limerick (County Limerick) to Tralee (County Kerry) via a number of towns and villages including Tarbert and Listowel. The proposed road development under consideration is approximately 7 km in length, located in Listowel.

County Kerry is located in the southwest of Ireland, within the province of Munster. The county town is Tralee. After Tralee and Killarney, Listowel is the third-largest urban area in County Kerry. The town of Listowel is approximately 27 km to the northeast of Tralee and 70 km to the southwest of Limerick City. Other areas of importance within proximity to the town are the Port of Foynes and the Tarbert Industrial Land Bank.

The proposed road development includes an online upgrade of the existing N69, local and regional roads and the J.B. Keane Road and an offline section, see Figure 2.1.1 – 2.1.5. The study area boundary applied within the human being and socio economic assessment differs from that applied for other assessments in this EIS. This is to ensure that all appropriate receptors are identified and impacts on these captured within the assessment.

It has been determined that the influence of the proposed works on socio-economic factors will be primarily realised within Listowel. For the purpose of this assessment, Listowel is defined as the area contained within the Listowel (Urban) and the Listowel (Rural) Electoral Divisions (EDs). The Listowel Urban ED encompasses the majority of the built-up area of Listowel within a boundary of approximately 1 km radius. The Listowel Rural ED is an area stretching from the edges of the Urban ED to the edge of the Galey River some 2 km to the north, 2 km east to Skehanierin, south to Billeragh, and 1 km west to Gortcurreen.

4.2.2 Plans and Policies

National, regional and local plans and policies are reviewed in Chapter 1 of this EIS. The outcomes of that review have been considered within this Chapter 4 with regard to how the proposed development is likely to facilitate the achievement of the economic and community objectives set out in them.

The proposed development has been included in the Listowel Town Development Plan 2009-2015 and will pass through a section of agricultural and educational land to the north of the Greenville area, and the west of Market Street. It will also run adjacent to the Retail Opportunity Site “ROS3”, an area of land that “has the potential to be developed for enhanced town centre related uses”. The proposed development traffic will have implications for the use of this land as town centre related land.

4.2.3 Baseline

(a) Population

The proposed development passes through rural areas to the west of Listowel, then the suburban areas to the north, prior to joining the existing road to the east of the town.

The Listowel Urban ED, described in the previous section, comprises the central urban area of Listowel through which the N69 currently passes. According to the 2011 census this area has a population of just over 4200. In the 2006 census this ED had a population of just over 2900, indicating a growth of 45% in five years. The ED contains 1777 private households; primarily detached houses/bungalows (1663) with the remaining being flats/apartments and caravans.

The Listowel Rural ED comprises the land surrounding the urban core of Listowel. The N69 passes through the southern and eastern areas of this ED. The area is primarily rural and agricultural land. According to the 2011 census this area has a population of approximately 1570. In the 2006 census this ED had a population of almost 1070, indicating a growth of 47% in five years. The ED contains 596 private households, primarily houses/bungalows (587).

The Listowel Town Development Plan makes a projection for the future population and housing demand within the town Variation No.2 projects a population increase of 314 between 2015 and 2021. In addition, it estimates that 1225 new homes will be required in the area to accommodate this population growth.

According to the 2011 Census, the population of County Kerry is just over 145,500. The 2006 census recorded a population of 105,168; indicating a growth of 38% in five years. At the time of the 2011 Census there were 53,306 private households.

These data are summarised in Table 4-1, showing the rapid growth in the area.

Table 4-1 Population, 2006-2011

Area	2006 Population	2011 Population	Population growth rate (2006-2011)
Listowel (Urban)	2,905	4,205	45%
Listowel (Rural)	1,067	1,567	47%
County Kerry	105,168	145,502	38%

(b) Economic Activity

The businesses in the vicinity of the existing N69 are a mixture of retail facilities, industrial complexes, such as Kerry Ingredients, petrol stations and a town-centre commercial “high street”. The current N69 also passes adjacent to the Tanavalla Industrial Estate, location of various commercial and retail operations such as Carey’s Electrical Rewinds, North Kerry Tool Hire, the Mart and McElligott’s Carpets.

To the west of the town, the area comprises primarily agricultural land. The John B. Keane Road will form part of the proposed development where it will pass by Clieveragh Industrial Estate, Listowel Enterprise Centre and various commercial and retail operations including petrol stations and two supermarket retailers.

At the national level, the construction sector is considered in detail, due to the potential for the proposed development to impact economic activity in this sector. The construction sector has seen a drop in turnover and Gross Value Added[1] (GVA) over the last few years. Published data shows that the total turnover in the construction sector dropped by over 57% between 2009 and 2010, while GVA has reduced by over 66%. Table 4-2 summarises changes in turn over and GVA for the construction sector for 2009-2015 and shows this, albeit some data is missing, some recovery in these figures can be seen by 2013.

Table 4-2 Gross Value Added by Construction sub-sector (€m)

Year	Turnover	% difference	GVA	% difference
2009	22,108.1		9,045.6	
2010	9519.3	-57%	3,043.0	-66%
2011	9316.0	-2%	3,363.0	+11%
2012	-		-	
2013	9764.0	+5%	-	
2014	14,208.2	+46%	4,759.3	+42%
2015	-		-	

Source: Annual detailed enterprise statistics for construction (NACE Rev. 2, F), Eurostat

(c) Employment

Listowel provides key services for the local region and serves as a market town for the North Kerry area. In addition, tourism plays a large role in Listowel, as in Ireland as a whole, which is covered in more detail in section (f) of this chapter.

Employment figures for the area are presented in Table 4-3.

Table 4-3 Population aged 15 years and over by principal economic status

Area	Principal Economic Status	
	At work	Unemployed (having lost or given up previous job)
Listowel (Urban)	1,282	492
Listowel (Rural)	592	107
County Kerry	55,767	12,598

Within Listowel, in the vicinity of the current N69 and the proposed development, there are employees from a wide range of sectors, see Table 4-4 for detail of employment by industrial grouping.

[1] Gross value added (GVA) is the value of output less the value of intermediate consumption; it is a measure of the contribution to Gross Domestic Product (GDP) made by an individual producer, industry or sector. (OECD Glossary of Statistical Terms)

Table 4-4 Employment by Industrial Group

Industrial group	Listowel %	Kerry %	South West %	Ireland %
Agriculture, forestry and fishing (A)	2.6	8.1	5.9	4.2
Mining and quarrying (B)	0.1	0.2	0.1	0.3
Manufacturing (C)	9.4	7.6	11.0	8.6
Electricity, gas, steam and air conditioning supply (D)	0.8	0.6	0.7	0.6
Water supply; sewerage, waste management and remediation activities (E)	0.4	0.0	0.0	0.0
Construction (F)	3.9	4.8	4.6	4.0
Wholesale and retail trade; repair of motor vehicles and motorcycles (G)	12.1	12.0	12.2	11.9
Transportation and storage (H)	1.4	2.9	3.7	4.4
Accommodation and food service activities (I)	5.2	7.9	5.4	4.6
Information and communication (J)	1.2	0.0	0.0	0.0
Financial and insurance activities (K)	2.3	2.5	2.6	4.2
Real estate activities (L)	0.2	5.0	7.6	8.3
Professional, scientific and technical activities (M)	3.7	0.0	0.0	0.0
Administrative and support service activities (N)	1.9	0.0	0.0	0.0
Public administration and defence; compulsory social security (O)	4.4	4.3	4.4	5.1
Education (P)	7.1	6.9	7.4	7.3
Human health and social work activities (Q)	7.6	9.3	9.4	9.1
Arts, entertainment and recreation (R)	1.0	0.0	0.0	0.0
Other service activities (S)	2.0	3.4	3.4	3.8
Unemployed	27.7	19.5	17.1	19.0

Source: Adapted from CSO.

CSO data demonstrate that in 2010 there were 13,307 active enterprises in County Kerry, employing 26,789 employees. These enterprises occupied around 48% of working persons in County Kerry.

The latest available data on employment by sector published by the CSO are from 2010. For Ireland as a whole, this data recorded 580 construction companies related to the construction of roads and railways, employing 1,896 people. The total number of construction companies in Ireland for 2010 was 32,070, which provided employment for 94,636 people. Therefore road and railway construction accounted for about 2% of the employment in the sector.

National-level data for all sub-sectors of construction are presented in Table 4-5.

Table 4-5 Persons engaged in construction activities (number)

Persons engaged by Construction sub-sector	2009	2010	% difference
Development of building projects	5,629	4,252	-24
Construction of residential and non-residential buildings	32,933	37,525	+14
Construction of roads and railways	2,975	1,896	-36
Construction of utility projects	1,815	1,094	-40
Construction of other civil engineering projects	4,818	2,835	-41
Demolition and site preparation	1,728	5,283	+206
Electrical, plumbing and other construction installation activities	19,592	27,797	+42
Building completion and finishing	12,148	6,892	-43
Other specialised construction activities	11,165	7,062	-37
Construction total	**92,803**	**94,636**	**+2**

Source: Adapted from CSO.

These figures include both employees (manual labour and other) and persons engaged (Proprietors and Unpaid Family Workers and labour on subcontract basis). Figures show an overall increase in employment in the construction industry of approximately 2% over the period from 2009 to 2010.

The overall unemployment rate in Ireland in March 2017 was 6.45% compared to the majority of which were between 20 and 34 years old. Live Register figures show that between March 2016 to March 2017 unemployment in the South West went from just over 40,876 to 34,017. Previous figure from the 2011 census data showed unemployment in the southwest at almost 62,000.

The *Quarterly National Household Survey* (QNHS) provides an analysis of changes in unemployment over the period Q2 2006 to Q2 2012, during which overall unemployment increased by more than 225% in Ireland as a whole.

The largest increases in unemployment occurred for persons previously employed in primarily the *Construction*, as well as the *Wholesale & Retail* and *Industry* sectors. In the first quarter of 2011 specifically this amounted to 79,500 people who had previously worked primarily in the Construction sector.

Table 4-6 is adapted from the QNHS and shows average employment figures (in thousands of people) by sector over the period 2006-2012. It can be seen from this table that increases in total employment shows a similar pattern to increases in construction-related employment over the presented 7-year period, with a marked decrease between 2008 and 2009 and a steady decline thereafter.

Table 4-6 Employment in thousands, by Sector, 2010-2016.

	Economic sector	2010	2011	2012	2013	2014	2015	2016
A	Agriculture, forestry and fishing	85.1	85.7	87.1	103.4	109.8	112.5	116.4
B-E	Industry	244.7	239.5	231.7	238.4	235.7	245.8	255.0
F	**Construction**	**126.5**	**106.4**	**99.6**	**102.7**	**106.3**	**125.9**	**136.9**
G	Wholesale & Retail trade; Repair of motor vehicles and motorcycles	278.4	274.5	268.2	271.5	269.5	271.7	274.1
H	Transportation and Storage	90.8	95.7	90.9	86.0	90.5	92.8	94.9
I	Accommodation & food service activities	127.2	114.4	120.0	129.6	137.7	136.7	145.8
J	Information & communication	76.6	77.9	81.2	80.4	81.9	82.3	84.7
K-L	Financial, insurance and real estate activities	104.2	105.1	99.3	98.9	97.2	102.7	101.6
M	Professional, scientific and technical activities	101.9	103.8	102.6	108.0	114.1	115.8	115.0
N	Administrative and support service activities	63.8	69.3	63.0	58.0	64.2	63.8	70.1
O	Public administration and defence; compulsory social security	106.7	99.1	99.6	95.1	96.6	100.4	105.0
P	Education	149.4	146.1	146.3	150.3	151.2	150.7	150.9
Q	Human health and social work activities	237.1	243.3	244.4	244.6	246.1	249.1	251.1
R-U	Other NACE activities	92.4	96.3	100.6	101.8	99.0	102.1	106.5
Total Persons		**1,893**	**1,861**	**1,836**		**1,870**	**1,901**	**1,959**

Source: Adapted from CSO.

(d) Land use and development

The area immediately surrounding the existing N69 route is predominantly rural between Six Crosses in the south and the existing Listowel Bridge, with a retail park located at Tanavalla. After crossing the River Feale, the N69 passes through mixed residential and commercial areas before reaching the commercial centre of Listowel. Due to the one-way system currently in place, northbound traffic heads north to the R552 junction, then east along the John B. Keane Road to Roundabout 4 (referred to locally as the Caherdown Roundabout). Southbound traffic travels along N69 College Lawn and Church Road. On both of these routes there is a mix of commercial and residential properties. Once the N69 turns east from both Church Street and the John B. Keane Road the commercial properties give way to primarily residential properties until reaching Roundabout 4, the Caherdown roundabout, at the eastern edge of the town. After this the landscape is primarily rural with scattered residential properties.

Along the route that the existing N69 takes are several important properties and facilities. To the south of the town, the road passes by the Tanavalla retail park and the Kerry Group factory. After crossing the River Feale, the N69 passes Listowel Community Centre and Sports Complex, St Mary's Church and St. John's, a converted church now used as an Art and Theatre Centre and The Seanchaí: Kerry Literary and Cultural Centre. To the east of central Listowel, Upper Church Street (N69) is home to Scoil Réalta na Maidine, an all-boys Catholic Primary School, Listowel Community College, an Adult

education centre, St. Michael's burial ground and St Michael's College, an all-boys secondary school.

IThe area of the proposed development is located is primarily agricultural land, farm houses and scattered residential properties. The proposed development joins existing roads at Ballybunion Road (R553) and continues along the John B. Keane Road. It will then pass near to existing residential properties, the Clieveragh Industrial Estate, two supermarkets (Lidl & Aldi) and the Listowel Fire Station.

While the N69 is the only national road in the area, there are other key roads that lead to Listowel. The R553 connects the coastal town of Ballybunion and Listowel and the R557 runs between Listowel and Tralee, via several smaller villages and hamlets. The R555 runs between Listowel and Abbeyfeale, following the route of the River Feale. The R523 leads from Listowel into County Limerick, when it converges with the N21 prior to reaching the town of Rathkeale.

The Route 13 bus travels along the N69 between Limerick and Tralee, passing through Listowel twice a day in each direction. The Route 272 bus travels between Tralee and Ballybunion, via Listowel, once a day in each direction. These buses currently stop at The Square, Listowel, located along the current N69.

The Listowel Town Development Plan has five areas zoned as "retail opportunity spaces", which can be developed for enhanced town-centre uses. In addition, over 120 hectares of land are zoned for housing use. The Plan states that infill housing is to be encouraged prior to development on the outskirts of the town. Despite this, new house completions in County Kerry were down in 2012 compared to 2011, from 387 to 348.

(e) Commuting patterns

Commuting patterns in Listowel are outlined in Table 4-7 and Table 4-8 and are based on CSO Small Area Statistics from the 2011 Census. They indicate that the majority of trips undertaken are short distance, and shorter than the Irish average. Foot traffic is higher than average, while bus traffic is lower. It can be read from this data that a large number of journeys conducted by residents are short distance travel within the town; this conflicts with the traffic on the N69, and is one of the motivators for the proposed development.

Table 4-7 Commuting patterns - time

Time travelling	Listowel %	County Kerry %	Ireland %
Under 1/4h	55.3	43.1	34.1
1/4h – 1/2h	18.7	28.7	30.1
1/2h – 3/4h	12.9	13.6	17.1
3/4h – 1h	1.5	3.0	5.7
1h – 1 1/2h	3.7	2.9	5.2
1 1/2h and over	1.8	1.7	1.9
Not stated	6.1	7.0	6.0
Total responses	2,966	80,605	2,704,404

Table 4-8 Commuting patterns - means

Means of travel	Listowel %	County Kerry %	Ireland %
On foot	16.7	10.7	14.9
Bicycle	1	1.5	2.2
Bus, minibus or coach	5.7	8.5	10.3
Train	0.1	0.2	2.5
Motorcycle or scooter	0.2	0.2	0.3
Car driver	41.7	42.2	40.3
Car passenger	22.6	20.9	18.2
Other	8.4	6.3	4.3
Not stated	3.7	5.7	3.8
Total responses	3,045	84,845	2,794,133

(f) Tourism, recreation and access

There were 7.4 million overseas visitors to Ireland in the first nine months of 2016 - an increase of 12% on the same period in 2015. In 2015, County Kerry received approximately 1,026,000 visitors and €234 million in tourism revenue.

In the local economy of Listowel, tourism makes a significant contribution. Visitors are attracted by several local features. In addition to the attraction of the wider County Kerry area, Listowel has the Seanchaí (Literary and Cultural) Centre, Listowel Castle, the historic Lartigue Monorail and Museum, a park, race course, golf course and the River Feale. In addition, Listowel hosts a number of events and festivals that draw in more visitors. These include Food Fairs, the Writers Week festival, the Listowel Races and a number of other events[2]. Listowel is also in close proximity to the seaside resort town of Ballybunion, providing a further draw for visitors.

The Sive Walk (part of the Listowel Village Walk) is a "greenway" trail that uses the route of the former Great Southern and Western Railway between Tralee and Limerick. A stretch of the trail has been developed near the Lartigue Monorail and Museum in Listowel. See Figure 11.1.1 for walk location.

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 net additional socio-economic impacts of the proposed development over and above those predicted to occur without the proposed development.

An analysis of the main socio-economic indicators and available information was undertaken. 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 current (baseline) conditions at the site and the wider area;*
- *A review of relevant plans and strategic documents;*
- *A review of consultation responses received in relation to the proposed development; and*
- *The identification of key socio-economic impacts.*

[2] http://www.travelireland.org/kerry/listowel/

Information was also sourced from:

- *National statistics web pages such as the Central Statistics Office (CSO) on population, demographics, employment status, etc.; and*
- *Local council and community web pages.*

As noted above, as part of the desk assessment relevant local, regional and national policies were reviewed. These included the:

- *National Spatial Strategy for Ireland (2009 – 2020);*
- *Kerry County Development Plan (2009-2015);*
- *Listowel Town Development Plan (2009 -2015); and*
- *Listowel Town Core Strategy (2009 -2015).*

A detailed review of these documents is provided within Chapter 1 of this EIS.

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

- *Environmental Protection Agency EIA Advice Notes (2003);*
- *National Roads Authority Environmental Impact Assessment of National Road Schemes – A Practical Guide (2008);*
- *UK Government Treasury Green Book(2003);*
- *Additionality Guide (English Partnerships) (2008); and*
- *Failte Ireland guidelines on the treatment of Tourism in an Environmental Impact Assessment (2007).*

Impacts are assessed in terms of whether they will benefit the receptor (a positive impact); harm the receptor (a negative impact); or have no impact on the receptor(a 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.*
- ***Major:*** *the residual effect significantly changes the relevant circumstances for the receptor.*

4.4 Predicted Impacts of the Proposed Development

4.4.1 Construction Phase

(a) Economic activity and employment

The construction phase of the proposed development will result in direct construction employment positions over an 18 to 24 month period. The likely number of construction-related jobs can be estimated using assumptions used as standard in assessments of major capital works.

The capital cost for the Listowel Bypass has been estimated at €40.8 million. It is assumed that one person year of employment equates to approximately €150,000 of capital construction expenditure[3]. This assumption leads to an estimate of approximately 270 person years of employment relating to the construction of the proposed development. As the construction period is projected to last for up to 24 months, this equates to 135 construction related jobs associated with the proposed development.

Given the nature of the construction industry locally and nationally, shown in Table 4-4, and the capacity within that industry to take up work wherever available, it is possible that many of these jobs will be realised within County Kerry. The remainder are likely to be realised either regionally or nationally, with no expectation that jobs will be created outside of Ireland.

The value of these jobs, in terms of gross value added (GVA) will depend on whether they are skilled or unskilled positions. The total GVA at factor cost for the construction sector in 2014[4] was €4,759.3 million. The average GVA contribution of each employee in the construction sector in Ireland in the same year was €70.800. Therefore it can be expected that the GVA associated with the construction jobs realised through the proposed development will be in the region of €9.5 million per year of construction. It is however recognised that a proportion of this will refect displacement so it could be expected that the net annual growth could be in the region of £7.2 million per year.

The level of employment and output from the construction sector within Kerry would be strengthened by the contribution of this project. Given the current capacity in the County and the potential to retain the vast majority of the jobs created locally, the impact is estimated to be of moderate positive.

Indirect expenditure (possibly resulting in additional employment) is likely to be generated in the area as a result of the works during the construction stage of the proposed development. This will mainly be related to the service industries in the area. It is anticipated that material supplies and services will be sourced locally where feasible, therefore creating a positive socio-economic impact in County Kerry.

Any indirect income generated locally through increased employment and knock-on economic activity, in the form of increased trade in local shops, petrol stations, restaurants, temporary accommodation and other services is captured within the GVA estimates presented above.

Impacts on local businesses may result from increased traffic related to construction, causing temporary inconvenience to road users. However as many of the local businesses do not rely on passing trade this impact is thought to be slight-negative.

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

(b) Commuting patterns and health and safety

During the 24 month construction period, people using the existing roads in the vicinity of the proposed development will be affected by traffic management restrictions at certain locations due to the realignment of existing roads which are to be crossed by the proposed development and the online upgrade to the John B. Keane Road.

Increased numbers of heavy goods vehicles, as a result of required deliveries to the proposed development construction site, will impose a slight negative impact on other road users in the area during the construction phase.

A large proportion of the construction work will occur away from the primary roads of Listowel, which naturally minimises the impacts of severance and changes in traffic. However, lane closures will be required for proposed development works on the John B.

3 This is established by dividing the turnover of the construction sector by the total persons employed in the construction sector.

4 The latest year for which data are available.

Keane Road requiring shuttle and diversions as necessary, however accesses to properties, dwellings and businesses will be maintained. There may be some short-term disruption to property owners' or tenants' movements, but this should be kept to a minimum and affected parties will be notified in advance. These impacts are not likely to be significant.

(c) Tourism, recreation and access

The construction works will be concentrated to the immediate west and north of Listowel. While the works will be visible from residential, industrial and commercial developments in the town, and from residential and agricultural properties in the surrounding area, there is no significant impact expected on tourism as the works will not significantly alter the character of the area. Visitors may however experience some delays caused to travel through the duration of the construction period.

The proposed development will intersect and be routed along the disused Great Southern and Western Railway route for approximately 700-800 m. This includes part of the "Sive Walk"[5], which uses part of the disused railway as a section of an 11 km greenway trail. During the construction period, access to large amounts of this area is likely to be restricted, negatively impacting recreational users.

Beyond the greenway trail, it is not expected that construction will infringe on land where recreational activities are carried out. It is not anticipated that this project would have any further significant impact on local or regional recreational activities.

The majority of access rights will be maintained during the construction period, so no impact, in excess of the minor delays noted above, will be expected with regard to access in and around the town. Some residences will experience changes to their access and regular routes, both during construction and once the proposed development is in operation. This is discussed in more detail in Section 4.4.2(b).

Overall, the impacts on tourism, recreation and access during the construction phase are thought to be slight-negative.

(d) Land use and development

Permanent land take comprises the land that will be used in the scheme and not be returned to the previous use. These impacts are dealt with in Section 4.4.2(d). The construction compounds are planned to be placed on farmland adjacent to Roundabout 3 in the permanent landtake boundary. This farmland is subject to significant permanent land take due to the alignment of the proposed scheme and there is sufficient space to locate the compound on land which will be permanently acquired due to severance.

Residences close to the proposed development may be affected by dust, noise, vibration and visual impacts during the construction phase. These impacts are discussed in more detail in Chapters 10, 11 and 12.

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

5 http://www.irishtrails.ie/Trail/Listowel-Village-Walks---Sive-Walk/601/

4.4.2 Operation

(a) Economic activity and employment

No significant negative impacts on the local economy and businesses have been identified as a result of the operation of the proposed development.

The overall positive impact of relieving the congestion in Listowel town centre is envisaged to facilitate the movement of people and freight. These improvements will in turn lead to time and fuel savings, improvements in access and overall improvements in road transport connectivity within the region. In addition to the individual economic savings due to travel time and reduced stress, this may in turn invite further economic opportunities to this region in terms of increased economic activity.

In general, bypasses may affect certain commercial activities, including retailing and tourism. The removal of traffic from the town centre has the positive effect of enhancing safety and convenience for residents and visitors and will provide an environment conducive to walkers and cyclists; this is coupled with a potential negative impact of removing custom from the town, in the form of passing trade.

Increasing the attraction of the town centre as a destination for tourism, the bypass can encourage the development of further tourist facilities. In addition, the improvements are also likely to benefit tourism businesses in the wider area due to the anticipated improvements in access.

The removal of traffic and heavy goods vehicles from the town centre will provide opportunities to introduce pedestrian friendly measures.

Outside of the town centre, the Tanavalla Industrial Estate may no longer attract a significant level of passing trade. However, due to the nature of these businesses it is likely that passing trade is not a significant component of their trade. In addition, the site would benefit in terms of access and travel safety from reduced traffic on the former N69.

The site of the Kerry Foods Group would achieve benefits in terms of access and travel safety from reduced traffic on the former N69, which would benefit employees and, due to benefits for associated business vehicles, may improve business efficiency.

Access to the Cleveragh Industrial Istate, to the north of the existing John B. Keane Road, will be via the proposed development; due to the additional traffic this has the potential to be negative to these businesses. However, businesses in this industrial estate will have better access to the national road network. This may provide a slight benefit.

Overall, during operation of the proposed development it is likely that there will be a moderate-positive impact to economic activity and employment.

(b) Commuting patterns and health and safety

One of the objectives of the proposed development, as emphasised in the Listowel Town Development Plan, is to improve pedestrian and cyclist connectivity through the town centre, thereby encouraging alternative, more sustainable, modes of travel. This will be achieved through the removal of "through-traffic" and re-routing of HGVs onto the proposed development.

As the majority of people in Listowel and County Kerry choose to drive or are a passenger in a car for commuting purposes, the increased capacity of the N69 resulting from the proposed development may serve to improve commuting times for people using this route during their commute.

The proposed design and route for the bypass also aims to ensure a reduction in the potential for accidents by separating out local and strategic traffic, thereby reducing potential traffic conflicts. Further, the separation of cyclists from traffic is likely to reduce traffic conflicts while ensuring a safer and more pleasant journey for cyclists commuting or travelling for leisure through the town. As the current level of commuting cyclists is low this is not assessed as significantly contributing to the impact of the development.

The route and design of the proposed bypass also aims to reduce and minimise the severance of local roads. The existing N69 cuts through the centre of Listowel and, in conjunction with traffic flow, results in community severance. The proposed development will remove through-traffic from Listowel, leading to a more pleasant and safer town centre environment for pedestrians, cyclists and non-vehicular road-users, and for vehicle users making local journeys.

There are several areas around Listowel that will benefit from improved, and safer, access to the town centre, and either unchanged or improved access to the national road system; they may experience safer and swifter travel during this part of their trip. These are the areas of Greenville, to the west of the town centre; Castleinch, to the south of the town centre;, and Gurtinard, to the east of the town centre.

Residents located to the west of the proposed development, in the vicinity of Gortcurreen, will have to cross the N69 national road in order to reach the town centre of Listowel as a result of the proposed development. However, they will benefit from improved access to the national road network. This also applies to residences in Cleveragh, to the north of the town and the proposed development.

Residences of the Ballygologue Road, the L-1018, currently have to cross the N69 to reach destinations to the south, including Listowel Town centre. The John B. Keane Road / Ballygologue Road junction will continue to operate as it does at the moment and there will not be a significant change to the traffic volumes at this location as a result of the proposed development. Many key community destinations, such as the schools on Upper Church Street, currently require crossing the N69 at the John B. Keane road. Pedestrian traffic surveys indicate that foot traffic along the John B. Keane road during the school traffic peak time of 8.45 am to 9.30 am and 2.40 pm to 4.30 pm is approximately 60-70 people in each period. The residences in this area have no significant changes to their access to the national road network.

Overall, during operation of the proposed development it is thought that there will be a moderate-positive impact to commuting patterns and health and safety.

(c) Tourism, recreation and access

The proposed development is not expected to impact negatively on tourism or recreation once operational. A significant positive impact is expected on tourism due to the reduction of traffic within the town centre and the core retailing area; further, a safer and more pleasant journey for cyclists, due to the shared pedestrian/cyclist track along the online J B Keane section of the proposed development, may contribute to greater numbers of recreational cyclists. The proposed development is currently not expected to significantly alter the visual character of the area.

The diversion of strategic traffic away from Listowel Town centre has the potential to impact upon tourist related activities situated along the N69. These may experience a reduction in trade, due to a reduction passing travellers, and therefore in passing trade. Conversely, easier access to the town may encourage tourist traffic due to improvement in the amenity of the area, and allow for new uses of the town.

The proposed development will intersect and be routed along the disused Great Southern and Western Railway route for approximately 900 m. This includes part of the “Sive Walk”[6], which also uses part of the disused railway as a section of an 11 km trail. Access is to be provided alongside the N69, in order to retain the route and access to the trail when it resumes; the amenity value of this replacement track is likely to be lower than the original, in both the short term and the long term. Additionally, access to the Sive Walk will be retained for other affected properties, with increases in travel distance and travel nuisance. However, it is planned that the changes to the Sive walk will include improvements to potential walking conditions and connectivity. The proposed access track can be seen on Figure 2.1.1 – 2.1.5: Scheme Plan.

Footpath facilities will be provided from the confluence of the Forge Road to the proposed development to Roundabout 2, crossing facilities will be provided at Roundabout 2 and from there a footpath will be provided on the western edge of the scheme to the confluence of the proposed development to the Forge Road north of the proposed development. Although provisions for residential properties near the Forge and Greenville Road in the area of Kilcreen have been provided for in the proposed development these residents will be impacted during the operation period of the proposed development. This will result in additional time requirements for those residents to access the Sive Walk due to the severance of the road. The significance of this change is considered to be slight, with the exception of the residences on the severed Forge Road, to the south of the proposed bypass, for which the impact of the c. 600 m diversion to reach the Sive Walk is considered to be slight to moderate-negative.

Overall, during operation of the proposed development it is thought that there will be a slight-positive impact to tourism, recreation and access.

(d) Land use and development

The proposed development requires land take. For the purposes of this assessment, residential and commercial land uses is considered to be land that has been identified as principally homes or business use. Further, community land is considered to relate to areas that provide an established public recreational resource, such as playing fields, country parks or areas identified as Public Open Space.

The principal land uses within this area are primarily agricultural, but also includes land used by business and land associated with residential property. The area of land take, by assessed land use, is presented in Table 4-9.

Table 4-9 Land take

Owner Reference	Land take area - ha
Farmland	19.005
Community land, including the Sive Walk	2.585
Commercial land	0[7]
Residential land	0.002

The required land take may impact the business operations of a local bed and breakfast business, which is located close to proposed Roundabout 2, by disrupting the local visual character, which may otherwise be a draw to this business, but is otherwise not thought to impact any other businesses. No demolition of property is required.

Residential land take is primarily from the edges of property, as a result of road or route widening. As residential property is considered to be a sensitive receptor, the 0.46 ha of land take is considered to be a slight negative impact

[6] http://www.irishtrails.ie/Trail/Listowel-Village-Walks---Sive-Walk/601/
[7] Non zero, 44 m^2

Land take will occur on land that has been zoned for low density residential housing, in the Phase 2 stage of development as outlined in the Listowel Town Development Plan. The land take from this designated land is approximately 2.65 ha, which is 1.28% of the total Phase 2 residential zoning.

As the Listowel Development Plan notes, an excess of land has been zoned for residential use, allowing it to more than meet its 20 year targets. Therefore the impact of this is considered to be slight negative impact.

Overall, during operation of the scheme it is thought that there will be a slight negative impact to land use and development, on both residential land and some commercial property.

Agricultural impacts are not assessed here; refer to Chapter 5 Agronomy for further details on the impact on agriculture.

4.5 Proposed Mitigation and Avoidance Measures

Barring the land-take impacts, which are non-mitigatable (but which are compensated through the Compulsory Purchase Order (CPO) process), the most significant impact identified is upon local recreation and tourism from the land take from the Sive Walk. To mitigate the impact to access on the Sive Walk pedestrianized access to the “green way” has been considered, with measures to retain access adopted. Signage will be installed and maintained to ensure visitors are made aware of access arrangements to this feature. Planting and landscaping will be undertaken to maximise the amenity value of the road-side access, see Section 11: Landscape and Visual.

On the online section of the proposed road development (the John B. Keane Road) the existing pedestrian facilities will remain in place in a form of a shared pedestrian/cyclist path and pedestrian crossing phases will be incorporated for lights at Ballylongford junction.

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

4.6 Residual Impacts

Table 4-10 presents a summary of the expected impacts of the proposed scheme on socio-economic receptors; people, communities and businesses. The table looks at each of the topics that have been previously discussed in order to present the balance of impact that will occur as a result of the construction and operation of the scheme,

The construction of the scheme will also provide an estimated 78.5 construction jobs over a 2 year period. The majority of these positions are expected to be filled from within the region. This is considered to be of moderate significance to the local economy given the current situation with regard to unemployment and the nature of the construction industry.

It is evident from this table that the bypass is expected to deliver significant benefits to all road users and specifically to both local commuters and pass-through commuters, and is also likely to provide significant economic benefits as a result of its strategic importance for business and tourism connections to all parts of the country.

Impacts during construction and operation of the scheme on the Sive Walk are thought to be slight negative.

Land take from the scheme is overall assessed to be slight negative. This is due to the impact on sensitive receptors (residential property). The impacts on agricultural land are covered in detail in Chapter 5: Agronomy.

Table 4-10 Summary of Impacts

Impact category	Construction (temporary)	Operation
Economic activity and employment	Moderate positive	Moderate positive
Commuting patterns and health and safety	Slight negative	Moderate positive
Tourism, recreation and access	Slight negative	Slight positive
Land use and development (excluding agricultural land)	Slight negative	Slight negative

4.7 Difficulties Encountered in Compiling Information

4.7.1 Baseline Data

Local area statistics are presented in a variety of forms by different source documents. There has therefore been a need to present information in the baseline which covered a number of local area boundaries and time periods. This can lead to discrepancy between figures for which the derivation is different across government departments, such as employment numbers. This is not considered to impact on the quality or robustness of the impact assessment as presented.

4.8 Cumulative Impacts and Impact Interrelations

4.8.1 Landscape and Visual Impacts

The landscape and visual impact assessment concludes that there will be benefits to the town centre, due to the alleviation of traffic.

This reinforces the evaluation of the positive impact to economic activity and employment during the operational phase that has been assessed.

4.8.2 Air and Noise Impacts

The air and noise impact assessment do not identify any significant impacts upon sensitive businesses or community facilities that would disrupt or close them.

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

5 Agronomy

5.1 Introduction

This chapter of the EIS considers the potential agricultural impact of the proposed N69 Listowel Bypass. The proposed development will traverse agricultural land passing through two Electoral Divisions (EDs); Listowel Rural and Listowel Urban.

The proposed development is approximately 7 km in length with approximately 4.75 km being offline. The area to be removed from agricultural production is approximately 24.56ha. The proposed development will directly impact on 21 farms by either sub-dividing them or reducing the area farmed. The purpose of this chapter is to describe the impact on agronomy at a national, regional, local and at an individual farm level. The impacts of this are classified in accordance with EPA guidelines. Philip Farrelly & Company was commissioned to carry out this assessment.

5.2 Approach & Methodology

An assessment of the existing agricultural environment was carried out through a desktop survey of currently available mapping, the completion of a detailed farm visit and questionnaire with landowners. The questionnaire assessed how the proposed development would impact on current farming activities carried out on individual holdings and what mitigation measures would be necessary to reduce or eliminate negative impacts. The personnel who undertook the farm visits drew on their experience as agricultural consultants and their knowledge of farming practices in the region to:

- *Identify and describe the agricultural enterprises;*
- *Identify the potential impacts of the potential development on agricultural activities; and*
- *Propose mitigation measures to reduce or eliminate potential impact.*

The assessment methodology has considered the following guidelines:

- *Advice notes on current practice in the preparation of Environmental Impact Statements (EPA, 2003), including draft revised advice notes for preparing Environmental Impact Statements (EPA, 2015)*
- *Guidelines on the information to be contained in Environmental Impact Statements (EPA, 2002) including draft revised Guidelines on the information to be contained in Environmental Impact Statements (EPA, 2015)and*
- *Environmental Impact Assessment of National Road Schemes - A Practical Guide, Revision 1 (NRA, 2008).*

5.2.1 Desktop Study

A desktop study was carried out of available mapping. The mapping included Ordance Survey of Ireland (OSI) mapping with indicative landownership information delineated.

5.2.2 Farm Surveys

The study area considered in this report includes agricultural land in agricultural use at the time of the farm assessment. The study area encompasses land along the proposed development as outlined in Figure 5.1.1-5.1.3.

While all landowners were approached not all expressed a willingness to be interviewed or permitted a walkover of their lands. The farm survey consisted of a physical walk-over of the lands that the survey team were permitted access to, together with an interview of the landowner/occupier and the completion of a detailed questionnaire. An assessment of the existing agricultural environment was carried out through the completion of detailed farm surveys. The surveys assessed how the proposed development would impact on current farming activities carried out on the lands and what mitigation measures would be necessary to alleviate negative impact. Where the farm survey did not take place because the landowner could not be contacted or cooperation with the assessment was withheld, a detailed desktop assessment was undertaken on the basis of a roadside inspection, land registry details and professional opinion. The study commenced in 2013 and landowners were interviewed and farm visits were conducted. Repeat interviews and roadside inspections were conducted in for 2017.

5.2.3 Impact Assessment Methodology

In rating the significance of impacts from an agricultural perspective the following criteria, as recommended by the EPA, were adopted. Impacts were categorised as neutral, significant or profound. Significant impacts are further sub-divided as minor, moderate, or major. The degree of impact was assessed having regard to the sensitivity of the receptor and the magnitude and duration of impact.

The impact assessment considered the overall effect of the proposed development on a farm holding. The following significance criteria presented in Table 5.1 were used to assess the impact on individual farm holdings.

Table 5-1 Significance Criteria Used to assess overall impact

EPA Glossary of Impacts	Level of Impact	Criteria
Neutral, Imperceptible or slight Impact	Not Significant	An impact is not significant where the farm enterprise suffers a slight inconvenience such as the relocation of access or loss of shelter.
Significant Impact:	Minor	Minor impact occurs where the farm enterprise suffers inconvenience as a result of the proposed development. Sub-division would not occur or is insignificant and the farm buildings and facilities would be left in place. Typically only a small portion of land would be removed from the boundary of the farm.
	Moderate	Moderate impact occurs where the farm enterprise can be continued as before but with increased management or operational difficulties. While portions of the land would be sub-divided the enterprise mix would be such that the farming system could continue perhaps with reduced stock numbers or additional labour, contractor or other charges.
	Major	Major impact occurs where the farm enterprise cannot be continued without considerable management or operational changes. There would be significant sub-division on the affected land parcel(s). The proposed development may affect farm buildings and / or facilities. Access to the sub-divided portions of land can only be achieved through the use of non-farm roadways to access sub-divided lands. Where the impact is major an enterprise change may be necessitated e.g. from dairy to drystock.
Profound Impact:	Profound	Profound impact occurs where the farm enterprise cannot be continued as a result of the proposed development. This would occur where land-take and sub-division was of such a nature to make the holding unworkable and/or where important farm buildings and facilities were removed. Impact of this degree would be rare and is most likely to occur on a dairy or stud farm.

5.2.4 Impact Magnitude

Various elements of both the construction and operational phases have the potential to impact on agriculture. The likely potential impacts for both construction and operation of the proposed development prior to mitigation are described. The proposed mitigation measures and any residual impacts after the mitigation measures have been implemented are also described. The magnitude of the impact takes into account the type and range of impact that will occur as well as the duration over which the impact will occur. The degree to which the proposed development impacts upon an individual farm depends on:

- *Land take;*
- *The degree of sub-division;*
- *The type of farm enterprises carried out;*
- *Impact on farm buildings and/or facilities; and*
- *Impact on shelter.*

a. Landtake

(i) Individual Fields

Reduction in the field size due to landtake results in increased costs for the farmer. In general the larger the field size the more useful the field. This is particularly important because of the ease of use of machinery in larger fields.

(ii) Farm Holdings

Land take is one of the main impacts on a farm and the degree of impact varies with the area of land taken and the quality of the land taken. The impact of the loss of land on a particular farm is complex. Increasing production levels elsewhere can compensate for the loss of land. Furthermore land can be purchased or rented to replace land lost. However this land may not be adjacent to the existing land and increased costs to the farmer can result.

The location of land taken is also a factor. For example land take on the main land parcel will have a greater impact on a fragmented farm holding than a land parcel which is removed from the main land parcel or has no farm buildings. Also in the case of dairy farmer, taking land laid out in paddocks adjacent to a milking parlour would have a larger impact than taking land located on an out farm.

The size of the farm affected is also of interest. In general land take on a smaller farm would have a greater impact than on a larger one.

(iii) Intensity of Land Use

Farming systems can vary with regard to the intensity of the land use. Any reduction in land area can reduce intensity. In general the impact will be greater on more intensively farmed lands. This would often be the case on dairy and beef farms with high stocking rates. There are a number of farms along the route which are not intensively farmed.

b. Sub-Division

For the purpose of this assessment, sub-division of a land parcel is defined as occurring when a road alignment splits a field or land parcel into two or more units. This results in fragmentation of the farm into a greater number of management units. Sub-division is important because it affects the future management of the remaining land, which is not taken for the proposed development. It extends the impact of the road scheme outside the footprint of the actual land take.

(i) Sub-Division of Individual Fields or Land Parcels

Farm holdings are more efficient in single land parcels. Fragmentation of farms results in greater costs to the farmer due to increased livestock and grassland management involved in farming more than one unit e.g. movement of livestock between land parcels and increased travel distances for grassland, silage and tillage machinery.

Where farm buildings are located on the land parcel being sub-divided the impact of sub-dividing the land from these buildings is considered. Land isolated from the farm buildings by a proposed development may be left without access to facilities previously available. The greater the area of land sub-divided from the farm buildings the greater the potential impact. Constructing new farm buildings in certain cases can mitigate this impact. The impact of sub-division on farm buildings is particularly acute in the case of dairy farming where the dairy and milking parlour are sub-divided from the grazing paddocks. The impact is greater because dairy herds require twice-daily access from the grazing area to a milking parlour.

Animal handling facilities such as cattle pens may be present for loading/unloading and treatment of livestock. The impact of sub-dividing such holdings can be mitigated by the replacement of the facilities on the sub-divided area.

In many instances land parcels do not have any farm buildings or animal handling facilities. This may occur when the farm buildings are located on another part of the farm.

The following significance criteria presented in Table 5-2 are used to rank sub-division of individual fields or land parcels.

Table 5-2 Significance Criteria Used to rank Sub-division of Land Parcels

EPA Glossary of Impacts	Level of Impact	Criteria
Neutral, Imperceptible or Slight Impact:	Not Significant	The proposed development passes generally along the external field boundary leaving the bulk of the land in one unit. There is no sub-division caused.
Significant Impact:	Minor	The proposed development passes generally along the external boundary leaving the bulk of the land in one unit. There may be sub-division of a small area. Farmyard facilities are not affected.
	Moderate	The proposed development passes through the land parcel causing sub-division. It is divided into two units. Access is available to the two areas. The sub-divided area is less than one third of the land parcel. Where present, the farm buildings and facilities remain on the larger area.
	Major	The proposed development passes through the land parcel causing sub-division. It is divided into two units and the sub-divided area is greater than one third of the land parcel. There is no access to the sub-divided area or it may be a by way of a considerable distance. Farm buildings and facilities are left on less than half the original area. In addition both areas may be irregularly shaped and less useful.
Profound Impact:	Severe	The proposed development passes through the land parcel causing sub-division. It is divided into two units. There is no access to the sub-divided area. The sub-divided area is greater than two thirds of the land parcel. There is a loss of access to farm buildings and / or facilities.

Land take and sub-division are two terms, which outline the effects of the proposed development on a field or land parcel. However, many farm holdings may be fragmented and may consist of several land parcels. The proposed development may impact on the main land parcel consisting of farm buildings and facilities or on a second land parcel where no facilities are present. Although land take and sub-division on both land parcels would be comparable, the overall impact on the farm holding could differ significantly.

Fragmented farms may also be affected by the proposed development on more than one land parcel. Different impacts on each land parcel may not accurately reflect the overall impact on the farm holding.

c. The Type of Farm Enterprise

Farm enterprise types that are intensively farmed could be more severely affected by the proposed development. As explained above these would frequently be dairy farms and intensive beef farms. A reduction in the available forage area may result in a reduction in the number of dairy cows that can be maintained on the farm. A significant reduction in land take, or sub-division of the grazing paddocks from the farm buildings, may result in the farmer being forced to change the enterprise type to a less profitable enterprise.

Table 5-3 Significance Criteria for Overall Impact on the Farm Holding

EPA Glossary of Impacts	Level of Impact	Criteria
Neutral, Imperceptible or slight Impact	Not Significant	An impact is not significant where the farm enterprise suffers a slight inconvenience such as the relocation of access or loss of shelter.
Significant Impact:	Minor	Minor impact occurs where the farm enterprise suffers inconvenience as a result of the proposed development. Sub-division would not occur or is insignificant and the farm buildings and facilities would be left in place. Typically only a small portion of land would be removed from the boundary of the farm.
	Moderate	Moderate impact occurs where the farm enterprise can be continued as before but with increased management or operational difficulties. While portions of the land would be sub-divided the enterprise mix would be such that the farming system could continue perhaps with reduced stock numbers or additional labour, contractor or other charges.
	Major	Major impact occurs where the farm enterprise cannot be continued without considerable management or operational changes. There would be significant sub-division on the affected land parcel(s). The proposed development may affect farm buildings and / or facilities. Access to the sub-divided portions of land can only be achieved through the use of non-farm roadways to access sub-divided lands. Where the impact is major an enterprise change may be necessitated e.g. from dairy to drystock.
Profound Impact:	Profound	Profound impact occurs where the farm enterprise cannot be continued as a result of the proposed development. This would occur where land-take and sub-division was of such a nature to make the holding unworkable and/or where important farm buildings and facilities were removed. Impact of this degree would be rare and is most likely to occur on a dairy or stud farm.

5.3 Description of the Existing Environment

In assessing the impact of the proposed development on agriculture, it is useful to compare the general agricultural activity at a national and county level with that of the area immediately affected by the proposed development. This will indicate if there is any significantly unusual agricultural production taking place along the alignment of the proposed development.

5.3.1 Agriculture in County Kerry

County Kerry has a total Utilisable Agricultural Area (UAA) of almost 290,000 hectares (Central Statistics Office, Census of Agriculture 2010). This represents approximately 6.3% of the national agricultural land area. There are over 8,400 farms in County Kerry with the average farm size in the County being 34 ha. This is slightly higher than the national average farm size of 33 ha.

Grassland based livestock farming is the dominant farm type in Co. Kerry. The predominant farm enterprise is specialist beef with a total of 3,921 farms (46.61% of farms). Specialist Dairying has a total of 1,522 farms (18.09% of farms). Specialist sheep and mixed grazing livestock are also important with 1,408 farms (16.73%) and 790 farms (9.4%) respectively. There is a low level of specialist tillage farming in Co. Kerry with a total of 60 farms (0.71%) involved in Tillage.

5.3.2 Agriculture along the Proposed Development

The proposed development will pass through two Electoral Divisions (EDs); Listowel Urban and Listowel Rural.

The topography in the area is generally flat to undulating lowland consisting mainly of dry mineral soils. There are no unusual features or elements along the proposed development from an agricultural perspective.

5.3.3 Soils

The soils are described in detail in Chapter 7: Geology, Soils and Hydrogeology. Soil types influence the nature and intensity of farming carried out. The soil types through which the proposed development passes through are typical of soil association, number 22 Gleys 75%, Acid brown earths 15%, Peats 10%. The soils are derived from till of upper Carboniferous Shale and Sandstone. The soils are normally heavy in nature and are generally not suited to tillage production. A soil association is a mapping unit on a soil map, which consists of two or more soils. A soil map is a representation of the distribution of soil types of a given landscape (An Foras Taluntais – Soil Associations of Ireland and their land use potential).

The soil association characteristics are outlined in Appendix 5.1.

5.3.4 Farm Type

Table 5-3 presents the category of crop type and farm size in the affected EDs and how they compare with the national percentages for each category.

Table 5-3 Farms Classified by Farm Type within affected E.D.'s and Nationally

Crop Types	Area within EDs (ha)	% of Area	% of National Area under Crops and Pasture
Total Crops, Cereals, potatoes Fruit, Horticulture	290	9.18%	7.75%
Total Pasture	1,666	52.72%	54.88%
Total Hay	127	4.02%	4.24%
Total Silage	973	30.79%	23.56%
Rough Grazing in use	3,160	3.29%	9.57%
Total	3,160	100%	100%

The high level of grass-based farm enterprises is reflected in the high levels of grassland crop types. There is a higher level of silage than the national average. There is a lower level of rough grazing than the national average. The proposed development will not cause a severe reduction in area of any particular crop type.

5.3.5 Farm Size

Table 5-4 presents the size of farms within the affected EDs and how they compare with the county and national percentages for each category.

Table 5-4 Number of farms classified by farm size in each Electoral District (Listowel Urban and Listowel Rural)

Farm Size	No of farms classified by farm size	% of Farmers in each category	National % of farms in each category
<10 Hectares	21	24.71%	18.20%
10 -<20 Hectares	22	25.88%	24.00%
20 - <30 Hectares	6	7.06%	17.60%
30 - <50 Hectares	16	18.82%	21.90%
50 - <100 Hectares	16	18.82%	14.80%
>=100 Hectares	4	4.71%	3.50%
Total	85	100%	100

The figures in Table 5-4 indicate that there are a larger percentage of smaller farms in the EDs than that occurring nationally. Of all farms, 50.59% are less than 20ha in size in contrast with the national average of 42.20% for the same category.

5.4 Predicated Impacts on Agriculture during Construction

The principal impacts on agricultural activity during the construction phase of the proposed development will be:

- *Construction noise and dust;*
- *Restricted access to sub-divided land parcels; and*
- *Disturbance of drainage system and/or services.*

5.4.1 Construction Noise & Dust

Construction traffic and operations, such as transport vehicles and other ancillary vehicles and earth moving machinery, will generate additional noise emissions in the immediate vicinity of the proposed development during construction. Noise can be of significance for farm animals (i.e. when noise becomes excessively loud). In general, animals become accustomed to regular noises and sounds. Intermittent noises can cause fright and distress. Blasting activity, which is sometimes necessary during construction, can be of particular significance however blasting is unlikely to be required during the construction of the proposed development. Intermittent noises close to farm buildings, particularly milking parlours, can be of significance.

Dust generated from the exposure of soil to the atmosphere during construction could cause annoyance or nuisance to the farmer and farm animals. The proliferation of dust during construction has a nuisance effect and, if produced in high volumes near milking parlours or on-farm bulk milk storage tanks, may constitute a risk as a source of contamination to the milk.

Livestock are at risk of eye irritations from high levels of windblown dust particles. This stress may reduce productivity and increase management difficulties, especially on dairy and equestrian farm holdings.

5.4.2 Restricted access to Sub-Divided Land Parcels

Farmers will require access to the sub-divided land parcels during the construction period. It is to be expected that there will be increased difficulties in maintaining such access during the construction phase due to the need to allow machinery and equipment

continual movement along the construction corridor. This may conflict with a farmer's requirements to move livestock from one part of a farm holding to another in order to utilize all available grazing areas.

5.4.3 Disturbance of Drainage Systems & Services

It is to be expected that field drainage systems currently in situ will be disturbed during construction. The operation of these systems will be restored as part of the permanent works, but there may be impaired drainage in the period of time between initial disturbance and final reinstatement of such drainage works.

Piped water and power systems on some farms may be sub-divided. Access to either piped water or drinking points on watercourses may be affected. Electric fencing required to help stock-proof non-roadside boundaries may also be affected.

5.5 Construction Mitigation Measures

5.5.1 Construction Noise & Dust

Measures will be taken by the contractor to control dust, noise and vibration during the construction phase as discussed in Chapter 9 Air Quality and Climate and Chapter 10 Noise and Vibration.

Good communication with farmers will facilitate the organisation of farm enterprises, so that vulnerable livestock are kept as far away as feasible from the construction work during critical times. To ensure this communication is facilitated between affected landowners and the contractor during the construction phase a contact person will be appointed by the contractor. This appointed person will inform members of the community directly affected by the construction phase on schedules for any activity of a particularly disruptive nature which is likely to impinge on their property (e.g. demolition, pile driving) and any mitigating actions that are being taken (e.g. shielding, restriction on work hours, etc.) to minimise such disruption to the landowners and local community.

To avoid adverse impacts to livestock from noise and dust the contractor will inform farmers affected by the construction phase on schedules for any activity of a particularly disruptive nature (i.e. demolition, pile driving) so that livestock are kept as far away as possible from the construction work during critical times.

5.5.2 Restricted access to Sub-Divided Land Parcels

To avoid disruption to access during construction the Contractor will maintain access to sub-divided land parcels at all times during the construction of the proposed development until such time as the permanent access arrangements are in place and operational, unless agreed otherwise in writing by the landowner and / or occupier. Temporary fencing will be erected to facilitate the use of affected areas during construction.

5.5.3 Disturbance of Drainage Systems & Services

To avoid the disturbance to drainage systems the contractor will maintain continuity of all existing ground and surface water drainage systems, such as lands drains, ditches and private outfalls, affected by the proposed development until the permanent drainage systems for the proposed development are installed and functioning satisfactorily.

To avoid disturbance to utilities services the contractor will maintain continuity of all existing services (e.g. electricity supply, mains water supply) affected by the proposed development until the permanent supply systems for the proposed development are installed and functioning satisfactorily.

5.6 Predicated Impacts on Agriculture during Operation

The proposed development is through lowland, which consists of lands of good agricultural range and usage. The main farm enterprises are dairying and mixed livestock. The impact on agriculture of the proposed development will be limited to those farms directly traversed by the proposed development.

5.6.1 Loss of Agricultural Land

Nationally there are over 4.5 million ha of agricultural land (excluding commonage) of which some 3.7 million ha are in grassland based enterprises excluding rough grazing and over 350,000 ha of cereal and non-cereal crop production. Approximately 24.56 ha of land will be lost to agricultural production as a result of this proposed development. This loss, while significant to individual farmers, is not significant on a county or national level.

5.6.2 Individual Farm Impact

There are 21 land holdings that are directly affected by the proposed development, see Figure 5.1.1 to 5.1.4. An assessment of the existing agricultural environment was carried out through the completion of detailed farm surveys. The farm surveys assessed how the proposed development would impact on the current farming operations carried out on the land affected by the route and what mitigation measures would be necessary to alleviate negative impact. The landowner was interviewed where possible and a detailed farm survey was carried out.

On two farms with a not significant impact, one farm with a minor impact and one farm with a moderate impact, the farm visit did not take place as the landowners could not be contacted. Where the farm visit did not take place a detailed desktop assessment was undertaken on the basis of a roadside inspection, land registry details and professional opinion in order to:

- *To conduct an appraisal of the land quality and farming practices along the proposed development;*
- *To conduct an appraisal of land take, degree of Sub-division and any farmyard disturbance arising from the proposed development;*
- *To gather data via a questionnaire to enable an assessment of the impact and mitigation measures required as a result of the proposed development;*
- *Farms were categorised according to the following criteria;*
    - *Total area of farm holding (hectares, ha);*
    - *Enterprise type(s);*
    - *Degree of overall impact;*
    - *Degree of land sub-division;*
    - *Buildings/facilities to be required; and*
    - *New access*

Table 5-5 presents details of the individual farm holding assessments and the potential impact of the proposed development on each farm holding prior to the implementation of mitigation measures and Table 5-6 summarises of the individual farm holding assessments see also Figure 5.1.1 to 5.1.4 for the location of each farm referernce number.

Table 5-5 Individual farm holding assessments (21 farms)

Farm Ref No.	Total Farm Holding (Ha)	Farm Enterprise	Level of overall impact	Parcel Ref	Land take (Ha)	Details of Impact
1	52.6	Dairying	Not Significant	1	0.35	Sub division- Not Significant Removal of hedgerow
2	78.9	Dairying	Not Significant	2	0.47	Sub division- Not Significant Removal of hedgerow Impact on an existing access point to land parcel
3	80.9	Mixed livestock including dairying	Moderate	3	1.39	Sub-division-Minor Reduction in area farmed Impact on existing access point to land parcel
4	32.3	Dairying	Major	4	1.95	Sub-division-Moderate Reduction in area farmed Impact on farm management Interruption of water supply Impact on existing access point to land parcel
5	6.5	Leased	Not Significant	5	0.04	Sub-division- Not Significant Slight reduction in area farmed
6	27.9	Beef	Minor	6	0.71	Sub-division- Not Significant Reduction in area farmed
7	10.9	Leased	Moderate	7	2.97	Sub-division- Not Significant Reduction in area farmed
8	33.1	Dairying	Major	8	6.05	Sub-division- Major Reduction in area farmed Impact on farm management Interruption of water supply Impact on existing access point to land parcel
9	16.9	Leased	Moderate	9a	0.89	Sub- division- Not Significant Reduction in area farmed Impact on existing access point to land parcel
				9b	0.60	Sub- division- Not Significant Reduction in area farmed
10	41.6	Leased	Moderate	10	3.16	Sub-division- Moderate Reduction in area farmed Interruption of existing paddocking system Impact on existing access point to land parcel
11	146	Dairying	Not Significant	11	0.23	Sub- division- Not Significant Removal of hedgerow Impact on existing access point to land parcel
12*	3.4	Equine	Moderate	12	1.26	Sub- division- Moderate Reduction in area farmed Impact on existing access point to land parcel
13*	4.6	Other - Grassland	Not Significant	13	0.31	Sub-division-Not Significant
14*	3.9	Other - Grassland	Not Significant	14	0.06	Sub-division-Not Significant

Farm Ref No.	Total Farm Holding (Ha)	Farm Enterprise	Level of overall impact	Parcel Ref	Land take (Ha)	Details of Impact
15	4.1	Leased	Minor	15	0.84	Sub-division-Not Significant
16	1.8	Other – Hay production	Not Significant	16a	0.06	Sub- division- Not Significant Removal of hedgerow
				16b	0.01	Sub- division- Not Significant Removal of hedgerow
17*	0.35	Other- grassland	Moderate	17	0.35	Sub-division – Not Significant Acquisition of entire land parcel
18	0.8	Leased	Not Significant	18	0.03	Sub-division – Not Significant Slight reduction in area farmed Removal of hedgerow
19	2.0	Other –grassland	Minor	19	0.44	Sub-division – Not Significant Reduction in farmed area
20*	4.1	Other – grassland	Minor	20	2.29	Sub-division – Minor Reduction in area farmed
21	21	Other- Hay production and leased	Minor	21	0.07	Sub-division-Not Significant Slight reduction in area farmed

Note: A provisional assessment of the agricultural impact has been carried out on four farms based on a desktop study and roadside survey, and one farmer did not wish to disclose full details of the area of the affected area, the affected area has been estimated for these land holdings. They are marked with an * in the table. All holdings currently in Agricultural use were assessed by landowner consultation or by Roadside inspection where landowner consultation was not possible.

Table 5-6 Summary of the individual farm holding assessments (21 farms)

Category	No. of Farms	% of Farms
Farm Size (ha): -		
<10	10	47.6
10 – <20	1	4.8
20 – <30	3	14.3
30 – <50	3	14.3
50 – <100	3	14.3
>=100	1	4.8
Farm Enterprises: -		
Dairy	5	23.8
Beef	1	4.8
Mixed Livestock*	1	4.8
Equine	1	4.8
Leased	6	28.6
Other**	7	33.3
Overall Impact on Farm (21 farms)		
Not Significant	8	38.1
Minor	5	23.8
Moderate	6	28.6
Major	2	9.5
Under Major Impact		
Dairy Farms	2	9.5
Equine Farms	0	0.0
Beef	0	0.0
Tillage	0	0.0
Mixed Livestock	0	0.0
Leased	0	0.0
Other	0	0.0
Land Sub-division (of 23 individual land parcels):		
Not Significant	17	73.9
Minor	2	8.7
Moderate	3	13.0
Major	1	4.3
Severe	0	0.0
Facilities to be acquired (i)	0	0.0
Access required to sub-divided area (ii)	3	13.0
Access points to be provided/Restored (iii)	9	39.1

Table 5- Key:

* Mixed Livestock includes one farm primarily involved in dairying with an ancillary beef enterprise.

** Includes one land parcel where the land is not farmed,four land parcels involved in hay production, and two grassland farms.

(i) Facilities include farmyards, slurry storage facilities, animal handling facilities, stone sheds.

(ii) Access is deemed to be required where it has to be provided to a sub-divided portion of land.

(iii) Access points are to be provided where the access point or gates have to be replaced or restored on a land parcel.

Note: In the case of access required or facilities required, the figure refers to the number of land parcels in each case. It does not relate to the number of farms. In some cases access may be required on more than one land parcel on a farm holding.

The farm enterprises on the affected holdings are predominantly grass and livestock based.

5.6.3 Overall Impact on Individual Farm Holdings

Where a profound impact occurs the farm enterprise cannot be continued as a result of the proposed development. There are no farms on which the agricultural impact of the proposed development would be profound.

Prior to any mitigation measures being implemented there are two farm holdings (Farm 4 & 8) along the proposed development on which the agricultural impact would be major representing 9.5% of all farm holdings along the proposed development.

There are six farm holdings (Farms 3, 7, 9, 10, 12 & 17) that would experience a moderate level of impact representing 28.6% of all farm holdings along the proposed development.

There are five farm holdings (Farms 6,15, 19, 20, & 21,) that would experience a minor level of impact representing 23.8 % of all farm holdings along proposed development.

There are eight farm holdings (Farms 1, 2, 5, 11, 13, 14, 16, & 18) that will experience a not significant level of impact along the proposed development representing 38.1% of all farm holdings along the proposed development.

The proposed development affects more than one land parcel on two farm holdings on the alignment and as a result the level of land sub-division on each land parcel is assessed separately. There are 23 individual land parcels directly affected along the proposed development.

Without mitigation measures being taken into account the levels of sub-division on land parcels along the proposed development will be as follows:

- *No Severe land sub-division;*
- *Major land sub-division on one land parcel (Parcel 8);*
- *Moderate land sub-division on three land parcels (Parcel 4, 10, & 12);*
- *Minor land sub-division on two land parcels(Parcel 3 and 20); and*
- *Not significant sub-division on seventeen land parcels.*

5.6.4 Proposed Development Design and Mitigation Measures

Mitigation measures are the measures proposed in order to avoid, reduce or where possible remedy the significant adverse effects on agriculture. Mitigation measures have been incorporated into the design of the proposed development including minimising the landtake requirements so that only lands required for the proposed development are acquired. In some cases it will be necessary to acquire sub-divided land where access cannot reasonably be provided.

Mitigation measures when implemented will mitigate the adverse impact on agriculture. The assessment does not consider compensation under the CPO process for land acquisition and disturbance.

The following general mitigation measures will be implemented for the proposed development in terms of providing boundary fencing and disturbance to services:

- *The permanent boundary fence between the proposed development and the agricultural lands will consist of a timber post and rail fence that will be stockproof and timber treatment which will be appropriate for the type of livestock present.*
- *The Local Authority will maintain the fence along the national road element of the proposed development.*
- *It will be the responsibility of the landowners to maintain the fence along regional, local and accommodation roads.*
- *Ducting will be provided for the restoration of water and electricity supplies, with the agreement of the landowner.*

Access will be restored to lands where it is impacted by the proposed development. In most cases this is restoring existing farm access points or providing new gateways, the location of which will be with the agreement of the landowner. This is true for nine land parcels (Parcel 2, 3, 4, 8, 9a, 10, 11, 12 and 20), where the existing access point will be affected, a new access point off an existing road will be required.

On land parcels where sub-division occurs the provision of an underpass is required. Three underpasses are being provided in total along the proposed development. On Farm 4, one livestock underpass is being provided. On Farm 8, one livestock underpass and one farm machinery underpass is being provided. The structures included within the design and assessed in this EIS are described in Table 5-7 see also Figure 2.1.1 to 2.1.5.

Table 5-7 Structures on the Proposed Development

Ref.	Chainage	Description of Structure	Farm Ref No
ST11	1,050	Private underpass suitable for livestock use (3.0 X 3.5 m)	4
ST18	1,790	Private underpass suitable for agricultural vehicle and livestock use (4.5 X 4.5 m)	8
ST24	2,500	Private underpass suitable for livestock use (2.1 m X 3.0 m)	8

5.7 Residual Impacts

Residual impacts have been assessed following the implementation of mitigation measures. Table 5-8 details the level and nature of the impact the proposed development will have on each individual farm and proposed mitigation measures relating to accommodation works and Table 5-9 presents a summary of the overall and residual impact of the proposed development.

Table 5-8 Residual Impacts on the Individual Farms

Farm Ref No.	Level of overall impact	Parcel Ref No.	Details of Impact	Mitigation Relating to Sub-division only	Residual Impact
1	Not Significant	1	Sub division- Not Significant Removal of hedgerow	N/A	Not Significant
2	Not Significant	2	Sub division- Not Significant Removal of hedgerow Impact on an existing access point to land parcel	N/A	Not Significant
3	Moderate	3	Sub-division-Minor Reduction in area farmed Impact on existing access point to land parcel	Restore access to sub- divided land parcel	Minor
4	Major	4	Sub-division-Moderate Reduction in area farmed Impact on farm management Interruption of water supply Impact on existing access point to land parcel	Provide access to sub-divided land parcel	Moderate
5	Not Significant	5	Sub-division- Not Significant Slight reduction in area farmed	N/A	Not Significant
6	Minor	6	Sub-division- Not Significant Reduction in area farmed	N/A	Minor
7	Moderate	7	Sub-division- Not Significant Reduction in area farmed	N/A	Moderate
8	Major	8	Sub-division- Major Reduction in area farmed Impact on farm management Interruption of water supply Impact on existing access point to land parcel	Provide access to sub-divided land parcel	Major
9	Moderate	9a	Sub- division- Not Significant Reduction in area farmed Impact on existing access point to land parcel	N/A	Moderate
		9b	Sub- division- Not Significant Reduction in area farmed		
10	Moderate	10	Sub-division- Moderate Reduction in area farmed Interruption of existing paddocking system Impact on existing access point to land parcel	Restore access to sub-divided land parcel	Moderate
11	Not Significant	11	Sub- division- Not Significant Removal of hedgerow Impact on existing access point to land parcel	N/A	Not Significant
12*	Moderate	12	Sub- division- Moderate Reduction in area farmed Impact on existing access point to land parcel	Restore access to sub-divided land parcel	Moderate
13*	Not Significant	13	Sub-division-Not Significant	N/A	Not Significant
14*	Not Significant	14	Sub-division-Not Significant	N/A	Not Significant
15	Not Significant	15	Sub-division-Not Significant	N/A	Not Significant

Farm Ref No.	Level of overall impact	Parcel Ref No.	Details of Impact	Mitigation Relating to Sub-division only	Residual Impact
16	Not Significant	16a	Sub-division-Not Significant Removal of hedgerow	N/A	Not Significant
		16b	Sub- division- Not Significant Removal of hedgerow		
17*	Moderate	17	Sub-division – Not Significant Reduction in farmed area	N/A	Moderate
18	Not Significant	18	Sub-division – Not Significant Slight reduction in area farmed Removal of hedgerow	N/A	Not Significant
19	Minor	19	Sub-division – Not Significant Reduction in farmed area	N/A	Minor
20*	Minor	20	Sub-division – Minor Reduction in area farmed	Restore access to sub-divided land parcel	Minor
21	Minor	21	Sub-division-Not Significant Slight reduction in area farmed	N/A	Minor

Note: A provisional assessment of the agricultural impact has been carried out on four farms based on a desktop study and roadside survey, and one farmer did not wish to disclose full details of the area of the affected area, the affected area has been estimated for these land holdings. They are marked with an * in the table. All holdings currently in Agricultural use were assessed by landowner consultation or by Roadside inspection where landowner consultation was not possible.

Table 5-9 Summary of Residual Impacts on the Individual Farms

Category	Overall Impact No. of Farms	Residual Impact No. Of Farms	Residual Impact % of Farms
Overall Impact on Farm (21 farms)			
Not Significant	8	8	38.1
Minor	5	6	28.6
Moderate	6	6	28.6
Major	2	1	4.8
Severe	0	0	0.0
Of those with Major Impact:			
Dairy Farms	2	1	4.8
Equine Farms	0	0	0.0
Beef	0	0	0.0
Tillage	0	0	0.0
Mixed Livestock	0	0	0.0
Leased	0	0	0.0
Other	0	0	0.0

As a result of the proposed development design, specifically the accommodation works, one farm (Farm 4) will have a major impact reduced to a moderate residual impact and one Farm (Farm 3) will have a moderate impact reduced to minor. One farm (Farm 8) will still have a residual impact of major (representing 4.8% of all farms) as the permanent land take significantly reduces the dairy herd grazing area. Part of the severed land will need to be accessed on a twice daily basis to continue the enterprise if this is impractical then a major farm management changes will be required. Therefore the mitigation does not reduce the impact.

Six farms will have a moderate residual impact (Farm 4, 7, 9, 10, 12, and 17). Five farms (Farm 3, 6, 15,19, 20 and 21, will have a minor residual impact and eight farms will have a not significant residual impact (Farm 1, 2, 5,11,13,14,15,16, and 18).

5.8 Difficulties Encountered

On four farms the landowners could not be contacted and a provisional assessment of the impact was carried out on these farm holdings based on a desktop survey of relevant mapping and a roadside survey of the lands, and on one farm the landowner did not wish to give full details of the area affected or the farming enterprise.

5.9 Cumulative Impacts and Impact Interrelations

No significant cumulative agricultural impact will occur as result of the proposed development. There is a potential interaction between Agriculture and Noise on agricultural property. This impact has been recognised in the noise and vibration chapter and noise mitigation measures have been proposed.

5.10 References

EPA (2002) *Guidelines on the information to be contained in Environmental Impact Statements*. Wexford: Environmental Protection Agency.

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

EPA (2015) Draft revised EPA *Guidelines on the information to be contained in Environmental Impact Statements*. EPA, 2015 Wexford: Environmental Protection Agency.

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Central Statistics Office (2010) 2010 Census Of Agriculture (Internet) Dublin, CSO. Available from: http://www.cso.ie/.

6 Flora and Fauna

6.1 Introduction

This chapter of the EIS considers and assesses the potential direct, indirect and cumulative ecological impacts of the proposed development on terrestrial and aquatic ecology.

6.2 Methodology

The methodology undertaken as part of this assessment is detailed in the following sections.

6.2.1 Desk Study

The desk study involved a review of relevant legislation and policy, collation of existing information on the ecological environment and consultation with relevant statutory bodies.

(a) Relevant Legislation and Policy Context

This assessment has had regard to the following policy documents and guidelines:

(i) Relevant Policies and Plans

- *Ireland's National Biodiversity Plan, 2011 – 2016 (Department of Arts, Heritage and the Gaeltacht, 2011);*
- *Kerry County Development Plan 2015 – 2021 (Kerry County Council, 2015);*
- *Listowel Town Development Plan, 2009 – 2015 (Listowel Town Council, 2009);*
- *Listowel/Ballybunion Functional Areas Local Area Plan 2013-2019 (Kerry County Council, 2013);*
- *Heritage and Biodiversity Plan, 2008 – 2012 (Kerry County Council, 2008); and*
- *Biodiversity Actions 2008-2012 (Kerry County Council, 2008).*

(ii) Relevant Guidelines

- *Guidelines on the Information to be contained in Environmental Impact Statements (Environmental Protection Agency, 2002 and updated Draft 2015);*
- *Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) (Environmental Protection Agency, 2003 and updated Draft 2015);*
- *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (Chartered Institute of Ecology and Environmental Management, 2016);*
- *Environmental Impact Assessment of National Road Schemes – A Practical Guide (National Roads Authority, 2008);*
- *Environmental Guidelines Series for Planning and Construction of National Roads (National Roads Authority, 2005-2009);*
- *National Roads Authority 2010 Project Management Guidelines (National Roads Authority, 2010b);*
- *Design Manual for Roads and Bridges (Highways Agency, 2001a and 2001b and amendments);*
- *Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd Edition) (Collins, 2016);*
- *Bats & Lighting. Guidance Notes for Planners, engineers, architects and developers (Bat Conservation Ireland, December 2010b);*
- *Bats in Buildings. Guidance Notes for Planners, engineers, architects and developers (Bat Conservation Ireland, December 2010a);*
- *Bat Mitigation Guidelines for Ireland (Kelleher and Marnell, 2006);*
- *Bat Mitigation Guidelines (Mitchell-Jones, 2004);*
- *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (Inland Fisheries Ireland, 2016);*
-
- *Newt Surveys – Specific Requirements (Northern Ireland Environment Agency, 2011); and*
- *Herpetofauna Worker's Manual (Gent and Gibson, 2003).*

(b) Consultation

The following organisations with relevance to ecology were consulted. Any official correspondence received has been included in Appendix 6.1 of this EIS:

- *Inland Fisheries Ireland (IFI);*
- *Bat Conservation Ireland (BCI);*
- *BirdWatch Ireland (BWI);*
- *Irish Whooper Swan Study Group;*
- *Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs; and*
- *National Parks & Wildlife Service (NPWS) local and regional staff.*

In addition to written correspondence, meetings were held with NPWS regional staff on the 2nd May 2013 and 24th October 2016 and an informal site meeting with the local conservation ranger on the 11th June 2013 regarding the scope of the ecological field survey work, existing records of rare and protected species and the likely potential impacts of the proposed development. A data request was submitted to the NPWS on the 10th September 2013 requesting any records of protected species or habitats, and any habitat mapping/surveys undertaken in the vicinity of the proposed crossing point of the Lower River Shannon SAC.

BWI were consulted regarding known records for Barn owl, and other raptor species, in the locality (19th March 2013 and the 17th October 2013) and in relation to whooper swan *Cygnus cygnus* and other wintering bird records (11th June 2013). Updates to these records were requested in December 2015 and in April 2017. The Irish Whooper Swan Study Group was also consulted in relation to whooper swan records in the locality. The NPWS were consulted on the 9th October 2013 in relation to known Hen harrier nesting sites within 10 km of the proposed development.

The Bat Conservation Ireland database was searched for known roosting sites within 10 km of the proposed development.

The Senior Fisheries Environment Officer with IFI was consulted regarding IFI requirements in relation to bridge and structure design on the 23rd August 2013 and on the 10th September 2013 regarding the fisheries value of the watercourses crossed.

(c) Desktop Data Sources

The following sources were consulted during the desktop study;

- *Environmental Protection Agency online databases on water quality. Available online at <http://gis.epa.ie/Envision/>;*
- *Ordnance Survey Mapping. Available online at <www.osi.ie>;*
- *Aerial photography available online at Google Maps <http://maps.google.com/> and Bing Maps <http://www.bing.com/maps/>;*
- *Online data available on Natura 2000 sites as held by the National Parks and Wildlife Service (NPWS). Available online at <www.npws.ie/protectedsites/> and < http://webgis.npws.ie/npwsviewer/>. Information on the Shannon International River Basin District. Available online at <http://www.shannonrbd.com/index.htm>;*
- *Information on soils, geology and hydrogeology in the area available from <www.gsi.ie>;*
- *Information on the location, nature and design of the proposed development supplied by the project design team;*
- *A previous aquatic ecology and fisheries study carried out for the Route Selection stage of the proposed development (Mott MacDonald, 2009a);*
- *A previous flora and fauna report carried out for the Route Selection stage of the proposed development (Mott MacDonald, 2009b)*
- *A previous water quality report carried out for the Route Selection stage of the proposed development (Mott MacDonald, 2009c);*
- *A previous river habitat survey undertaken for Kerry County Council as part of the route selection process (Ryan Hanley, 2012);*
- *Previous bat surveys carried out as part of the Route Selection studies (McCarthy, Keville, O'Sullivan, 2012, and Kelleher, 2013);*
- *BirdWatch Ireland and British Trust for Ornithology Bird Atlas 2007-2011 online database. Accessed 23/04/2012;*
- *Irish Wetland Bird Survey Data (IWeBS) 2004-2016 for relevant sub-sites;*
- *Irish Whooper Swan census counts for relevant subsites;*
- *Data on Lamprey populations in the River Feale (O'Connor, 2006);*
- *National Biodiversity Data Centre On-line Database. Available online at <http://maps.biodiversityireland.ie/#/Map>; and*
- *Water Framework Directive Water Maps. Available online at <http://www.wfdireland.ie/maps.html>.*

6.2.2 Field Survey

A suite of terrestrial and aquatic surveys were undertaken between February 2013 and June 2014. Updates to several of these surveys were carried out between June 2016 and April 2017 as summarised in Table 6-1. Surveys spanned all four seasons and covered the optimal survey periods for all flora and fauna species. The requirement for specialised invertebrate sampling of the proposed crossing point of the River Feale arose out of the consultation meetings with the NPWS in May 2013.

Table 6-1 Ecological Surveys and Survey Dates at Listowel 2013/2014

Survey	Survey Date(s)
Multi-Disciplinary Walkover (Habitats and protected Fauna)	3rd - 5th April 2013
Birds (Breeding)	1st - 2nd May 2013 & 11th June 2013
Amphibians	3rd - 5th April, 1st May & 10th June 2013
Bat Surveys	February – October 2013
Freshwater Pearl Mussel Survey	10th-12th June 2013, & 13th June 2015
Additional Botanical and Habitat Surveys	17th – 18th July 2013, & 26 June 2014
Invertebrate Survey at River Feale (Spider)	1st September 2013
Whooper Swan Surveys	30th October – 1st November 2013, 21st November 2013, 19th December 2013, 9th January 2014, 17th February 2014, 28th March 2014, 24th November 2016, 8th December 2016, 5th January 2017, 19th February 2017, 13th March, 2017 and 2nd April 2017
Otter Surveys	3rd - 5th April 2013, 11th June 2013, 30th October – 1st November 2013, 8th – 10th January 2014, 28th & 29th April 2014
Barn Owl Surveys	June – August 2016
Updated Bat Activity Surveys and Building Inspections	29th August – 1st September 2016
Updated Walkover for Habitat and Mammal Surveys	31st August – 2nd September 2016

(a) Habitats

Flora and habitats within the study area were surveyed using the methodology outlined in the guidance document *Best Practice Guidance for Habitat Survey and Mapping* (Smith *et al.*, 2011). All parcels of land through which the proposed development passes were surveyed. This was extended to include any adjacent or nearby land considered to be within the zone of influence of the proposed development[8]. All habitat types were identified and classified using the *Guide to Habitats in Ireland* (Fossitt, 2000). Guidance on European Annex I habitat classification was sought from the *Interpretation Manual of EU Habitats* (European Commission, 2007). Within each habitat dominant and abundant plant species, indicator species and/or species of conservation interest were recorded. Further detailed botanical surveys were undertaken in July 2013 and June 2014, and were re-checked in 2016, of habitats that were considered to be of a higher ecological value; including the lands within the boundary of the Lower River Shannon cSAC at the proposed crossing point of the River Feale.

Plant nomenclature follows that of the *Checklist of the Flora of Britain & Ireland* (Botanical Society of Britain & Ireland, 2007), and bryophyte nomenclature follows the *Checklist of British and Irish Bryophytes* (British Bryological Society, 2009).

(b) Protected Mammals - Bats

A suite of bat surveys were undertaken in winter, spring, summer and autumn (refer to Table 6-2) to assess the use of the zone of influence of the proposed development by bats and to cover periods of peak bat activity throughout the annual bat lifecycle, in accordance with the requirements of TII guidance (National Roads Authority, 2005b and 2006a). The field survey was supplemented by evaluation of relevant literature and

[8] In accordance with TII guidance (National Roads Authority, 2009b), the zone of influence is an important term to define the receiving environment for the activities associated with the project and the biophysical changes that are likely to occur. The Zone of Influence is the 'effect area' over which change is likely to occur. The zone of influence will evidently differ for different species and habitats, due to varying sensitivities to varying impact types.

reviews of the NPWS National Lesser Horseshoe Bat Roost Database and BCI's National Bat Records Database.

Table 6-2 Bat Survey Dates at Listowel in 2013

Bat Survey	Date(s)
Winter Surveys	28th February - 1st March 2013
Spring Surveys	20th April – 2nd May 2013
Summer Surveys	27th-29th July 2013, 5th August 2013 and 29th August – 1st September 2016.
Autumn Survey	6th and 8th October 2013

(i) Winter Surveys

An area within approximately 2 km of the proposed development was assessed for potential bat roost features. A review of recent aerial photography, and consultation with Bat Conservation Ireland and local residents, assisted with the identification of suitable trees, buildings and other structures with the potential to support roosting bats. Potential roost value was assessed using the NRA's '*Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes'*, the Bat Conservation Ireland guidance document '*Bats in Buildings. Guidance Notes for: Planners, Engineers, Architects and Developers*', and the Bat Conservation Trust's '*Bat Surveys for Professional Ecologists: Good Practice Guidelines'*. A questionnaire was provided to local landowners and data was gathered from their responses on anecdotal bat activity, including known bat roosts. Following their identification in winter 2013, roost features potentially impacted by the proposed development were subjected to more detailed surveys in the active bat season (May to October) in 2013 and again in late summer 2016 using the techniques described below.

The tree grading system uses four categories (after Collins, 2016) to classify potential and known bat roosts which can be applied to potential tree roosts. These categories can be seen in Table 6-3 below.

Table 6-3 Grading system for trees with the potential to support roosting bats (Collins, 2016)

Tree category	Description
High	A structure or tree with one or more potential roost sites that are obviously suitable for use by larger numbers of bats on a more regular basis and potentially for longer periods of time due to their size, shelter, protection, conditions and surrounding habitat.
Moderate	A structure or tree with one or more potential roost sites that could be used by bats due to their size, shelter, protection, conditions and surrounding habitat but unlikely to support a roost of high conservation status (with respect to roost type only – the assessments in this table are made irrespective of species conservation status, which is established after presence is confirmed).
Low	A structure with one or more potential roost sites that could be used by individual bats opportunistically. However, these potential roost sites do not provide enough space, shelter, protection, appropriate conditions[9] and/or suitable surrounding habitat to be used on a regular basis or by larger numbers of bats (*i.e.* unlikely to be suitable for a maternity or hibernation). A tree of sufficient size and age to contain potential roosting features but with none seen from the ground or features seen with only very limited roosting potential.[10]
Negligible	Negligible habitat features on site likely to be used by roosting bats.

[9] For example, in terms of temperature, humidity, height above ground level, light levels or levels of disturbance.
[10] This system of categorisation aligns with *BS 8596:2015 Surveying for bats in trees and woodland* (BSI, 2015).

(ii) Spring/Summer/Autumn Surveys

The spring, summer and autumn surveys were conducted during periods of warm temperatures (>7^{0}C) and avoided periods of heavy rainfall and high winds to ensure optimal conditions for detecting bat activity. Bat roost inspections were conducted by licenced bat surveyor Conor Kelleher in 2013 and by Daniel Buckely in 2016 under Scott Cawley's licence (Der/Bat 2016-09).

Manual surveys were employed where visual observation of bats was important in confirming potential roosts and interpreting the importance of habitat features to local bat populations. The proposed alignment and the adjacent habitats were walked whilst listening for bat activity with a detector during the period two to three hours after dusk and up to two hours before dawn. During manual surveys in the 2013 field season, bat calls were recorded using a heterodyne/time expansion detector (Pettersson D-240x) and an MP3 recorder for subsequent analysis using 'BatSound' software (Version 1.01) enabling identification of species or, where not possible, species groups (e.g. *Myotis* sp. or *Pipistrelle* sp.). During bat surveys in 2016 the surveyors recorded activity on Echo Meter EM3+ bat detector and recorder, and sound analysis was conducted using Analook software. Buildings adjacent to the proposed development were externally surveyed by detector at dusk and dawn to determine if any of the structures supported bat roosts. High potential buildings were also inspected internally, where accessible. Bat boxes were inspected where these were not sealed.

Automatic ultrasound recording equipment (Anabat SD1 frequency division recorders) was deployed to supplement the manual surveys at selected sites in 2013. Identification of species using recorded data was carried out using Analook Software and the *Bats of Britain & Ireland* (Russ, 1999).

(c) Protected Mammals - Badger & Otter

A corridor of approximately 500m was surveyed for badger and otter activity as part of the multi-disciplinary walkover survey. The status and activity of any badger setts or otter holts was recorded along with any evidence of activity, including paths, tracks, feeding signs, latrines or couches (otter resting places). The relevant TII guidelines recommend that surveys are best undertaken during the period November to April when vegetation cover is low and does not obscure setts or holts. All initial surveys in 2013 for these species were undertaken during this period. Walkover surveys of the route corridor to update results were undertaken outside of this season in September 2016, although this was not considered to be a significant limitation in this instance.

Additional survey work was undertaken for otter activity and their breeding and resting places, having regard to the survey methodology set out in the *Design Manual for Roads and Bridges* (Highways Agency, 2001). A dedicated survey for otter was undertaken on the 11th June 2013 covering a distance of 600 m either side of the proposed crossing point of the River Feale. In October 2013, January 2014 and April 2014, further otter surveys were undertaken on all watercourses crossed by the proposed development. These surveys covered a distance of *c.*2 km upstream and downstream of the proposed crossing points (where access allowed) in conjunction with spot checks of main bridge sites within a 5 km radius for signs of otter activity, refer to Table 6.12 for details of the bridge sites surveyed. The results of these surveys were updated by a mammal survey of the proposed route in September 2016.

(d) Protected Mammals - Other

No formal surveys were undertaken for other protected mammal species for which field signs are less frequent and/or reliable than other larger mammals. Care was taken to search for activity signs such as searching soft muds for tracks, and to look for droppings. Potential presence of these species in suitable habitat was recorded based on the habitat preferences described in Hayden & Harrington (2001). The results of these surveys were updated by a mammal survey of the proposed route in September 2016.

(e) Birds

(i) Wintering Birds

Following consultation with BirdWatch Ireland and the NPWS, it was established that an internationally important population of wintering whooper swans was resident in the locality.

As a result, monthly whooper swan surveys were carried out over the periods October 2013 to March 2014 and November 2016 to April 2017. During each survey visit over the winters of 2013/14 and 2016/17, the following sites were visited to record and count any whooper swans present: the known principal feeding site at Ballyouneen (*c*.6 km west of the proposed development); another known feeding subsite at Finuge (Galvin's Farm, *c*.275 m west of the River Feale crossing point); and all suitable agricultural fields within 400 m of the off-line section of the proposed development. Additional sites were also counted as information on the species distribution developed over the winter season, including: Lixnaw Canal, Ballynagare Bridge, Ardcullen Marshes, and Cloneen Causeway. Records were also made of any other wintering bird species present within 400 m of the off-line section of the proposed development.

(ii) Breeding Birds (General)

Breeding Birds within the zone of influence of the proposed development (100m) were surveyed over two visits in May and June 2013 in line with the Common Birds Census territory mapping method (Gilbert *et al*., 1998). The categories of breeding evidence developed by the British Trust for Ornithology[11] were applied to all birds recorded. The conservation status of the bird species recorded is as per the Birds of Conservation Concern in Ireland (BoCCI) lists which classify bird species into three categories: red listed birds are of high conservation concern; amber listed birds are of medium conservation concern; and green listed birds are not considered threatened (Colhoun & Cummins, 2013). Any observations of nocturnal species (*e.g.* barn owl) recorded during the various bat surveys undertaken were also noted.

(iii) Barn Owls

BirdWatch Ireland were commissioned to undertake surveys for barn owls between June and August 2016. The zone of influence with regards to barn owl was determined to be all lands within a 5km radius from the proposed development.

All roads within the survey boundaries were travelled and the suitability of all buildings within the survey area was assessed. Sites that were considered to be potentially suitable were comprehensively searched for signs of the presence of barn owls. All sites were categorised on a scale of 0–3 based on potential nesting and roosting opportunities for barn owls, 0 for unsuitable; 1 representing potentially suitable sites for roosting but unlikely for nesting; 2 being suitable roosting or nesting sites and 3 representing sites considered to be very suitable.

At each site, a thorough search was conducted inside and outside of the building in order to locate signs indicating the presence of barn owls, particularly pellets, evidence of whitewash splashings and moulted feathers. Where potential roost/nesting sites were concealed, surveys were supplemented by a dusk roost watch.

Tree sites were not assessed as part of this study. However information on barn owl activity was sought from landowners encountered over the course of survey work and on an opportunistic basis during fieldwork.

At all active or potentially active sites or those where it was deemed necessary to conduct a roost watch to accurately determine status, additional nocturnal visits were carried out to confirm activity and breeding status in July and August 2016.

The survey extent, and further details on methodology are shown in the barn owl survey report in Appendix 6.9.

(f) Amphibians & Reptiles

All suitable watercourses and drainage ditches crossed by the proposed development were surveyed for the presence of amphibians in accordance with the methodology described in National Roads Authority's guidelines (NRA 2009a). An initial assessment of the suitability of the surface water features was carried out during the multi-disciplinary walkover in February/March 2013. Suitable features were subsequently surveyed on two occasions (1st May and 10th June 2013) using a combination of torchlight inspections and manual egg searches. These surveys were augmented by searches of suitable features over the course of other ecological surveys carried out along the route of the proposed development.

No formal surveys were undertaken for reptiles in 2013 as a previous survey undertaken in 2012 did not record any common lizard from the study area (Ryan Hanley Consulting Engineers, 2012). However, care was taken to look for common lizards at exposed basking sites in suitable habitat during the course of other ecological survey work.

(g) Invertebrates

(i) Freshwater Pearl Mussel

A stage 1 (presence/absence) survey for the freshwater pearl mussel was carried out by Dr Evelyn Moorkens & Associates from the 10th to the 12th June 2013. The survey of the River Feale was carried out by three surveyors; two of whom were in the water at all times, with the other acting as 'bank manager'. The surveyors wore wetsuits to enable snorkelling as well as the standard survey technique using glass bottomed viewing buckets (bathyscopes). The River Feale within the entire footprint of the potential impact zone of the proposed works was surveyed, and for survey purposes, was sub-divided into 8 survey sections.

Brief assessments were also made in the main River Feale at Finuge Bridge, downstream of the proposed crossing point, and in Listowel, upstream of the proposed crossing point. Five associated watercourses along the proposed route were surveyed upstream and downstream of proposed crossing points (this was carried out by one surveyor on foot as the watercourses were found to be very narrow and shallow).

[11] http://www.bto.org/volunteer-surveys/birdatlas/taking-part/breeding-evidence

An additional stage 1 (presence/absence) survey was carried out on the 13th June 2015 downstream of an additional drainage outfall that drains to the Cashen River (and estuary) via the Gortcurreen and Derra West streams, and the lower Galey River, before entering the Cashen River. The 2015 stream survey was carried out by walking the bank, entering watercourses where there was any potential habitat and surveying using a viewing bucket.

The survey extent and locations are shown in the freshwater pearl mussel survey report in Appendix 6.2.

(ii) Other

Wolf Spider Survey of the Proposed River Feale Crossing Point

The initial survey plan consisted of two collecting approaches. Random turning of stones across the area of the river bank; and, demarcation of the bank into a grid of one metre squares followed by exploration of a number of these by completely removing all stones exposing the substrate of sand/grit/fine gravel underneath. One meter squares were demarcated in areas of unvegetated gravels. Two such areas were located where unvegetated or thinly vegetated gravel was dominant: the bank's river margin, where a strip of unvegetated gravel one to two metres wide ran the full length of the bank; and, an open area central to the bank and separated from the river margin by a dense stand of tall (170 cm) grasses.

Five one metre square areas were demarcated by laying string loosely around a perimeter measured with a measuring tape. Surface stones in the sample squares were then removed by hand. When necessary a lump-hammer was used to knock large boulders loose from the soil. As stones were lifted their undersides were inspected for potential specimens and they were then set aside. If a spider was seen when a stone was lifted, either on a stone or underneath, an attempt was made to collect it by hand into a plastic tube. One tube was used to gather specimens from each of the five sample squares and each tube labelled after each collection effort. The squares were cleared of stone until an essentially homogenous substrate of fine gravel/soil had been exposed and seen to be free of burrows and other indicators of the target species' presence. A GPS reading was taken at the three most widely separated sample squares; Sample square 1 Q 97262 32461, Sample square 4 Q 97286 32515 and Sample square 5 Q 97239 32442 (Irish National Grid coordinate system). When it was felt that a square had been sufficiently sampled the stones piled to the side were replaced into the square.

The second element of the survey was carried out between, and after, the sampling of one metre squares. It consisted of walking the whole area and randomly flipping larger stones, then clearing a small area and searching for living specimens or other evidence of the presence of the wolf-spider *Arctosa cinerea*. Again, when spiders were seen they were collected and the tubes marked. Given the relatively small area of exposed gravel that characterised the location it was felt that a substantial area of the exposed gravels available were examined either by eye or by actual removal of stones. At a minimum, some 200-300 stones were lifted/turned/examined in this manner.

6.3 Description of the Existing Environment

6.3.1 Zone of Influence of Proposed Development

The following section describes the existing environment within the zone of influence of the proposed development.

(a) Zone Of Influence on Key Ecological Receptors

The zone of influence over which significant impacts may occur will differ for key ecological receptors[12] (KERs), depending on the pathway for any potential impact(s).

The zone of influence for terrestrial habitats is generally limited to the footprint of the proposed development, and immediate environs (to take account of shading or other indirect impacts, such as air quality). Hydrological linkages (*e.g.* rivers or groundwater flows) between impact sources and aquatic habitats and species can often result in impacts occurring at significant distances. The distances over which water-borne pollutants are likely to remain in sufficient concentrations to have a significant impact on receiving waters is difficult to quantify and highly site-specific and related to the predicted magnitude of any potential pollution event. Evidently, it will depend on volumes of discharged waters, concentrations and types of pollutants (in this case sediment, hydrocarbons, and heavy metals), volumes of receiving waters, and the sensitivity of the ecology of the receiving waters.

The zone of influence for significant impacts to breeding birds is considered to extend no more than 100m from the proposed road development to take account of disturbance during construction, and disruption in territorial singing due to noise during operation. There are no highly sensitive breeding bird species (*e.g*. raptors) for which disturbance to breeding sites over greater distances might be expected; although indirect impacts within breeding territories may occur (*e.g*. 5 km in the case of barn owl). The zone of influence for wintering birds is at least 200m, as many species are highly susceptible to disturbance from loud and unpredictable noise during construction. A conservative (*i.e.* worst case scenario) estimate of the zone of influence for whooper swans from general construction disturbance is *c.*300 m based on the findings of Rees *et al.* (2005).

The zone of influence for small mammal species, such as the Pygmy Shrew, would be expected to be limited to no more than 100m due to their small territory sizes and sedentary lifecycle. The zone of influence for otters, badgers, stoat, and hedgehogs may extend over greater distances than small mammal and bird species due to their ability to disperse many kilometres from their natal site. Impacts to bats may potentially occur at distances up to 13km due to known long-distance foraging of Irish Leisler's bats from their nursery roost sites (Shiels *et al.,* 2006). The zone of influence for terrestrial invertebrate species, amphibians and reptiles is likely to be limited to the immediate vicinity of the impact due to the restricted habitat niche and poor dispersal ability of these species (unless the species depends on specific hydrological conditions which could be influenced indirectly from a greater distance).

6.3.2 Desk Study

(a) Designated Sites

There are nine designated areas for nature conservation located within 15 km of the proposed development (as listed in Table 6-4 below) and of these, only the Lower River Shannon SAC and the Cashen River Estuary pNHA are considered to be within the potential zone of influence of the proposed development.

Candidate Special Areas of Conservation (cSAC) are designated under the EC Habitats Directive (92/43/EEC) as amended, which is transposed into Irish law through a variety of

[12] 'Significant' impacts are deemed to be those with impacts resulting in a likely change in conservation status of a key ecological receptor (KER). According to NRA Guidelines (2009a), KERs will be features of sufficient value to be material in the decision-making process for which potential impacts are likely. According to the NRA Guidelines, KERs are therefore defined as features of local importance (higher value), county importance, national importance, or international importance.

legislation including the Birds and Habitats Regulations and the Planning Acts, for the protection of habitats listed on Annex I and/or species listed on Annex II of the Directive.

Special Protection Areas (SPAs) are designated under the Birds Directive (2009/147/EC) for the protection of protected bird species listed on Annex I of the Directive, regularly occurring populations of migratory species (such as ducks, geese or waders), and areas of international importance for migratory birds.

National Heritage Areas (NHAs) are designations under the Wildlife Acts to protect habitats, species or geology of national importance. Many of the NHAs in Ireland overlap with the boundaries of European sites. Although many NHA designations are not yet fully designated under this legislation (referred to as 'proposed NHAs' or pNHAs), they are offered protection in the interim period under existing planning legislation which requires that planning authorities give due regard to their protection in planning policies and decisions.[13]

The proposed development crosses the River Feale which is designated as part of the Lower River Shannon SAC [002165] at the proposed bridge site. The Cashen River Estuary pNHA [001340] is located approximately 8.5 km downstream of this location.

Table 6-4 Designated sites for nature conservation within 15 km of the proposed development

Name & Code	Distance	Reasons for Designation	Do any potential source-pathway-receptor links exist between the proposed development and the Designated Site?
Bunnaruddee Bog NHA [001352]	6.6 km north-east	Raised bog and associated peatland habitats	No; due to distance and the absence of a hydrological impact pathway between the proposed development and the designated site
Ballylongford Bay pNHA [001322]	10.7 km north	Concentrations of wintering birds and this site also forms part of the cSAC and SPA designations of the River Shannon Estuary	No; due to distance and the absence of a hydrological impact pathway between the proposed development and the designated site
Cashen River Estuary pNHA [001340]	5.3 km west	Historic rare plant records, whooper swan wintering site and the presence of otter	Yes; as the pNHA lies downstream of the proposed new River Feale bridge
Moanveanlagh Bog pNHA [000374]	3.2 km east	Raised bog and associated peatland habitats	No; due to distance and the absence of a hydrological impact pathway between the proposed development and the designated site
Lower River Shannon cSAC [002165]	Crossed by the proposed development	A range of fluvial, estuarine, coastal and marine habitats and associated aquatic Annex II species	Yes; as the proposed new River Feale bridge crosses the cSAC
Moanveanlagh Bog SAC [002351]	3.2 km east	Raised bog and associated peatland habitats	No; due to distance and the absence of a hydrological impact pathway between the proposed development and the designated site
River Shannon and River Fergus Estuaries SPA [004077]	10.7 km north	A range of wintering waterbird species and breeding and wintering cormorant	No. The proposed development will not result in any significant direct or indirect impacts to the SPA. The proposed development sits within the River Feale catchment, a catchment which does not drain directly to this European site.
Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA [004161]	3 km south	Hen harrier	No. This European site is not directly impacted. Given the distance of the proposed development from the known hen harrier nest sites (there are no known nest sites within 6km), and the low susceptibility of the species to impacts from road traffic, the operation of the proposed development will not result in any significant effects on this species.
Kerry Head SPA [004189]	14.2 km west	Fulmar and chough	No; due to distance and the absence of a hydrological impact pathway between the proposed development and the designated site

[13] Source: NPWS Website. Available online at http://www.npws.ie/protectedsites/naturalheritageareasnha/. Accessed 24/09/2013; updated 21/04/2017.

(b) Records of Protected, Rare and other Notable Species

The proposed development is located within Irish National Grid 10 km squares Q93 and R03.Table 6-5 and Table 6-6 summarise available records of protected and rare flora and faunal species within these 10 km squares.

(i) Flora

There are no European protected flora species known from within the zone of influence of the proposed development. A single species protected under the Flora (Protection) Order 2015, Triangular club-rush *Scirpus triqueter* is known historically from the River Cashen and may be present in the estuarine reaches of the River Feale downstream of the proposed development. This is summarised in Table 6-5 below.

Table 6-5 Records of Protected, Red-listed or Notable Flora Recorded in the desk study in the vicinity of the proposed development

Common Name	Scientific Name	Protection/Red-list	Habitat[14]	Location
Triangular club-rush	*Scirpus triqueter*[15]	Flora Protection Order, 2015 Near Threatened[16]	Tidal muds of rivers	River Cashen

(ii) Fauna (excluding wintering birds)

There are a number of European and nationally protected mammal, bird, fish and amphibian species which have been recorded within the zone of influence of the proposed development (the desk study sources are listed in Section 6.2.1(c)).These are summarised in Table 6-6. In the case of bird species, only those species listed in Annex I of the EC Birds Directive 2009/147/EC or red listed on the Birds of Conservation Concern in Ireland (BoCCI) are included in the table below.

There was anecdotal evidence from a local landowner of hen harrier *Circus cyaneus* sightings in the Curraghatoosane area. Barry O'Donoghue (NPWS) was consulted regarding the known nesting sites of the species within 10 km of the proposed development; there are no known nesting sites within 6 km of the proposed development.

BirdWatch Ireland have records of four barn owl nest sites within 10 km of the proposed development; the closest of these is located *c.*2.4 km to the north, with the three others located *c.*3.6 km, 7 km and 10 km away. BirdWatch Ireland also has records of six kestrel nest sites within 10 km of the proposed development; the closest of these is located *c.*460 m to the east, with the others located *c.*1 km, 3.6 km, 5 km, 7 km and 10 km away.

Table 6-6 Records of protected fauna recorded in the desk study in the vicinity of the proposed development

Common Name	Scientific Name	Protection[17]	Red-list[18]	Location & Reference
Brook lamprey	*Lampetra planeri*	Annex II Fisheries Acts	Least concern	River Feale (O'Connor, 2006)
River lamprey	*Lampetra fluviatilis*	Annex II & V Fisheries Acts	Least concern	River Feale (O'Connor, 2006)
Sea lamprey	*Petromyzon marinus*	Annex II Fisheries Acts	Near threatened	River Feale (O'Connor, 2006)
Atlantic salmon	*Salmo salar*	Annex II Fisheries Acts	Vulnerable	River Feale
Brown trout	*Salmo trutta*	Fisheries Acts	Least concern	River Feale
European eel	*Anguilla anguilla*	Fisheries Acts	Critically endangered	River Feale
Common frog	*Rana temporaria*	WA	Least Concern	Within the study area
Otter	*Lutra lutra*	Annex II & IV, WA	Near Threatened	Within the study area
Kingfisher	*Alcedo atthis*	Annex I	Amber listed	Grid square Q93 (Mott MacDonald, 2009b)
Badger	*Meles meles*	WA	Least Concern	Q9731, Q9632, Q9633, Q9733
Whooper swan	*Cygnus cygnus*	Annex I	Amber	Listowel area
Barn owl	*Tyto alba*	WA	Red	Listowel area
Kestrel	*Falco tinnunculus*	WA	Amber	Listowel area
Common pipistrelle	*Pipistrellus pipistrellus*	Annex IV WA	Least Concern	Listowel area
Soprano pipistrelle	*Pipistrellus pygmaeus*	Annex IV WA	Least Concern	Listowel area
Leisler's bat	*Nyctalus leisleri*	Annex IV, WA	Near Threatened	Listowel area
Whiskered/Brandt's bat	*Myotis mystacinus/ brandtii*	Annex IV, WA	Least Concern /Data Deficient	Listowel area
Brown long-eared bat	*Plecotus auritus*	Annex IV, WA	Least Concern	Listowel area
Daubenton's bat	*Myotis daubentonii*	Annex IV, WA	Least Concern	Listowel area
Natterer's bat	*Myotis nattereri*	Annex IV, WA	Least Concern	Listowel area

(iii) Wintering Birds

Irish Wetland Bird Survey (I-WeBS) count data was provided by BirdWatch Ireland (BWI) relating to wintering waterbirds within the Cashen River and Estuary site(Table 6-7) and records of Whooper swan numbers within the sites and sub-sites surveyed as part of the Swan Census were provided (Table 6-8).

From consultation undertaken with the local NPWS conservation ranger (pers. comm. Tim O'Donoghue), there were observational records of whooper swan using the agricultural fields to the west of the proposed development at Finuge and to the east of the proposed development at Garryantanvally (both sites are adjacent to the south bank of the River Feale).

[14] Stace (2010)
[15] Named as *Schoenoplectus triqueter* in Wyse Jackson *et al.* (2016), although listed within the Flora (Protection) Order, 2015 as *Scirpus triqueter*
[16] Wyse Jackson *et al.* (2016)
[17] WA Wildlife Act. Annex II/IV = Annex II & IV of the EU Habitats Directive. Annex II species are protected within cSACs only. Annex IV species are protected wherever they occur.
[18] Red-List for vascular plants from Wyse Jackson *et al.* (2016); mammals from Marnell *et al*. (2009); amphibians and freshwater fish from King *et al.* (2011); and birds from *Birds of Conservation Concern in Ireland 2014-2019* by Colhoun and Cummins (2013). green-listed bird species are of low conservation concern, while amber-listed birds are of Medium Conservation, and Red-listed birds are of High Conservation Concern.

Table 6-7 I-WeBS counts from the Cashen River and Estuary 2003/4 to 2014/15

Species	1% National	1% International	2003/4	2004/5	2006/7	2007/8	2008/9	2011/12	2013/14	2014/15	5-Year Mean*	Peak 2003-2015
Mute Swan	**90**	**-**	-	-	2	-	12	-	2	2	1	12
Whooper Swan	**150**	**270**	288	229	-	-	157	257	-	-	86	288
Pink-footed Goose	-	**3,500**	2	-	-	-	-	1	-	-		2
Greylag Goose	**50**	**980**	-	-	-	-	-	1	-	-		1
Light-bellied Brent Goose	**360**	**400**	-	-	3	9	60	135	128	42	88	135
Shelduck	**120**	**3,000**	-	14	14	-	-	12	-	-	4	14
Wigeon	**630**	**15,000**	146	278	76	18	120	458	59	170	314	458
Teal	**340**	**5,000**	-	-	87	-	23	300	23	113	206	300
Mallard	**290**	**20,000**	8	12	8	8	46	-	-	10	3	46
Shoveler	**30**	**400**	-	-	-	-	-	11	-	-	4	11
Common Scoter	**120**	**16,000**	-	-	-	-	-	-	-	12	4	12
Red-throated Diver	**20**	**3,000**	-	-	3	-	-	-	-	-	0	3
Great Northern Diver	**20**	**50**	-	4	8	-	2	-	3	2	1	8
Cormorant	**120**	**1,200**	7	18	19	-	9	4	12	26	15	26
Shag	**-**	**2,000**	-	12	-	-	-	-	-	-	-	12
Little Egret	**20**	**1,300**	-	-	1	-	5	-	2	3	2	5
Grey Heron	**25**	**2,700**	2	4	7	1	3	-	5	3	2	7
Oystercatcher	**690**	**8,200**	49	17	68	64	38	-	70	88	44	88
Ringed Plover	**100**	**730**	26	-	32	10	22	21	55	200	110	200
Golden Plover	**1,200**	**9,300**	9,000	420	4,800	7,500	400	2,000	800	1,120	1,560	9,000
Grey Plover	**30**	**2,500**	5	-	12	-	2	-	-	-	-	12
Lapwing	**1,100**	**20,000**	3,500	-	2,340	3,000	800	3,000	602	847	1,924	3,500
Knot	**280**	**4,500**	-	-	12	-	-	180	-	-	60	180
Sanderling	**60**	**1,200**	2	-	-	-	4	-	-	250	83	250
Dunlin	**570**	**13,300**	-	-	800	120	80	84	960	150	117	960
Snipe	-	**20,000**	-	-	-	-	8	-	-	-	0	8
Black-tailed Godwit	**180**	**350**	-	-	-	-	-	-	-	28	9	25
Bar-tailed Godwit	**150**	**1,200**	-	-	4	-	4	23	36	122	72	122
Whimbrel	-	**6,700**	-	-	56	247	-	-	-	-	-	247
Curlew	**350**	**8,400**	460	495	970	380	220	-	10	96	48	970
Greenshank	**20**	**2,300**	1	5	2	-	-	14	-	-	5	14
Redshank	**300**	**3,900**	13	76	224	12	4	25	70	116	70	224
Turnstone	**95**	**1,400**	24	-	-	-	10	16	-	-	5	24
Mediterranean Gull	-	**770**	-	-	-	-	-	6	1	-	3	6
Black-headed Gull	-	**20,000**	14	-	30	-	18	11	345	240	126	345
Ring-billed Gull	-	**20,000**	-	-	-	-	-	1	-	-	-	1
Common Gull	-	**16,400**	20	12	105	5	38	130	1	-	65	130
Lesser Black-backed Gull	-	**5,500**	-	-	-	32	-	2	24	48	25	48
Herring Gull	-	**10,200**	-	-	6	-	-	-	34	97	48	97
Iceland Gull	-	**1,600**	-	-	-	-	-	2	-	-	1	2
Glaucous Gull	-	**2,200**	-	1	-	-	-	1	-	-	-	1
Great Black-backed Gull	-	**4,200**	14	10	12	8	4	4	24	14	9	24
Sandwich Tern	-	-	-	-	42	-	-	-	-	-	-	42

* the 5-year mean is based on available counts for the most recent 5 years covered (*i.e.* for the period 2010/11 - 2014/15) but excluding inaccurate counts.

Table 6-8 Counts from available years from the Swan Census from sites in the Listowel area

Site	Subsite	Grid Reference	Date	Count
Cashen River & Estuary	*Ballyouneen*	Q907342	14.01.05	229
Lixnaw Canal	*Lixnaw*	Q894306	14.01.05	6
Lixnaw Canal	*Ballynagare Bridge*	Q887325	14.01.05	6
Cashen River & Estuary	*Cashen River Estuary*	Q870385	16.01.10	68
Cashen River & Estuary	*Ballyouneen*	Q907342	17.01.10	391
Lixnaw Canal	*Lixnaw*	Q894306	17.01.10	6
Crompaun River	*Crompaun River*	Q853304	17.01.10	9
Cashen River & Estuary	*Finuge, Galvins Farm*	Q955322	17.01.10	47
Cashen River & Estuary	*Ballyouneen*	Q907342	2011/2012	257
Cashen River & Estuary	*Ballyouneen*	Q907342	2014/2015	241
Cashen River & Estuary	*Finuge, Galvins Farm*	Q955322	2014/2015	27
Lixnaw Canal	*Lixnaw*	Q894306	2014/2015	67
Lixnaw Canal	*Ballynagare Bridge*	Q887325	2014/2015	13

(iv) Fish

The River Feale is considered to be a nationally important river system for Atlantic salmon and brown trout. Water quality in the River Feale is classified by the EPA as being of good status (Q4) *c.*1.7 km upstream of the proposed crossing point (sampling station at Listowel Racecourse footbridge) and is classified as being of moderate status (Q3-4) at Scartleigh Weir, *c.*1.3 km downstream of the proposed crossing point. The Galey River is also considered to be a nationally important river system for Atlantic salmon and brown trout and is classified as being of poor status (Q2-3/Q3) at the nearest sampling station to the proposed development (bridge downstream of Inch Bridge).

Previous studies undertaken in relation to the proposed development noted the presence of holding pools for Atlantic salmon in the vicinity of the proposed crossing point, and spawning and nursery areas were present throughout the lower River Feale in the locality (Mott MacDonald, 2009 and Ryan Hanley, 2012).

All three species of lamprey are known from the River Feale with juvenile lamprey previously recorded at sampling stations at the Listowel Racecourse footbridge and upstream of the weir at Scartleigh (O'Connor, 2006). O'Connor (2006) did not record any

lamprey species at sampled sites on the Galey River. The larvae (or ammocoetes) of these species burrow into fine silts in areas of slack flow along the river bank; a habitat that is not present at the proposed crossing point.

6.3.3 Field Survey Results

(a) Habitats

The habitats recorded within the vicinity of the proposed development are described in this section and shown on Figures 6.1.1-6.1.5 in Volume 3. Habitat codes (after Fossitt, 2000) are given in parenthesis in the descriptions below and in the legend of the habitat map.

(i) Habitat Descriptions

The principal land-uses along the proposed development are agricultural pasture and urban and sub-urban development. The off-line section of the proposed development passes through mainly agriculturally managed and urban landscapes with very few areas of semi-natural habitat.

Earth Banks (BL2)
Some of the field boundaries crossed by the proposed development are comprised of earth banks; sometimes associated with drainage channels on either side. Along the southern section of the proposed development, south of the R557, earth banks are common along the roadways and field boundaries. In places, the banks are dominated by red fescue *Festuca rubra* with grass species such as cock's-foot *Dactylis glomerata* and creeping bent *Agrostis stolonifera* also present. Herb species are similar to those found in the adjoining improved agricultural grassland fields, with creeping species such as bramble *Rubus fruticosus* agg., common ivy *Hedera helix*, cleavers *Galium aparine* and hedge bindweed *Calystegia sepium* present. Bracken *Pteridium aquilinum* is also found in some sections. Those earth banks present along field boundaries in the northern part of the off-line section of the proposed development (between the Forge Road and the R553) are generally covered in bramble scrub, gorse *Ulex europaeus,* willow *Salix* spp. and common nettle *Urtica dioica.* Earth banks along the abandoned railway line are, in sections, collapsing into the adjacent drainage ditches.

Buildings and Artificial Surfaces (BL3)
This habitat classification includes built ground such as domestic, commercial and agricultural buildings (including the associated yards and driveways), paved roads, footpaths and car parking areas. This habitat is also listed as a mosaic with amenity grassland (GA2), flowerbeds and borders (BC4) and ornamental/non-native shrub (WS3) in cases of individual residential dwellings or areas of dense residential, industrial or commercial development in Listowel.

Exposed Sand, Gravel or Till/Reed and Large Sedge Swamps (ED1/FS1)
This habitat mosaic is present at the proposed crossing point of the River Feale. Along the southern bank there is a cliff face of unconsolidated alluvial deposits (coarse sands, gravels and cobble). This material is largely unvegetated save for sparse cover of reed canary-grass *Phalaris arundinacea*, creeping bent and occasional willow saplings along the waterside boulders (*e.g. Salix fragilis, S. cinerea*).

Along the northern bank of the River Feale, exposed gravels and cobbles are present in a transitional zone between the river and the more established scrub cover higher up the river bank. There is abundant growth of reed canary grass within this band, of varying densities.

Where habitat conditions support emergent vegetation, the river is fringed by species in addition to reed canary-grass such as purple-loosestrife *Lythrum salicaria*, common nettle, water forget-me-not *Myosotis scorpioides*, docks (*Rumex crispus, R. conglomeratus*), meadowsweet *Filipendula ulmaria*, great willowherb *Epilobium hirsutum*, hogweed *Heracleum sphondylium*, hemlock water-dropwort *Oenanthe crocata*, bittersweet *Solanum dulcamara*, water mint *Mentha aquatica*, branched bur-reed *Sparganium erectum*, wavy bitter-cress *Cardamine flexuosa*, fool's-water-cress *Apium nodiflorum*, water-cress *Rorippa nasturtium-aquaticum*, marsh valerian *Valeriana dioica*, water horsetail *Equisetum fluviatile* and very occasionally common spike-rush *Eleocharis palustris*.

On the exposed cobbles, species such as procumbent pearlwort *Sagina procumbens*, clovers *Trifolium* spp., redshank *Persicaria maculosa* and water-pepper *Persicaria hydropiper* occur.

Other species present include willows *Salix* spp., colt's-foot *Tussilago farfara*, dandelion *Taraxacum* spp., daisy *Bellis perennis*, creeping buttercup *Ranunculus repens*, red clover *Trifolium pratense*, common nettle, and yarrow *Achillea millefolium*, with willow scrub, becoming more frequent on the upper shores of exposed alluvial material.

The invasive alien plant species Indian balsam (also known as Himalayan balsam) *Impatiens glandulifera* and Japanese knotweed *Fallopia japonica* are also present along the river bank at the proposed crossing point as well as both up and downstream. A small patch of the invasive alien plant species montbretia *Crocosmia x crocosmiiflora* was identified growing on the northern bank of the River Feale, in close proximity to the proposed crossing point.

Spoil and Bare Ground/Recolonising Bare Ground (ED2/ED3)
An extensive area of disturbed ground is present in an unfinished section of the Ashfield housing estate next to the disused railway line. This area is predominantly recolonizing bare ground but forms a mosaic with areas of bare ground, and patches of scrub and species poor wet grassland, associated with the former grassland cover of the site. Species such as gorse, bramble and common nettle were noted as encroaching from adjacent habitats. A relatively small patch of this habitat type was also identified south of the R557 next to farm buildings and yard.

Plant species which occur in association with the disturbed areas included; colt's-foot, common nettle, dandelion, broad-leaved dock *Rumex obtusifolius*, annual meadow-grass *Poa annua*, cleavers, willowherbs *Epilobium* spp. and ragworts *Senecio* spp., greater plantain *Plantago major*, knotgrass *Polygonum aviculare*, pineappleweed *Matricaria discoidea* and shepherd's-purse *Capsella bursa-pastoris*. Invasive plant species such as montbretia *Crocosmia x crocosmiiflora* have also become established in this area.

Eroding/upland Rivers (FW1)
Ballygrenane Stream (WF4)
The Ballygrenane Stream rises within a small woodland area to the east of the N69. It flows underneath the N69 via a culvert that forms the western extent of the proposed tie-in with the N69 from the R557 junction. The banks of the stream at this point are heavily overgrown with hedgerow and scrub vegetation. From here, it flows in a north-westerly direction to the crossing point at proposed structure ST13. At the crossing point the stream channel width varies between 0.5 – 1.3 m and is 1.0 – 1.5 m in depth, from the top of the banks. The water over most of its length is a slow to medium flow, with some small riffles, over a substrate of cobbles, sand and gravels and silt/fines. Water depth at

the time of the survey was approximately 10 cm and aquatic vegetation was limited to occasional Water-cress cover.

Garryantanvally Stream (WF5)
The Garryantanvally Stream drains a number of agricultural fields to the east of the proposed alignment, joining up with the Ballygrenane Stream c.130 m west of the crossing point. The stream channel width varies between 0.7 m and 2.0 m and is 1 m in depth from the top of the banks. At the time of the survey this watercourse had been subject to some mechanical clearance works, with the majority of the bankside vegetation and all in-stream vegetation having been removed – only the treeline along the northern bank remained. As a result the substrate was comprised entirely of silt with slow flowing water.

Mill Stream Upper (WF0) and Mill Stream Lower (WF1)
The Mill Stream Upper and Mill Stream Lower flows in a south-westerly direction from the area surrounding the Famine Memorial Graveyard, in the townland of Curraghtoosane, to the River Feale at Scartleigh. This stream is crossed by the proposed development at two locations: at proposed structure ST39, as it passes underneath the disused railway line; and at proposed structure ST27, to the south of the Greenville Road.

At the crossing point along the railway embankment, the stream is approximately 0.7-1 m in width with a depth of c.2 cm. The flow regime in the stream in the vicinity is predominantly riffle over a largely silty and muddy substrate. Banks are steep and covered with rank gasses (e.g. cock's-foot and creeping bent) with bramble encroaching from the adjacent scrub. There is some sparse cover of fool's-water-cress instream.

The second crossing point at proposed structure ST27 is in an intensively managed agricultural grassland field and the bankside vegetation reflected a rank version of this. Vegetation in the watercourse is dominated by reed canary grass with a soft silt substrate evident in the unvegetated sections.

Depositing/lowland Rivers (FW2)
River Feale
The proposed crossing point of the River Feale is located approximately 3.8 km downstream of Listowel Bridge. It is evident that this part of the river has been modified in the past and has embankments along either side of the channel. Some rock armouring has been installed along the southern bank to prevent erosion. Similarly, for a stretch of approximately 360 m along the northern bank a short distance upstream of the proposed crossing point, concrete reinforcement forms part of the riverbank. This appears to be a stabilisation/protection measure to minimise erosion of the riverbank.

The crossing point is at a shallow pool on a bend in the river. The width of the river at the time of the survey was approximately 20 m. The flow regime in the river in the vicinity was a combination of pool, riffle and glide over a largely cobble based substrate.

At the proposed crossing point the southern bank of the river consists of a high, vertical bank (*c.*4/5 m above the water level) of unconsolidated gravel and cobbles. At the top of the bank is an area of dense bramble scrub with narrow bands of alder *Alnus glutinosa* woodland to the west and east (described in more detail under the WN6 woodland classification below). At the proposed crossing point the northern bank of the river consists of an area of reed swamp on alluvial cobbles and gravels grading to an area of dense gorse scrub on the embankment separating the river channel from the agricultural field beyond. The habitats present on either bank are described in more detail under the relevant habitat classification categories in this section. Instream aquatic plant species were generally quite limited in extent and included Canadian pondweed *Elodea canadensis*, water-starwort spp. *Callitriche* spp. and *Fontinalis* spp.

Some water-crowfoot occurs to the east of the proposed crossing point (*c.*70 m upstream), the principal species of which is *Ranunculus penicillatus var penicillatus*. This area of habitat, given that this species is characteristic, may correspond with the Annex I habitat type *Water courses of plain to montane levels with the* Ranunculion fluitantis *and* Callitricho-Batrachion *vegetation* [3260]. The EU definition of this habitat is broad, and despite work undertaken by Kelleher (2011), there is no agreed definition of this habitat and its sub-types in Ireland (NPWS, 2013a). Based on the *Lower River Shannon SAC conservation objectives supporting document - Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation* (National Parks and Wildlife Service, 2012), the conservation objectives for this habitat apply to three high conservation element sub-types to which the area of water crowfoot east of the bridge crossing does not correspond. This habitat therefore, irrespective of its classification, does not form part of the qualifying interest for the Lower River Shannon cSAC.

Drainage Ditches (FW4)
Field boundaries along the proposed development are often delineated with drainage ditches in association with hedgerows and/or treelines. The drainage ditches are in various states; some are entirely overgrown with vegetation, while others have been recently cleared, evident by the spoil mounds along the banks. They are also very transitional in nature, with almost all recorded as dry during the spring and summer period. Bank height measurements vary, ranging in depth from 1-2 m and a width of 1-3 m, with the wetted area generally 0.5 m in width with a water depth up to 0.5 m in the more persistent ditches (along the field boundaries between the Forge Road and the R553). The majority of the drains contain abundant leaf litter, with soft muddy substrates.

Vegetation along the margins include soft rush *Juncus effusus*, bramble, creeping bent, reed canary grass and willow saplings. Aquatic vegetation (where present) includes hemlock water-dropwort, water-plantain *Alisma plantago-aquatica*, and some drains also support branched bur-reed and water-cress.

Improved Agricultural Grassland (GA1)
A large proportion of the lands crossed by the proposed development correspond to this habitat type. The majority of fields are subject to intensive grazing and/or regular cutting for silage, with others having been re-sown with agricultural grasses following a change in use from arable crops. Species composition is typically poor with grass species present including: rye-grasses *Lolium* spp., cock's-foot, Yorkshire fog *Holcus lanatus*, creeping bent, crested dog's-tail *Cynosurus cristatus*, meadow foxtail *Alopecurus pratensis* and meadow-grasses *Poa* spp. Herb species are generally limited to species such as creeping buttercup, meadow buttercup *Ranunculus acris*, ribwort plantain *Plantago* lanceolata, dandelion, white clover *Trifolium repens*, daisy, common mouse-ear *Cerastium fontanum*, docks *Rumex* spp. and thistles *Cirsium* spp. Some improved agricultural fields between the River Feale and the R557 and between the Forge Road and the R553 have abundant rush cover in places; soft-rush and jointed rush *Juncus articulatus*. These fields are included within the GA1 classification where rushes did not dominate the vegetation. Wetter patches (with some wet grassland characteristics) are present in the improved agricultural fields south of the River Feale. For example, some patches of yellow iris *Iris pseudacorus* are present in small isolated wet areas in some fields.

Amenity Grassland (improved) (GA2)
This habitat type includes areas of recreational and landscaped grassland associated with managed roadside verges in Listowel, and recreational grassland areas associated

with housing developments and residential gardens and lawns. Common broadleaved herbs include dandelion, white clover, red clover and daisy.

The grassland along the disused railway line also conforms to this habitat type by virtue of the regular mowing management regime in place. Along the uncut margins, the character of the grassland is more akin to neutral grassland. Grass species present include cock's-foot, Yorkshire fog, meadow foxtail and red fescue. Herb species included dandelion, bush vetch *Vicia sepium*, ribwort plantain, white clover and daisy. Occasional species such as square-stalked St. John's-wort *Hypericum tetrapterum* were noted along the margins.

Dry Meadows and Grassy Verges (GS2)
This habitat type was identified within an area of land located on the flood embankment along the south bank of the River Feale, and in rank field verges and road margins that are minimally managed or mown.

Drier areas of this rough grassland support a high proportion of tall, coarse and tussocky grasses such as false oat-grass A*rrhenatherum elatius* and cock's-foot. Other grasses included Yorkshire fog, smooth meadow-grass *Poa pratensis*, red fescue, sweet vernal-grass *Anthoxanthum odoratum* and bent grasses *Agrostis* spp. The broadleaved herb component is characterised by a range of species including, hogweed, oxeye daisy *Leucanthemum vulgare*, cat's-ear *Hypochoeris radicata*, common knapweed *Centaurea nigra*, common nettle and clovers, (principally *T. repens, T. pratense, T. dubium* and *T. arvense*), thistles (*Cirsium vulgare* and *C. arvense*), common ragwort *Senecio jacobaea*, sow-thistles *Sonchus* spp., bush vetch, common sorrel *Rumex acetosa*, docks (*Rumex obtusifolius* and *R. crispus*), meadow vetchling *Lathyrus pratensis*, black medick *Medicago lupulina*, common figwort *Scrophularia nodosa*, lesser stitchwort *Stellaria graminea* and great willowherb *Epilobium hirsutum*. Occasionally upright hedge-parsley *Torilis japonica* and field horsetail *Equisetum arvense* occur. Along the field and railway margins species such as hedge-bindweed, cut-leaved crane's-bill *Geranium dissectum* and hedge woundwort *Stachys sylvatica* are present. The sedges glaucous sedge *Carex flacca* and hairy sedge *Carex hirta* are infrequently recorded.

Patches of regenerating and encroaching scrub also occur in a mosaic with this habitat in disturbed areas associated with the unfinished housing developments between the disused railway line and the Greenville Road which includes species such as willows, hawthorn *Crataegus monogyna*, gorse and bramble.

Occasionally the non-native plant species montbretia occurs in this habitat.

In damper fields the vegetation also includes indicators of damp field conditions such as abundant rushes and meadowsweet.

Dry-humid Acid Grassland/Immature Woodland (GS3/WS2)
The north-western section of the proposed development, north of the disused railway line, contains patches of humid, acid grassland. These areas are on higher ground and show acidic grassland characteristics with elements of peatland and heath vegetation also present. Within these areas, there are also scattered patches of alder and crack willow *Salix fragilis* tree species associated with the area of Immature Woodland (WS2) located directly to the south-east. The vegetation displays a mix of wet grassland and dry-humid acid grassland characteristics with soft rush, together with bent grass species (*Agrostis* spp.), Yorkshire fog and sweet vernal-grass present. Other plant species present include creeping buttercup, sedges *Carex* spp., sharp-flowered rush *Juncus acutiflorus,* heather *Calluna vulgaris,* hard-fern *Blechnum spicant*, purple-loosestrife and meadowsweet. Bryophytes such as common haircap moss *Polytrichum commune,* and *Rhytidiadelphus* spp. (e.g. springy turf-moss *Rhytidiadelphus squarrosus*) were also common in this habitat type. Gorse scrub and bramble were noted to be encroaching into the grassland from the adjacent unmanaged hedgerows.

Wet Grassland (GS4)
Improved grasslands along the northern section of the proposed development, which retains its original wetland character predominantly through rush cover of 50% or greater, corresponds to this habitat type; in particular, the complex of fields between the Forge Road and the R553 support soft rush dominated pasture with some jointed rush, and very occasionally sharp rush *Juncus acutus* present.

Together with the rushes, the grasses Yorkshire fog, meadow foxtail, timothy *Phleum pratense*, rough meadow-grass *Poa trivialis* and creeping bent are present; and occasional red fescue and rye grass, where some re-seeding may have occurred. The herb species meadowsweet, creeping buttercup, greater bird's-foot-trefoil *Lotus pedunculatus,* meadow buttercup, common sorrel, cuckooflower *Cardamine pratensis* and yellow iris *a*re also present. Other species associated with this habitat type in the study area include the herbs selfheal *Prunella vulgaris,* white clover, common mouse-ear, ribwort plantain, common ragwort and marsh ragwort *Senecio aquatica*. Occasional patches of meadow vetchling, purple-loosestrife, ragged-robin *Lychnis flos-cuculi*, silverweed *Potentilla anserina,* wild angelica *Angelica sylvestris*, great willowherb, marsh woundwort *Stachys palustris*, marsh thistle *Cirsium palustre* and water mint also occur.

In very wet stands of this vegetation type, species such as marsh-marigold *Caltha palustris*, redshank, water-pepper and pointed spear-moss *Calliergonella cuspidata a*re present.

Other species occasionally recorded in this habitat type include oval sedge *Carex ovalis*, marsh-bedstraw *Galium palustre*, toad rush *Juncus bufonius*, glaucous sedge, *Hypericum* spp., cut-leaved crane's-bill and hairy sedge.

Areas of ephemeral ponding water also occur in the fields to the south of the River Feale crossing point and support wet grassland vegetation which is sometimes inundated by water. There is obvious poaching by livestock in these fields. Here the vegetation is dominated by the grasses marsh foxtail *Alopecurus geniculatus,* creeping bent, floating sweet-grass *Glyceria fluitans* and Yorkshire fog. Soft rush and jointed rush are also common and the herbaceous species creeping buttercup, curled dock, marsh-marigold, water mint, silverweed, marsh ragwort *Senecio aquaticus*, autumn hawkbit *Leontodon autumnalis,* and bog stitchwort *Stellaria alsine* also occur.

Riparian Woodland (WN5)
This woodland type occurs primarily in mosaic with Scrub WS1 habitat on the northern bank of the River Feale a short distance downstream of the proposed crossing point, on the lower portions of the slope transitioning to reed swamp and exposed cobble mosaic (Exposed Sand, Gravel or Till/Reed and Large Sedge Swamps ED1/FS1). The tree species present are willows (*Salix cinerea*, *S. fragilis* and occasional *Salix alba*) with ground flora supporting reed Canary-grass, meadowsweet, rough meadow-grass, remote sedge *Carex remota* and opposite-leaved golden-saxifrage *Chrysosplenium oppositifolium*.

Another area of this habitat occurs on the southern bank of the River Feale a short distance upstream of the crossing point and is similar in nature except that it additionally contains occasional ash *Fraxinus excelsior*. It is present adjacent to a planted Treeline (WL2) also containing ash as well as alder and sycamore tree species.

Detailed botanic surveys of these areas of woodland were undertaken on 26th June 2014 and again on the 1st and 2nd September 2016. Neither of these areas corresponds to the Annex I habitat *91E0 Alluvial forests with and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*). An assessment of the habitats (based on EC 2013, NPWS 2013a and Perrin *et al.* 2008) confirmed that although both areas of woodland support three positive indicator tree species (ash, alder and grey willow) for the Annex I habitat *91E0, neither areas meet other criteria for meeting the Annex I habitat type *91E0 e.g. an absence of enough of positive indicator non-tree species, not meeting various criteria for habitat structure, inadequate representation of tree ages and size classes, and presence of the negative indicator species sycamore *Acer pseudoplatanus*.

Wet Willow-Alder-Ash Woodland (WN6)

Along the banks of the River Feale on both the southern and northern banks there are relatively narrow linear strips of alder dominated woodland. These wooded areas do not directly correspond to Wet Willow-Alder-Ash Woodland (WN6) as described by Fossitt but this is the closest habitat match in that classification system. The habitat most closely corresponds to the *Alnus glutinosa – Filipendula ulmaria* group (3b *Alnus glutinosa – Rubus fruticosus*) vegetation type as per Perrin, *et al.*, (2008). This habitat does not correspond to the Annex I habitat *Alluvial forests with and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*).

Detailed botanic surveys of these areas of woodland were undertaken on 26th June 2014 and again on the 1st and 2nd September 2016. None of these areas corresponds to the Annex I habitat *91E0 Alluvial forests with and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*). An assessment of the habitats (based on EC 2013, NPWS 2013a and Perrin *et al.* 2008) confirms that although these areas of woodland support three positive indicator tree species (ash, alder and grey willow) for the Annex I habitat *91E0, none of these woodland areas meet other criteria for meeting the Annex I habitat type *91E0 *e.g.* an absence of positive indicator non-tree species, not meeting various criteria for habitat structure, inadequate representation of tree ages and size classes and presence of the negative indicator species sycamore *Acer pseudoplatanus*.

The tree species present primarily include alder *Alnus glutinosa* with occasional ash, willows (*Salix cinerea*, *S. fragilis* and occasional *Salix alba*) and sycamore. The understory layer is represented by hawthorn and elder *Sambucus nigra* and the field layer is dominated by bramble.

In drier stands the ground flora supports primrose *Primula vulgaris*, enchanter's-nightshade *Circaea lutetiana*, common ivy, bramble, ramsons *Allium ursinum*, male-fern *Dryopteris filix-mas*, hogweed, lesser celandine *Ranunculus ficaria*, wild angelica *Angelica sylvestris*, tutsan *Hypericum androsaemum*, bluebells *Hyacinthoides non-scripta (L.)*, wood avens *Geum urbanum*, broad-leaved dock, wood anemone *Anemone nemorosa*, great woodrush *Luzula sylvatica*, alexanders *Smyrnium olusatrum*, red campion *Silene dioica*, common nettle, cleavers, hedge woundwort, creeping buttercup, bittersweet, herb-robert *Geranium robertianum* and ground ivy *Glechoma hederacea*.

In more damp areas, the ground flora supports meadowsweet, rough meadow-grass, remote sedge *Carex remota,* opposite-leaved golden-saxifrage and hemlock water-dropwort.

Scrub (WS1)

There are a number of extensive areas of scrub along the proposed development. At the proposed crossing point of the River Feale there are substantial areas of scrub on both banks. Dense bramble cover is present along the embankment at the top of the southern river bank; there is complete cover on the north facing side with patches of bramble cover on the south facing side (and some gorse at the western end). An extensive area of gorse scrub is present along the northern riverbank at the proposed crossing point. A band of bramble scrub (up to 4 m wide in places) is present along both sides of the disused railway line between the Forge Road and the R553 and is encroaching into some of the adjoining fields. Smaller, more isolated patches of bramble and willow scrub are associated with the drainage ditches between the Forge Road and the R557.

Immature Woodland (WS2)

A relatively small area of this habitat type is located north of the disused railway line adjacent to a field of dry acid grassland (GS3). It is dominated by young alder and crack willow species.

Hedgerows (WL1)

The form and species composition of the hedgerows along the proposed alignment vary considerably. From the southern extent of the proposed development to the River Feale, the hedgerows are well developed in places and include species such as: hawthorn, blackthorn *Prunus spinosa*, willow *Salix* spp., wych elm *Ulmus glabra*, holly *Ilex aquifolium*, elder, gorse, dog-rose *Rosa canina*, honeysuckle *Lonicera periclymenum*, and bramble. Ash, both semi-mature and mature trees, are the most common tree species along the hedgerows. Oak *Quercus* spp., sycamore *Acer pseudoplatanus* and alder are also present. Ground flora includes: ivy, primrose, Hart's-tongue *Phyllitis scolopendrium*, hard shield-fern *Polystichum aculeatum*, barren strawberry *Potentilla sterilis*, lesser celandine, hogweed, lords-and-ladies *Arum maculatum*, ramsons, herb-robert, cleavers and common nettle.

The hedgerows between the Forge Road and the R557 are generally more dominated by willows *Salix* spp. (with Wych elm present in places), reflecting the wetter soil conditions in this area and the dense network of drainage ditches associated with the field boundaries. Snowberry *Symphoricarpos albus*, a non-native species, is located in hedgerows near the Forge Road and railway embankment, while non-native montbretia is found growing in association with a number of hedgerows located across the proposed development site.

Treelines (WL2)

Many treelines in the north-eastern section of the proposed development between the Greenville Road and the R553 are composed of sparse, overgrown hawthorn with occasional ash that are unmanaged. This area is grazed by horses and the hedgerows and treelines are often heavily trampled underneath with little or no understory.

The treelines located on the northern and southern banks of the River Feale, growing adjacent to Scrub (WS1), Riparian Woodland (WN5) and Wet Willow-Alder-Ash Woodland (WN6), are dominated by alder, ash and sycamore.

Treelines, and any associated hedgerow understory, are much better developed to the south of the River Feale. Here, planted species such as white willow *Salix alba* and poplar species (*Populus* spp.) are common in the treelines; especially planted in the floodplain of the river. Other dominant treeline species include ash, sycamore and grey willow *Salix cinerea*, with alder in areas adjacent to large drains or watercourses. Other tree species present include pedunculate oak *Quercus robur*, English elm *Ulmus procerea*, elder, crab apple *Malus sylvestris*, Scots pine *Pinus sylvestris* and Corsican pine *Pinus nigra*.

Woody shrub species include bramble, holly, dog-rose *Rosa canina*, common ivy, hawthorn, blackthorn, wild privet *Ligustrum vulgare* and honeysuckle. The non-native

species Japanese rose *Rosa rugosa* is present in a treeline located south of the R557 road.

In treelines with a well-developed understory a diverse fern flora was noted, especially in the field-boundaries south of the River Feale crossing. Species such as Hart's tongue, soft shield-fern *Polystichum setiferum*, male-fern *Dryopteris filix-mas*, broad buckler-fern *Dryopteris dilatata* and scaly male-fern *Dryopteris affinis* are present. Other hedgerow species present in the understory of treelines include tutsan *Hypericum androsaemum*, hedge bindweed, false-brome *Brachypodium sylvaticum*, hogweed, wood dock *Rumex sanguineus*, ground-elder *Aegopodium podagraria*, cow parsley *Anthriscus sylvestris*, herb-robert, wood avens, broad-leaved willowherb *Epilobium montanum*, cleavers, creeping buttercup, lesser celandine, lords-and-ladies, ramsons, and common nettle.

(ii) Summary of Rare/ Notable Flora Species recorded

There are no historical or current records of legally protected flora occurring within the proposed development footprint.

The species red campion, recorded in the woodland along the banks of the River Feale (outside of the proposed development footprint), is of interest, being more common in the north and east of Ireland with a restricted occurrence in southern Ireland and (Parnell *et al.*, 2012).

(iii) Invasive Species

There are four invasive, non-native plant species listed in the Third Schedule of the *European Communities (Birds and Natural Habitats) Regulations 2011* (as amended) present within, or in close proximity to, the proposed development (Table 6-9). The locations of these invasive species are shown on Figures 6.1.6-6.1.10 in Volume 3.

Table 6-9 Summary of Invasive Species Listed in the Third Schedule of the Birds and Habitats Regulations 2011 (as amended) Recorded within the zone of influence of the Proposed Development

Common Name	Scientific Name	Location
Japanese knotweed	*Fallopia japonica*	Along both banks of the River Feale upstream and downstream of the proposed crossing point; Along the Mill Stream - a watercourse/drainage ditch north of the River Feale; Along a field boundary within the proposed alignment at Islandganniv North; Along the disused railway embankment; Along the north-eastern road verge at the tie-in with the R553
Indian balsam	*Impatiens glandiflora*	On the banks of the River Feale, along the Mill Stream - a watercourse/drainage ditch north of the River Feale, and drainage ditches north and south of the proposed crossing point
Spanish bluebell & hybrids	*Hyacinthoides hispanica & H. x massartiana*	Along the southern roadside verge at the tie-in with the R557; Along a field/property boundary at the eastern end of the tie-in with the Greenville Road
Three-cornered garlic	*Allium triquetrum*	On the south bank of the River Feale at the proposed crossing point; On the bank of the River Feale/drainage ditch c.100 m north of the proposed crossing point; Along property boundary c.50 m north of the tie-in with the Forge Road

(b) Fauna

The precise location of the breeding/resting places of certain protected species is considered to be sensitive data by those agencies that have supplied records (*i.e.* the locations of raptor nest sites). Therefore, the locations of barn owl, hen harrier, and kestrel nest sites have not been disclosed in this document. However, the distance of such features relative to the proposed development is provided in all cases as this informs the impact assessment and mitigation strategy.

(i) Badger

Evidence of badger activity was found throughout the off-line sections of the study area (all areas within the zone of influence of potential impacts; up to 150 m) and was concentrated in the agricultural fields to the north and south of the River Feale and in Curraghatoosane between the Greenville Road and the disused railway line. A total of twenty-four badger setts were identified within the study area: twelve of which were active at the time of the survey with the remainder showing no signs of recent use. The status, description and distance from the proposed development boundary of each of the setts is provided below in Table 6-10. The results of the badger survey and subsequent site walkover in September 2016 are shown in Figures 6.1.11-6.1.17 of Volume 3.

Table 6-10 Badger setts within the study area of the proposed development

Ref. No.	Type of sett[19]	Status and description	Approximate distance from proposed development boundary
S1	Subsidiary	Active sett with two entrances. In hedgerow along field boundary.	270 m west of the proposed development boundary
S1a	Outlier	Inactive mammal burrow.	260m west of the proposed development boundary
S2	Outlier	Inactive sett with two entrances. In hedgerow along field boundary.	Along the western edge of the proposed development boundary
S3	Outlier	Active sett with a single entrance. In hedgerow along field boundary.	Along the western edge of the proposed development boundary
S4	Outlier	Active sett with two entrances. In hedgerow along field boundary.	Along the western edge of the proposed development boundary
S4a	Outlier	Active outlier sett.	Along the western edge of the proposed development boundary
S5	Main sett	Active sett with at least three entrances with fresh bedding and recently excavated spoil. In woodland at the top of the river bank/field boundary.	230 m west of the proposed development boundary
S6	Outlier	Inactive sett with a single overgrown entrance. Along the bank of a small stream.	160 m west of the proposed development boundary
S7	Main sett	Active sett with at least five entrances. In dense scrub cover at the top of the river bank/field boundary.	175 m east of the proposed development boundary

[19] Main sett = breeding sett, focus of most badger activity; Annexe sett = large sett, usually within 50 m of the main sett; Subsidiary sett = smaller sett, not peripheral, within territory of badger social group; Outlier sett = small sett, usually on periphery of group territory; Minor sett = incidental sett, not on periphery of group territory.

Ref. No.	Type of sett[19]	Status and description	Approximate distance from proposed development boundary
S8	Outlier	Active sett with two entrances. In hedgerow along field boundary.	120 m south of the proposed development boundary
S9	Subsidiary	Active sett with five entrances. In hedgerow along field boundary.	80 m south of the proposed development boundary
S10	Outlier	Inactive sett with a single entrance. In hedgerow along field boundary. Mammal burrow was in use by rabbits in 2016.	220 m north-west of the proposed development boundary
S11	Outlier	Inactive sett with a single entrance. In hedgerow along field boundary. Mammal burrow was in use by rabbits in 2016.	250 m north-west of the proposed development boundary
S12	Outlier	Inactive sett with a single entrance. In hedgerow along field boundary. Mammal burrow was in use by rabbits in 2016.	260 m north-west of the proposed development boundary
S13	Outlier	Inactive sett with a single entrance. In hedgerow along field boundary. Mammal burrow was in use by rabbits in 2016.	270 m north-west of the proposed development boundary
S14	Outlier	Active sett with a single entrance. In hedgerow above wet ditch along field boundary.	380 m north-west of the proposed development boundary
S15	Outlier	Inactive sett with a single entrance. In hedgerow along field boundary.	Along the southern edge of the proposed development boundary
S16	Annexe	Active sett with three entrances. In dense scrub cover at the top of the river bank/field boundary.	280 m west of the proposed development boundary
S17	Outlier	Active sett with two entrances. In dense scrub cover at the top of the river bank/field boundary.	590 m south-east of the proposed development boundary
S18	Outlier	Inactive sett with a single entrance. Along hedgerow on river bank.	1.3 km west of the proposed development boundary
S19	Outlier	Inactive sett with a single entrance. In dense scrub cover along the river bank.	1.35 km west of the proposed development boundary
S20	Outlier	Inactive sett with a single entrance. In scrub cover along the river bank.	290 m west of the proposed development boundary
S21	Annexe	Active sett with two entrances. In dense scrub cover at the top of the river bank/field boundary. May be linked underground to S7.	240 m east of the proposed development boundary
S22	Outlier	No-longer an active sett with a single entrance. In hedgerow along field boundary. 2016 Update: it appears that this sett has been covered by large felled tree trunks which were placed on top of it. No signs of activity in 2016.	Along the eastern edge of the proposed development boundary

(ii) Otter

Evidence of otter activity was recorded frequently along the banks of the River Feale and also on the Mill Stream Lower (as shown on Figures 6.1.11-6.1.17 in Volume 3). Although no evidence of otter was recorded along other watercourses within the study area, the network of streams and drains are probably routinely used by otter.

Three potential otter holts and an otter couch site were recorded within the study area. The status, description and distance from the proposed development boundary of each of these features are provided below in Table 6-11. The results of the otter surveys are shown on Figures 6.1.11-6.1.17 in Volume 3.

Table 6-11 Otter holts/couches within the study area of the proposed development

Ref. No.	Feature	Status and description	Approximate distance from proposed development boundary
H1	Potential holt	Active burrow. Hollow underneath exposed tree roots with well-worn path into the entrance.	1.95 km downstream of the proposed development boundary (*c*. 1.2 km straight line distance)
H2	Potential holt	Inactive potential holt. Hollow underneath exposed tree roots.	1.9 km downstream of the proposed development boundary (*c*. 1.1 km straight line distance)
H3	Couch site	Active couch site within a concrete pipe next to the river bank.	1.3 km downstream of the proposed development boundary (*c*. 560 m straight line distance)
H4	Potential holt	Inactive potential holt. Hollow underneath exposed tree roots on the stream bank.	Along the eastern edge of the proposed development boundary

Spot checks for evidence of otter activity were also undertaken at major bridge sites within a 5 km radius of the proposed development in 2013. The bridges surveyed and the results are given in Table 6-12 below.

Table 6-12 Otter survey results at selected bridge sites within 5 km of the proposed development

Bridge Name	Grid Reference	Evidence of Otter present? ✓/×		
		October 2013	January 2013	April 2013
Drommurrin Bridge	Q 94144 34402	×	✓	✓
Inch Bridge	Q 95728 36272	✓	✓	✓
Shrone Bridge	Q 97793 37235	✓	×	✓
Finuge Bridge	Q 95098 32166	✓	✓	✓
Listowel Racecourse (Greenville Road)	Q 98127 33640	×	×	×
Listowel Racecourse (Listowel Town Centre)	Q 98832 33584	×	✓	✓
Listowel Bridge	Q 99467 33248	×	×	✓
The Knight's Bridge	R 01890 31880	✓	✓	✓
Kennelly's Bridge	R 02481 32410	✓	✓	✓

(iii) Bats

The results of the activity surveys undertaken over the spring/summer/autumn surveys in 2013 and 2016 are illustrated on Figures 6.1.18-6.1.22 in Volume 3, showing the areas where bat activity was recorded.

The areas where the highest concentrations of bat activity were recorded were as follows: in the vicinity of the farm buildings and treelines along the R557; along the hedgerows and treelines on the bank of the Ballygrenane Stream and the field boundaries to the north; the River Feale in the vicinity of the proposed crossing point; the

farm outbuildings adjacent to the proposed Greenville Road junction; and, the eastern end of the disused railway line at the R553. Common and soprano pipistrelles were the most common bat species recorded along the proposed alignment. Leisler's bat and Daubenton's bat were also present along the alignment of the proposed development with brown long-eared bats and whiskered bats recorded at one location in 2013 along a laneway east of the proposed development at Garryantanvally.

Small numbers of bat passes of common pipistrelle and soprano pipistrelles were also recorded along the N69 at Coolnaleen Lower and along the disused railway line; with very low levels of bat activity recorded along the on-line section of the proposed development along the John B. Keane Road. It was also reported by local residents that bats foraged around the houses and outbuildings near the junction of the Forge Road and the disused railway line; no bat activity was recorded in this area during the surveys in 2013. However, there was whiskered bat *Myotis mystacinus* activity recorded along the Forge Road in 2016.

None of the residential dwellings immediately adjacent to the off-line section of the proposed development were found to support any roosting bat colonies. The open-fronted barns next to the Greenville Road junction were the only structures found to be used as a roost site; confirmed as a night roost for a small number of pipistrelle bats.

Bat roosts confirmed within the study area in 2016 include:[20]

- A small soprano pipistrelle roost (single bat observed) within the roof of a house within the vicinity of the proposed junction with the existing N69 at the southern end of the proposed road development;
- A small soprano pipistrelle roost (single bat observed) within a stable building (a dropping was sent for analysis and this was confirmed as soprano pipistrelle) at the southern end of the proposed road development within the vicinity of the proposed junction with the existing N69;
- A small soprano pipistrelle roost (two bats observed) in a Dutch shed in the vicinity of the proposed junction with Greenville Road; and,
- A small soprano pipistrelle roost (1 – 4 bats observed) in a bat box in the vicinity of the proposed junction with Greenville Road.

Spring Survey

Four bat species were recorded during the spring survey; common and soprano pipistrelles, Leisler's bat and Daubenton's bat. Observations of bats during the summer survey along with locations are given in Table 6-13 below.

Table 6-13 Spring bat survey results

Common Name	Scientific Name	Location
Common pipistrelle	*Pipistrellus pipistrellus*	Coolnaleen Lower, Garryantanvally , Greenville Road, Islandganniv North , Curraghatoosane
Soprano pipistrelle	*Pipistrellus pygmaeus*	Coolnaleen Lower, Garryantanvally , Greenville Road, Islandganniv North , Curraghatoosane
Leisler's bat	*Nyctalus leisleri*	Coolnaleen Lower, Garryantanvally , Greenville Road,
Daubenton's bat	*Myotis daubentonii*	Garryantanvally/River Feale

Summer Survey 2013 and 2016

The summer 2013 survey focused on the following areas: the junction of the disused railway line and the R553 Ballybunion Road at Curraghatoosane; Forge Road and Greenville Road in Islandganniv; and Garryantanvally, between the R557 Lixnaw Road and the River Feale.

During the summer survey in 2016, the entire proposed route was walked during a bat activity transect post dusk (29th) and pre-dawn (31st) in August, The same bat species were recorded in 2016, in similar locations to the 2013 surveys. One exception being that whiskered bat activity was recorded along the Forge road.

Six bat species were recorded during the summer survey in 2013 and 2016; common pipistrelle and soprano pipistrelle, Leisler's bat, brown long-eared bat, Daubenton's bat and the whiskered bat. Observations of bats during the summer surveys along with the location are given in Table 6-14 below.

Table 6-14 Summer bat survey results

Common Name	Scientific Name	Location
Common pipistrelle	*Pipistrellus pipistrellus*	Curraghatoosane, Islandganniv North and South, Garryantanvally and John B. Keane Road
Soprano pipistrelle	*Pipistrellus pygmaeus*	Curraghatoosane, Islandganniv North and South, and Garryantanvally
Unidentified pipistrelle	*Pipistrellus* sp.	Garryantanvally, Islandganniv South, Curraghatoosane and John B. Keane Road
Leisler's bat	*Nyctalus leisleri*	Islandganniv North and South, and Garryantanvally
Brown long-eared bat	*Plecotus auritus*	Garryantanvally and Islandganniv South
Daubenton's bat	*Myotis daubentonii*	Garryantanvally and Islandganniv South
Whiskered bat	Myotis mystacinus	Garryantanvally and the Forge Road (Islandganniv North)
Unidentified myotis	*Myotis* sp.	Garryantanvally and Islandganniv South

Although undetected during the surveys in 2013 and 2016, Natterer's bat was encountered in the area during a previous survey undertaken at route selection stage by Conor Kelleher. This is a woodland species that also hunts along hedgerows and treelines, within scrub and over watercourses.

The lesser horseshoe bat *Rhinolophus hipposideros* was not recorded during the surveys. Listowel is outside of the species' current known distribution (National Parks & Wildlife Service, 2013b) and in Kerry, it is mainly confined to the south and mid-county areas as these have the most favourable habitats for the species which prefers deciduous woodland and scrub. The nearest known roost sites are *c.*18km to the north, at Glin, Co. Limerick, and *c.*18km to the south near Tralee, Co. Kerry.

The remaining Irish bat species, Nathusius' pipistrelle *P. nathusii*, may occur in the area occasionally. To date, its known roosts are restricted to north-east Ireland but it is being recorded more often, probably as a result of the increased use of bat detector surveys in Ireland as well as climate change, with more animals of this highly migratory species possibly arriving from the continent. The species has yet to be recorded in the area of the proposed development but potential exists for its occurrence as it has been found in the county within Killarney National Park, approximately 50km to the south.

Dwellings and other buildings adjacent to proposed development in the three key areas surveyed were also externally surveyed by detector at dusk and dawn for any associated bat activity to determine if any of the structures supported bat roosts. Evidence of roosting bats (albeit small roosts) were observed at structures on the Forge Road, Greenville Road, and the N69 Road at Islandganniv, Curraghatoosane and Garryantanvally.

[20] To avoid roost disturbance, general rather than precise locations are shown on Figures 6.1.18-6.1.22.

Autumn Survey
The autumn bat survey in 2013 recorded four bat species: common pipistrelle; soprano pipistrelle; Leisler's bat; and Daubenton's bat. There were no mating roost sites identified within the zone of influence of the proposed development.

Both pipistrelle species were ubiquitous during each of the survey nights. Leisler's bat was detected on a single occasion on the 8th October 2013, commuting high overhead at Garryantanvally and Daubenton's bat was present on the River Feale at Garryantanvally on both dates.

No advertising male Leisler's bats were observed along the proposed development indicating that no lekking (mating) site of this species is present. Social calls of male pipistrelles, produced by flying individuals, were detected at Garryantanvally, Coolnaleen Lower and Kilcreen.

Winter Bat Survey
There are no known major bat hibernation roosts along the proposed development. There is however, almost unlimited potential for minor hibernation sites in the Listowel area in the form of abandoned dwellings and farm buildings, modern buildings, bridges and mature trees *etc*. that may be used by small numbers of hibernating bats. Some of the structures in the locality with higher potential to support hibernating bats include Listowel Castle, St. Mary's Church in Listowel, the convent site on Convent Road and St. John's Theatre and Arts Centre (confirmed as a roosting site during this survey). An unoccupied residential house *c.*650 m south of the proposed road development was also confirmed as a former bat roost.

None of these potential hibernation sites are located within, or adjacent to, the proposed road development boundary.

No confirmed tree roosts were recorded within the footprint of the proposed development. The trees identified as having potential to support roosting bats (Potential Tree Roosts or PTR) are listed in Table 6-15 below and shown on Figures 6.1.18-6.1.22 in Volume 3. Each tree, or grouping of homogenous trees, was classified with regard to their potential to support roosting bats after Collins (2016). Trees with negligible suitability for roosting bats are not described or mapped as they are assessed as not having potential to support roosting bats.

Table 6-15 Potential tree roosts along the alignment of the proposed development

Ref. No.	Description	Evidence of bat usage? Y/N	Tree Category (Collins, 2016)
PTR1	Mature Ash tree with dense ivy cover	N	Low
PTR2	Mature Ash tree with dense ivy cover	N	Low
PTR3	Mature Ash treeline with dense ivy cover	N	Low
PTR4	Semi-mature/mature Oak, Poplar and Pines	N	Low
PTR5	Treeline of four semi-mature Oak trees with dense ivy cover	N	Low
PTR6	Mature Ash trees	N	Low
PTR7	Mature Oak tree	N	Low
PTR8	Mature Oak tree	N	Low
PTR9	Mature treeline of Ash, Oak and Alder	N	Low
PTR10	Mature Ash trees along the Greenville Road	N	Low
PTR11	Mature Ash tree with knotholes and crevices present	N	Moderate
PTR12	Mature Ash tree	N	Low
PTR13	Group of two mature Ash trees	N	Low
PTR14	Group of three mature Ash trees	N	Low
PTR15	Mature Ash tree	N	Low

There is only one existing culvert impacted by the main alignment of the proposed development; at Ch. 3,880m where the Mill Stream Upper passes underneath the disused railway line. This is a stone culvert with limited clearance (*c.*1 m above water level) and although there are some small crevices present, the culvert was seeping water through these at the time of the survey. This structure is considered to have a low bat roosting potential.

The Ballygrenane Stream culvert at the tie-in of the R557 and N69 consists of a concrete pipe and offers no bat roosting potential. The Mill Stream culvert at the R553 tie-in consists of stone walls topped by a concrete slab. There is no evidence of any suitable roosting features in that portion of the structure that could be safely accessed. This structure is considered to have a low bat roosting potential.

(iv) Other Mammal Species

The Irish hare *Lepus timidus hibernicus* was recorded in the agricultural field adjacent to the north bank of the River Feale at Scartleigh. Evidence of fox *Vulpes vulpes*, rabbit *Oryctolagus cuniculus*, brown rat *Rattus norvegicus* and mink *Mustela vison* were also recorded within the study area.

Other mammal species likely to be present given the habitat types and land use present include hedgehog *Erinaceus europaeus*, Irish stoat *Mustela erminea hibernica*, pygmy shrew *Sorus minutus* and the house mouse *Mus musculus*.

(v) Amphibians

No smooth newts were recorded in any of the streams or drainage channels within the study area. Common frogs were only recorded in a single drainage feature along a field boundary east of the Forge Road. Common frogs were also noted to be present in the Garryantanvally Stream and Mill Stream Lower during the 2012 river habitat survey (Ryan Hanley, 2012).

Although the network of drainage channels and the areas of wet grassland at Islandganniv/Curraghatoosane offer good habitat for the common frog, the low records are most likely due to the transient nature of the streams and drainage features within the study area (during most visits to the study area the streams had very little water present and the drainage channels were generally dry). As such, the common frog could be expected to be present in any of these features subject to the water levels during any given season.

(vi) Invertebrates

Freshwater pearl mussel

No freshwater pearl mussels were found in the River Feale at the proposed crossing point or within the wider impact zone. This section of river has already been heavily modified with extensive rock armouring and a long concrete wall. There is very little potentially suitable freshwater pearl mussel habitat; the substrate comprises mostly coarse cobble with boulders. The substrate throughout the survey section was heavily silted and covered with dense growths of filamentous algae, resulting from erosion, run-off from agricultural land and elevated levels of nutrients. There was no evidence of freshwater pearl mussels and only very little potentially suitable habitat at sites both upstream and downstream of the proposed crossing site.

The Gortcurreen and Derra West streams were small, slow streams with no potential habitat for the freshwater pearl mussel. The Galey River downstream of the confluence with the Derra West and Gortcurreen Streams is a large, lowland, modified slow river, with no potential for freshwater pearl mussel habitat.

The freshwater pearl mussel is known from the River Feale and Galey River upstream of the survey area, and the species requires a co-existing population of salmonid fish as larval mussels spend the first months of their life attached to the fish gills of either salmon or trout (depending on the population), or occasionally both. None of the small watercourses crossed by the proposed development that feed into the River Feale could support freshwater pearl mussels, based on a survey of these watercourses.

(vii) Wintering Birds

Surveys to determine the usage of the fields within the zone of influence of the proposed development by whooper swans were carried out over two seasons: 2013-2014 and 2016-2017. The 2013-2014 season commenced in early November 2013 and finished in late March 2014, while surveys for the 2016-2017 season commenced in late November 2016 and ended in early April 2017. Both survey seasons encompassed six survey visits.

In both seasons, there were large flocks of whooper swans (maximum counts of 72 to 549 birds, with a mean of 226) feeding on improved agricultural fields at Ballyouneen (*c.* 6km west of the proposed River Feale crossing point). Whooper swans also fed on grassland in Finuge, *c*. 320m west of the River Feale crossing point, albeit in smaller numbers (counts ranging between 0 and 249, with a mean of 63). At Finuge, the date with the highest count of whooper swans corresponded to flooding of other favoured sites in the locality. Whooper swans were observed feeding at five other locations over the two survey seasons, although none of these locations were occupied by the species with the same regularity as Ballyouneen and Finuge. The lowest count of birds was recorded in early April 2014, which might be attributed to the migration of the species to its summering grounds in Iceland.

In addition to the feeding activity observed across the survey sites, whooper swans were observed night roosting within the River Feale, *c*. 320m west of the proposed development. The number of birds roosting here varied between seven and 59 birds.

With regards to other wetland bird species, a flock of *c.* 60 golden plover *Pluvialis apricaria* were recorded roosting in the agricultural field immediately to the north of the proposed crossing point of the River Feale in April 2013. A flock of *c.*170 golden plover were observed in December 2013 in the same area; occasionally settling in the same field between disturbance events. Flocks of up to 72 golden plover were observed overflying the Finuge whooper swan site on the 28th March 2014. In the 2016/17 survey season, 46 golden plover were recorded feeding at Finuge on 24th November 2016.

Snipe *Gallinago gallinago* were flushed from areas of rushy or rank grassland along the off-line section of the proposed development at Islandganniv, Garryantanvally and Coolnaleen Lower during the site surveys in April 2013, October 2013, December 2013, January 2014, February 2014, December 2016 and February 2017.

Flocks of mallard *Anas platyrhynchos* (up to 9 individuals) and teal *Anas crecca* (up to 26 individuals) were recorded along the River Feale in the vicinity of the proposed crossing point during the winter survey periods.

Black-headed gulls (in flocks of up to 50 birds) were routinely seen in many of the improved agricultural fields next to the River Feale over the course of the surveys; from Finuge Bridge to Listowel Racecourse, including the large field immediately north of the proposed crossing point.

Low numbers (i.e. 1-5) of oystercatcher *Haematopus ostralegus*, redshank *Tringa tetanus*, and greenshank *Tringa nebularia* were observed flying over the Finuge site in the 2016/17 survey season.

Pink-footed geese *Anser brachyrhynchus* (5 individuals) and one barnacle goose *Branta leucopsis* overflew the Finuge site on the 17th February 2014, entering and leaving the area from the direction of the Cashen Estuary. Eleven greylag geese *Anser anser* were grazing in fields alongside whooper swans on 8th December 2016.

Table 6-16 Whooper Swan Survey Results

Substitute	Grid Reference	01/11/2013	21/11/2013	19/12/2013	09/01/2014	17/02/2014	28/03/2014	24/11/2016	08/12/2016	05/01/2017	19/02/2017	13/03/2017	02/04/2017
Ballyouneen	Q907342	153	132	114	151	56	72	376	245	396	461	549	4
Finuge, Galvin's farm	Q955322	0	31	64	69	249	29	20	96	72	64	57	0
Ardcullen Marshes	Q892353	0	0	0	0	39	0	0	0	0	0	0	0
Lixnaw	Q894306	0	0	0	0	0	0	0	25	0	0	16	0
Ballynagare Bridge	Q887325	0	0	0	32	0	1	0	0	0	0	0	0
Cloneen	Q860303	0	0	0	0	0	0	0	0	0	12	0	0
Cloneen Causeway	Q839304	0	0	0	0	6	0	17	10	25	0	0	0

Table 6-17 Numbers of Whooper swan recorded at the Finuge Bridge site compared with the total number recorded at all surveyed sites by month

Date	No. Recorded at Finuge Bridge	Total	%[1]
1st November 2013	0	153	0%
21st November 2013	31	163	19%
19th December 2013	64	190	34%
9th January 2014	69	371	19%
17th February 2014	249	350	71%
28th March 2014	29	102	28%
24th November 2016	29	413	5%
8th December 2016	96	376	26%
5th January 2017	72	493	15%
19th February 2017	64	537	12%
13th March 2017	57	622	9%
2nd April 2017	0	4	0%

[1]rounded to nearest whole number

(viii) Breeding Birds

The results of the breeding bird surveys (including the breeding territories of all BoCCI Red and Amber List species) are shown on Figures 6.1.23-6.1.28 in Volume 3. The summary table below (Table 6-18) lists those bird species present within the zone of influence that are listed on the BoCCI Red and Amber Lists. A full species list of all birds recorded (including common and scientific names) during the surveys is included in Appendix 6.3.

Table 6-18 Summary of the breeding birds of conservation importance recorded within the zone of influence (ZoI) and wider area

Common Name	Conservation Importance		Estimated Territories within ZoI	Breeding Status within ZoI (BTO)	Comment
	Annex I	BoCCI			
Barn owl		Red	Records of 3 known nest sites within 10 km	Non-breeder	Single bird observed perched in tree near R553 (2013). Two nests, and one roost (potentially a nest site) confirmed in 2016. Nests were located in excess of 2.5km from the proposed development.
Meadow pipit		Red	2	Confirmed	
Cormorant		Amber	0	Non-breeder	Single bird in flight crossing River Feale. Does not breed locally.
Goldcrest		Amber	3	Confirmed	
Greenfinch		Amber	1	Probable	
House martin		Amber	0	Non-breeder	Frequent foraging bird in rural and urban areas. Several nests located in buildings in proximity to proposed development outside ZoI.
House sparrow		Amber	0	Non-breeder	Frequent colonies in nesting in eaves of residential housing throughout.
Kestrel		Amber	6 known nest sites within 10 km	Confirmed	Single foraging over study area near railway line. Known to breed locally.
Linnet		Amber	4-5	Confirmed	Several nest sites in scrubby wet grassland along railway line.
Robin		Amber	8-9	Confirmed	
Sand martin		Amber	1	Probable	Three birds foraging over River Feale near proposed crossing point. Nest site 20 m east of proposed crossing point. Crossing point contains suitable habitat (exposed clay cliff) for species to nest on.
Short-eared owl	✓	Amber	0	Non-breeder	Single roosting bird flushed from field (late wintering/passage bird).
Skylark		Amber	1-2	Probable	Two territories in field north of proposed River Feale crossing-point.
Snipe		Amber	0	Non-breeder	Several flushed from fields near the railway line (wintering feeding birds). Does not breed locally.
Starling		Amber	0	Non-breeder	Feeding flocks in roadside grasslands along R553 in Listowel town, likely to breed locally in housing outside ZoI.
Stock dove		Amber	0	Non-breeder (May breed locally outside ZoI)	Single bird in flight over Greenville Road
Swallow		Amber	0	Non-breeder	Frequent foraging bird in rural and urban areas. Several nests located in buildings in proximity to proposed development but outside ZoI.
Swift		Amber	0	Non-breeder	2 birds foraging over River Feale (no nesting habitat) and in Listowel Town where may breed locally in roadside buildings outside ZoI.

A kingfisher was recorded along the River Feale, immediately south of the proposed crossing point, on the 9th January 2014. The southern river bank of the River Feale at the proposed crossing point consists of a vertical bank with some potential as kingfisher nesting habitat. However, there were no kingfisher nests present during the field surveys.

Thirty sites were identified as being suitable for nesting barn owl within 5km of the proposed development. Evidence of barn owl occupation was confirmed from three sites, two of which were nest sites previously known to BirdWatch Ireland. A nest located at Shrone East successfully raised young while a pair at Cloontubrid failed to breed. Access was not granted to the third site (Moyassa), and therefore breeding could not be confirmed here. A full description of barn owl survey results is included within Appendix 6.9.

(ix) Fish

A single European eel *Anguilla anguilla* was recorded in the Garryantanvally Stream during the course of the amphibian survey in June 2013. This is consistent with existing information relating to the presence of the species in the lower reaches of the River Feale (Mott MacDonald, 2009a; Ryan Hanley, 2012), of which the Garryantanvally Stream is a tributary.

6.3.4 Summary Ecological Valuation and Identification of Key Ecological Receptors

Table 6-19 summarises the ecological evaluation of all receptors taking into consideration legal protection, conservation status and local abundance. Key Ecological Receptors (KER's)[21] are identified in grey in the table. Species, habitats and features not qualifying as KER's are not subjected to impact assessment in line with NRA guidelines (NRA, 2009b). European designated sites are listed in the table below but these have been assessed separately in the Natura Impact Statement in Appendix 6.4.

Table 6-19 Summary Ecological Valuation and Identification of Key Ecological Receptors (highlighted in grey)

Habitat/Species	Ecological Valuation (as per NRA, 2009b)	Potential Source-Pathway- Receptor Link	Key Ecological Receptor
Designated Sites			
Lower River Shannon cSAC	International	Yes	Yes (see NIS in Appendix 6.4)
River Shannon and River Fergus Estuaries SPA	International	No	No (see NIS in Appendix 6.4)
Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA	International	No	No (see NIS in Appendix 6.4)
Cashen River Estuary pNHA	National	Yes	Yes (see NIS in Appendix 6.4)
Other designated sites within 15 km	National - International	No	No (see NIS in Appendix 6.4)
Habitats (Non-Designated Sites)			
Earth Banks (BL2)	Local Importance (Lower Value)	Yes	No
Buildings and Artificial Surfaces (BL3)	Local Importance (Lower Value)	Yes	No
Spoil and Bare Ground/Recolonising Bare Ground (ED2/ED3)	Local Importance (Higher Value)	Yes	No
Eroding/upland Rivers (FW1)	Local Importance (Higher Value)	Yes	Yes
Depositing/lowland Rivers (FW2)	International (all within Lower River Shannon cSAC)	Yes	Yes
Drainage Ditches (FW4)	Local Importance (Higher Value)	Yes	Yes
Improved Agricultural Grassland (GA1)	Local Importance (Lower Value)	Yes	No
Amenity Grassland (improved) (GA2)	Local Importance (Lower Value)	Yes	No
Dry Calcareous and Neutral Grassland (GS1)	Local Importance (Lower Value)	Yes	No
Dry Meadows and Grassy Verges (GS2)	Local Importance (Lower Value)	Yes	No
Dry-humid Acid Grassland (GS3)	Local Importance (Higher Value)	No	No
Wet Grassland (GS4)	Local Importance (Higher Value)	Yes	Yes
Scrub (WS1)	Local Importance (Higher Value)	Yes	Yes
Hedgerows (WL1)	Local Importance (Higher Value)	Yes	Yes
Treelines (WL2)	Local Importance (Higher Value)	Yes	Yes
Rare/Notable Flora Species			
Red campion	Local Importance (Higher Value)	No	No
Triangular club-rush	County importance	Yes	Yes
Fauna			
Badger	Local Importance (Higher Value)	Yes	Yes
Otter	International importance	Yes	Yes
Bat species	Local Importance (Higher Value)	Yes	Yes
Other mammal species not protected under the Wildlife Acts (e.g. Fox, Rabbit, Mink, Brown rat)	Local Importance (Lower Value)	Yes	No
Irish hare	Local Importance (Higher Value)	Yes	Yes
Lamprey species	International Importance	Yes	Yes
Atlantic salmon	International Importance	Yes	Yes
Brown trout	National Importance	Yes	Yes
European eel	Local Importance (Higher Value)	Yes	Yes
Common frog	Local Importance (Higher Value)	Yes	Yes
Freshwater pearl mussel	International Importance	Yes	Yes

[21] In accordance with NRA guidelines (2009b), impact assessment is only undertaken of 'Key Ecological Receptor's' (KER's). These are features within the Zone of Influence of the proposed development which are defined by the NRA (2009b) as "both of sufficient value to be material in decision making, and likely to be affected significantly". According to the NRA guidelines, KER's are of Local Importance (Higher Value) or higher as per the NRA's ecological valuation guidance (see Table 1 of NRA, 2009b). Features of Local Importance (Lower Value) are not considered in this guidance as Key Ecological Receptors and are excluded from impact assessment. The Zone of Influence for KERs is defined in Section 6.3.1.

Habitat/Species	Ecological Valuation (as per NRA, 2009b)	Potential Source-Pathway- Receptor Link	Key Ecological Receptor
Whooper swan	National Importance	Yes	Yes
Other wintering birds - Golden Plover, Snipe, Black-headed gull, Teal, Mallard	Local Importance (Higher Value)	Yes	Yes
Barn owl	National Importance	Yes	Yes
Kestrel	County Importance	Yes	Yes
Kingfisher	County importance	Yes	Yes
Hen harrier	International Importance	Yes	Yes
Breeding birds – Other Amber listed birds throughout	Local Importance (Higher Value)	Yes	Yes
Breeding birds – Green listed birds throughout	Local Importance (Higher Value)	Yes	Yes

6.4 Appraisal Method used for Assessment of Impacts

6.4.1 Ecological Evaluation Criteria

The criteria used to assess the ecological value and significance of habitats is shown in Appendix 6.5, which follows *Guidelines for assessment of Ecological Impacts of National Road Schemes* (National Roads Authority, 2009b) and is consistent with the approach recommended in the *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal* (Chartered Institute of Ecology and Environmental Management, 2016).

6.4.2 Impact Assessment Criteria

The impact of the proposed development on ecology has been assessed according to:

- *Guidelines on the information to be contained in Environmental Impact Statements* (Environmental Protection Agency, 2002 and updated Draft 2015);
- *Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)* (Environmental Protection Agency, 2003 and updated Draft 2015)
- *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (Chartered Institute of Ecology and Environmental Management, 2016); and*
- *Guidelines for assessment of Ecological Impacts of National Road Schemes (National Roads Authority, 2009b).*

Details of the impact assessment methodology are provided in Appendix 6.6.

In accordance with NRA guidelines (2009b), impact assessment is only undertaken of 'Key Ecological Receptors' (KER's). These are features within the zone of influence of the proposed development which are "both of sufficient value to be material in decision making and likely to be affected significantly". According to NRA guidelines (NRA, 2009b), KER's are of local importance (higher value) or higher as per NRA value criteria. Features of local importance (lower value) are not considered in the guidance to be Key Ecological Receptors and are therefore excluded from impact assessment. The zone of influence for KERs is defined in Section 6.3.1.

6.5 Predicted Impacts of the Proposed Development

6.5.1 Characteristics of the Proposed Development

A detailed description of the proposed development is provided in Chapter 2 Description of Proposed Development. Key sources of potential ecological impact arising from the proposed development include direct habitat loss of terrestrial and fluvial habitats during construction, noise and physical disturbance during construction, surface water run-off during construction, spread of invasive species during construction, road crossings of water features creating obstructions to mammal movement during construction and operation, structure design, proposed road drainage during operation, and proposed lighting during operation. These are detailed in the impact assessment section (below) where relevant.

6.5.2 Impacts to Designated Sites

The Natura Impact Statement (NIS), included in Appendix 6.4, has identified one European site for which there is a potential source-pathway-receptor between it and the proposed development (see Table 6-4): the Lower River Shannon cSAC. This site has also been highlighted as a KER in Table 6-19. In addition to this European site, there is one nationally designated site considered to be a KER: the Cashen River Estuary pNHA.

The potential for impacts to the other designated sites within 15 km of the proposed development have been ruled out due to their distance from the proposed development (*i.e.* no potential for direct impacts) and the absence of any pathways by which the construction or operation of the proposed development could indirectly affect the conservation status of the habitats or species present, or the integrity of the sites.

6.5.3 Do-Minimum Scenario

The effects and impacts likely to occur to the ecological receptors present in the absence of the proposed development are discussed below.

(a) Designated Sites

(i) Lower River Shannon cSAC

The majority of the habitats listed as qualifying interests for this cSAC are currently assessed as being of unfavourable-inadequate and unfavourable-bad status (National Parks & Wildlife Service, 2013a) and are subject to a range of existing and potential threats and pressures including land reclamation, grazing pressures, industrial development, water pollution (from industrial, agricultural and domestic sources) and spread of *Spartina* spp. The Annex II species listed as qualifying interests for the cSAC either spend their entire life cycle in the aquatic environment or are intrinsically linked to it (in the case of otter) and as such are vulnerable to changes to water quality and/or changes to the functioning of the estuary and associated river systems, in particular by works such as flood relief works.

The evident abundance of the invasive plant species Japanese knotweed along the River Feale, from Listowel to the Finuge Bridge, is likely to continue to spread and increase its distribution along the river banks and encroach into adjacent habitats.

(ii) Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA

This SPA is selected for the conservation of breeding hen harrier. Management of the planting and felling regimes within the forestry is critical to maintaining the integrity of the site for this species. Increased planting and/or felling could affect the balance between available breeding sites and foraging habitat with the potential effect of causing a reduction in breeding density and productivity due to further fragmentation of available foraging areas. Existing forestry and agricultural management practices within the SPA are likely to continue into the future. Policies to promote tourism and increase public access to these upland areas have the potential to adversely affect Hen harrier nesting habitat and sites.

(iii) Cashen River Estuary pNHA

The boundary of this site encompasses the lower reaches of the River Feale which lies within the Lower River Shannon cSAC and as such, the do-minimum impacts in relation to the river and the aquatic species within is as described above under Section 6.5.3. (a)(i). The Cashen River Estuary pNHA also includes portions of the adjoining floodplain and the sand dune complex south of Ballybunion which will be subject to existing pressures in the absence of the proposed development; for example, agricultural management practices in the case of the floodplain, and recreational pressures in the case of the sand dunes due to the close proximity of the town and the current use of this area as a golf course. The Cashen River Estuary also supports internationally and nationally important numbers of wintering waterbirds (including the Annex I species, whooper swan) whose population dynamics will only be significantly affected if major changes to current land management practices in core feeding and roosting areas were to occur, or where the current hydrological regime is affected by anthropogenic or natural influences. Another interest of the pNHA lies in the rare plant species found there (triangular club-rush, dwarf spike-rush *Eleocharis parvula* and corn cockle *Agrostemma githago*) and these species would be adversely affected where significant land use changes were to occur affecting those areas and habitats within which they are present. The aquatic species triangular club-rush could also be negatively affected by hydrological and/or water quality changes.

(b) Undesignated Habitats and Flora

All watercourses within the study area are subject to existing water quality pressures including agricultural run-off, industrial discharges (e.g. Kerry Ingredients Ltd.), domestic waste water discharges, and run-off from the existing road network. The River Feale and Galey River in the vicinity of Listowel are classified as being 'at risk of not achieving good status' under the Water Framework Directive Risk Scores (Environmental Protection Agency, 2017). In the absence of the proposed development, potential impacts to water quality, along with any flood relief measures or similar works that may affect the hydrological or flood regime of the River Feale and its tributaries into the future, have the potential to result in negative impacts to the aquatic environment and associated habitats.

Lands adjoining the disused railway line are being encroached upon by the scrub which extends along both sides of the track from Listowel to the Forge Road. This loss of open grassland habitats to scrub encroachment is likely to continue in the absence of any active management. The habitats within the agricultural fields along the off-line section are likely to be subject to change based upon the agricultural management regime in place at any given time. For example, improving the field drainage, cutting and reseeding to reduce rush cover, and the application of fertilisers all contribute to affect the species composition and diversity of these grassland habitats.

The fields to the west of the town centre (from the R553 to the Forge Road) are zoned Residential Low Density and Educational (see map 6, Listowel Town Council, 2009) and as such, are likely to be developed in the medium to long term and will likely change in character to an urban or suburban landscape.

(c) Fauna

In the absence of the proposed development, local faunal populations are only likely to be significantly affected by such factors as: large scale changes to agricultural land use or practices; large scale or residential development, that may affect breeding sites or foraging habitat; and, significant pollution events affecting water quality and aquatic habitats locally.

Badger are likely to continue to be subject to some degree of existing road collision impacts in the locality. There are no known threats to their local breeding sites or the breeding or resting sites of otter.

There are currently no known proposed developments that are likely to result in any displacement of foraging or roosting bats. However, any buildings in the Listowel area that support roosting bats could potentially be impacted by property owners renovating or developing existing properties.

There is abundant suitable habitat in the locality for the other mammal species listed above in Table 6-6 and in Section 6.3.3(b) (iv), amphibian species, and invertebrates such that local populations would not be expected to be adversely affected by existing anthropogenic and natural influences in the absence of the proposed development.

(i) Wintering Birds

See Section 6.5.3(a) (iii) for Cashen River Estuary and potential impacts on wintering birds.

(ii) Breeding Birds

Breeding bird habitats may be threatened by sudden and large scale land use change in breeding and feeding habitats. This is most likely to occur as a result of agricultural land use change or, due to suburban or industrial development (see Section 6.9.2 for discussion of the potential for urban expansion of Listowel). There are currently no known proposed developments that are likely to result in any significant impact to local breeding bird populations.

(iii) Fish

All watercourses within the study area are subject to existing water quality pressures including agricultural run-off, industrial discharges, domestic waste water discharges, and run-off from the existing road network. The River Feale and Galey River in the vicinity of Listowel are classified as being 'at risk of not achieving good status' under the Water Framework Directive Risk Scores (Environmental Protection Agency, 2017). In the absence of the proposed development, potential impacts to water quality, along with any flood relief measures or similar works that may affect the hydrological or flood regime of the River Feale and its tributaries in the future, has the potential to result in negative impacts to fish species.

6.5.4 Construction Phase Impacts

Potential Impacts during construction may arise from:

- *Habitat loss for the road infrastructure;*
- *Surface water run-off into receiving waters;*
- *Accidental pollution events;*
- *Noise/disturbance to fauna;*
- *Crossing of watercourses and drainage features;*
- *Barriers to wildlife movement;*
- *Blasting or pile driving; and*
- *Spread of invasive species.*

Habitat loss to Key Ecological Receptors in terrestrial and aquatic zones will be caused by the construction of:

- *The landtake fence-line;*
- *Roadways, access tracks (both temporary and permanent) and embankments;*
- *Attenuation ponds and constructed wetlands, and the outfalls to the existing surface water network;*
- *Watercourse crossings (temporary and permanent);and*
- *Storage compounds and temporary storage areas.*

(a) Designated Sites

The Natura Impact Statement (NIS), included in Appendix 6.4, has identified only one European site to which there is a potential source-pathway-receptor link between it and the proposed development (see Table 6-4): the Lower River Shannon cSAC. This site has also been highlighted as a Key Ecological Receptor in Table 6-19. In addition to the Natura 2000 sites, there is one nationally designated site considered to be a KER: the Cashen River Estuary pNHA.

The potential for impacts to all other designated sites have been ruled out due to their distance from the proposed development (*i.e.* no potential for direct impacts) and the absence of any pathways by which the construction of the proposed development could indirectly result in any significant effects on the qualifying interest habitats or species, or on the sites as a whole.

The potential impacts of the proposed development, during construction, on the Lower River Shannon cSAC are discussed in detail in the NIS (Appendix 6.4). The NIS has concluded that with the implementation of mitigaiotn there is no risk of the proposed development resulting in adverse effects on the integrity of the Lower River Shannon cSAC or on its qualifying interests, either alone or in-combination with other impact sources.

The potentially significant construction related risks to the Lower River Shannon cSAC identified, relate to water quality, the spread of invasive plant species, installation of watercourse structures, and the potential effects these elements could have on the qualifying interests of the Lower River Shannon cSAC and their conservation objectives. Mitigation measures have been proposed in the NIS to ensure that these risks will be avoided or reduced during the construction of the proposed development such that there will be no adverse effect on the integrity of the Lower River Shannon cSAC or on its qualifying interests.

Following an examination, analysis and evaluation of the relevant information, in light of best scientific knowledge, including in particular the nature of the predicted impacts from the proposed development and with the implementation of the mitigation measures proposed, there is no risk of adverse effects on the integrity of the Lower River Shannon cSAC, either alone or in-combination with other plans or projects.

(i) Cashen River Estuary pNHA

Although this designated site is not directly impacted, the River Feale and its tributaries are crossed by the proposed development, and drainage from the proposed development discharges to the Galey River catchment, and these constitute pathways by which indirect impacts could affect the pNHA downstream.

An accidental pollution event during construction has the potential to result in a negative, indirect impact on water quality within the River Feale and the Galey River and consequently on the habitats and plant species within the pNHA downstream. Given the distance of the proposed development from the pNHA boundary, and the assimilative capacity of the River Feale in its lower reaches, and the Cashen Estuary itself, it is extremely unlikely that a pollution event would occur during construction of a magnitude or duration that would result in anything more than a locally significant impact, in relation to the habitats and plant species present.

Invasive plant species are present at the crossing point of the River Feale and in the sub-catchment of the Mill Stream Lower (Figure 6.1.8 in Volume 3). Construction works in these areas will disturb invasive species in these areas. Therefore, there is a risk that soils contaminated with invasive species will be washed downstream to the lower reaches of the River Feale and Cashen Estuary and result in indirect impacts on the habitats there. In the absence of mitigation the impact of spreading these species to the pNHA could potentially be significant at a local level.

Whooper swan and otter are also listed as features of interest of the pNHA. The potential construction phase impacts for these species are discussed in detail under the relevant sections below (Section 6.5.4 (d) (ii) and (vii)).

(b) Flora

There are no records of any rare or protected flora species within, or immediately adjacent to the proposed development boundary and as such, no direct impacts are predicted.

The known mapped location of the Flora (Protection) Order 2015 species, triangular club-rush, is *c.*7.4 km downstream (according to the NBDC online database). Triangular club rush is an emergent plant species found in the fringing muddy sediments of rivers where there is a tidal influence. An accidental pollution event during construction has the potential to result in a negative, indirect impact on water quality within the River Feale and Galey River and consequently on the habitat of this species downstream. Given the distance of the proposed development from the known locations of the species, and the assimilative capacity of the River Feale in its lower reaches, it is extremely unlikely that a pollution event would occur of a magnitude or duration that would result in an impact of significance at the county level or an impact of anything more than the local level in relation to this species.

(c) Habitats

The construction of the proposed development will result in the loss of habitat within the proposed development boundary. The habitats identified as KERs that will be directly impacted are listed in Table 6-19.

Impacts on terrestrial habitats to be lost (GS4, WS1, WL1 and WL2) will be significant the local level considering their baseline value and small areas to be lost.

With respect to aquatic habitats (FW1, FW2 and FW4), the construction of the temporary and permanent crossings of the Ballygrenane Stream, Garryantanvally Stream, the Mill Stream Lower, and the Mill Stream Upper, will result in the permanent loss of instream habitat. The area of instream habitat lost will be small on the Ballygrenane Stream and Garryantanvally Streams (*c.*60 linear metres each); however, a *c.*200 m section of the Mill Stream Upper along the disused rail line will need to be realigned to facilitate the construction works along with the loss of *c.*60 m of habitat on the Mill Stream Lower south of proposed Roundabout 2. The river substrate present in these streams is not suitable for lamprey or salmonid spawning. Habitat loss in the Ballygrenane Stream, the Mill Stream Lower and the Mill Stream Upper is predicted to result in an impact significant at the local level (the level at which these receptors have been valued). In the case of the Garryantanvally Stream there has been clearance works in the stream channel and therefore the impact is slightly less although still considered to be significant at the local level.

An accidental pollution event during construction has the potential to result in impacts significant at the local level in relation to water quality in receiving watercourses and as a result of indirect impacts on the associated aquatic habitats.

The following areas of terrestrial habitats valued as being of local importance (higher value) will be lost during construction: approximately 3.8 ha of wet grassland (GS4); approximately 1.6ha of scrub (WS1); approximately 1.5 km of hedgerow (WL1); and, approximately 400 m of treelines (WL2). The loss of areas of those habitats identified as KERs (valued as being of local importance, higher value) is considered to be significant at the local level.

Outside of designated sites, the accidental spread of invasive plant species as a result of construction works has the potential to result in significant impacts at the local level on affected habitats, but would be reversible with mitigation.

(d) Fauna

(i) Badger

There are a total of twenty-four badger setts within the study area of the proposed road development. Six of these setts are within the zone of influence of general construction activities based on the impact distance bands (*i.e.* within 50 m) described in the NRA guidance (National Roads Authority, 2006c). There are no setts within the zone of influence of the proposed pile driving at the River Feale bridge site (150 m). Three of the six setts within the zone of influence of general construction activities were active at the time of the survey and the other three setts (S2,S15 and S22) were inactive (see Table 6-10). The affected badger setts were considered to be within two distinct badger territories, separated by the River Feale; one along the southern bank of the river in the townlands of Coolnaleen Lower and Garryantanvally, covering an area of *c.*80 ha[22], the second on the north bank in the townlands of Scartleigh, Kilcreen and Islandganniv North, covering an area of *c.*105ha. These territory sizes are consistent with the findings of Byrne *et al.* (2012). There was also evidence of badger activity to the north of the R553 but no setts are present here; it is likely that this is from a badger group located further to the north and represents the southern extent of this group's territory.

Five setts of the badger group found south of the River Feale lie along the proposed road development boundary (S2, S3, S4, S4a, and S22). All of these setts are small outlier setts on the periphery of the badger group's territory. As a minimum, these setts will be subject to indirect, temporary disturbance as a result of increased human presence, noise and vibration associated with the construction works and will likely be abandoned for the duration of construction works. These setts may need to be removed to facilitate the site clearance and construction works. The site clearance works will result in the permanent loss of available foraging habitat (*c.*5 ha) within the proposed road development boundary. Also as a result of the construction works, the physical disturbance to the existing landscape will result in some initial temporary severance of the territory as all the setts were located to the west of the proposed road development, with a significant proportion of badger activity recorded along the river corridor to the east (although only during conditions of normal to low water levels). Regardless of whether or not the setts need to be removed for the proposed road development, the impact on this badger group is predicted to be significant at the local level (the level at which this receptor has been valued).

One of the setts of the badger group north of the River Feale lies along the proposed road development boundary (S15). This is a small outlier sett on the periphery of the badger group's territory. No other setts in this badger territory are located within the zone of influence of the proposed road development. As a minimum this sett will be subject to indirect temporary disturbance as a result of increased human presence, noise and vibration associated with the construction works and will likely be abandoned for the duration of construction works. This sett may need to be removed to facilitate the site clearance and construction works. The site clearance works will result in the permanent loss of available foraging habitat (*c.*11 ha) within the proposed road development boundary. Also as a result of the construction works, it is probable that the physical disturbance to the existing landscape will result in some initial severance of the territory as there were setts and badger activity present to the east and west of the proposed development. The impact on this badger group is predicted to be significant at the local level (the level at which this receptor has been valued), given that only a single outlier sett may be lost and any disturbance will be temporary in nature.

The third badger group, located to the north of the R553, will not be impacted in any way by the proposed development as there were no setts present, or evidence of any badger activity, within the zone of influence of the proposed development.

(ii) Otter

There are no confirmed or active otter breeding or resting places directly impacted by the proposed road development. There was one potential otter holt identified along the proposed road development boundary at Coolnaleen Lower/Garryantanvally (H4). Although this burrow along the stream bank displays the characteristics of otter holts, no evidence of any otter activity was recorded in its vicinity throughout the survey period. It

[22] The territory size is approximate and estimated based on the spread of recorded badger activity signs and setts, and therefore, may be larger in area than stated.

is included here, as it is deemed prudent to have this burrow mapped and rechecked prior to construction to confirm that it is not in use by otter at that time.

Given the distance that the active holt and couch sites are from the proposed road development site, and the absence of any other confirmed breeding or resting places within the zone of influence of the proposed development (the zone of influence in relation to active natal holt sites is 150 m - National Roads Authority, 2006d; Highways Agency, 2001b), the potential for disturbance to holt or couch sites during construction is extremely low and will not result in a significant impact at any geographic scale. However disturbance to the species is predicted to result in a significant negative impact at the local level.

The construction of the watercourse crossings will result in some permanent loss of existing aquatic and riparian habitat. Also as a result of the construction works, it is probable that the physical disturbance to the existing landscape in constructing the watercourse crossings will result in some initial severance along watercourses used by otter. However otter are predicted to habituate to the modified landscape and therefore, habitat severance is not predicted to result in a significant impact at any geographic scale.

Any disturbance due to increased human presence, noise and vibration associated with the construction works is unlikely to cause any significant disturbance to otter as the species is generally nocturnal in habit and therefore will not be affected by works during normal daylight working hours; and, otter are known to tolerate high levels of human disturbance under certain circumstances (Bailey & Rochford, 2006, The Environment Agency, 2010, and as evidenced by the presence of otter signs along the River Feale in Listowel Town) and they would be expected to habituate to the presence of construction activities. Disturbance in this regard, will not result in a significant impact at any geographic scale.

An accidental pollution event during construction has the potential to result in a negative indirect impact on water quality within the River Feale system which could potentially affect the local otter population directly or through any associated decreases in prey densities that may occur (*e.g.* reduction in fish stocks). The magnitude and significance of such an impact would be entirely dependent on the nature and scale of the pollution event. In a worst-case scenario this would probably result in a significant negative impact at the local level. However, it is considered extremely unlikely that an impact of this magnitude would occur under normal circumstances. In the unlikely event of a significant pollution event occurring, the impact of a reduction in water quality on otter during construction is predicted to be significant at the local level.

Overall, and based on the existing baseline conditions, the construction phase of the proposed development could result in a significant impact at a local geographic scale to the local otter population.

(iii) Bats

Bat Roosts

No buildings will be demolished to facilitate the construction of the proposed road development and there will be no loss of any known bat roosting sites.

The agricultural sheds next to Proposed Roundabout 2 (on the Greenville Road) and the two buildings within the vicinity of the proposed junction with the existing N69, which were confirmed as night roosting sites for a small number of pipistrelle bats, will not be subject to any construction phase disturbance as they will not be demolished and all adjacent works will be carried out during normal daylight working hours. Disturbance to bat roosts is predicted to result in a significan timpact at the local level (the level at which this receptor has been valued).

A number of trees within the proposed road development boundary have been identified as having potential bat roosting features; the felling of these trees has the potential to result in the loss of a minor bat roosting site. Given the absence of any evidence that any of the identified trees were used as a bat roost, the removal of trees with the potential to support roosting bats is predicted to result in an impact significant at the local level (the local level at which this receptor has been valued), albeit this is unlikely.

Bat Foraging Habitat

Indirect construction disturbance effects on any bats commuting or foraging within the zone of influence of the proposed road development is extremely unlikely as works will be undertaken during normal working daylight hours in the active bat season. Construction related disturbance is predicted to result in a significant impact at the local level (the level at which this receptor has been valued).

Given the availability of alternative suitable habitat in the immediate vicinity, the loss of available foraging habitat and hedgerows/treelines used by commuting bats in areas of high bat activity (Figures 6.1.18-6.1.22 in Volume 3) is predicted to result in a significant impact at the local level (the level at which this receptor has been valued) during construction.

(iv) Other Mammal Species

There are four other mammal species, protected under the *Wildlife Acts* (as amended), which are either known or likely to occur within the zone of influence of the proposed road development, based on the habitat types present: Irish hare; Irish stoat; hedgehog; and pygmy shrew. Site clearance is unlikely to result in any significant mortality to the larger and more mobile species but may result in some accidental mortality to the smaller pygmy shrew. The potential impact would be expected to be greater during the breeding season when juveniles would be present in nests, or in the case of hedgehog impacts may be greater during their hibernation period. Construction will also result in the permanent loss of available habitat for these species and will result in disturbance within the immediate area during working hours.

Overall, and based on the existing baseline conditions, habitat loss associated with the construction phase of the proposed development is predicted to result in a impact significant at the local level (the level at which this receptor has been valued).

(v) Amphibians

The common frog is the only amphibian species present within the zone of influence of the proposed development. Although common frog was only recorded at one location, it is possible that any of the drainage features could be used by this species at the time of road construction; particularly given the suitability of the habitat and the transient nature of the drainage ditches crossed by the proposed development (during the spring 2013 period the majority were completely dry). Construction will result in the permanent loss of small sections of potentially suitable habitat (*c.*360 linear meters in total) and if site clearance is undertaken during a period when the breeding season coincides with the drainage ditches holding water, there is a chance that frogs and/or frog spawn would be present. The removal of these drainage ditches at that time is predicted to result in an impactsignificant at the local level (the level at which this receptor has been valued).

An accidental spillage or pollution event into a surface water feature which contains either adult frogs or frog spawn is predicted to have a negative impact; the magnitude and significance of such an impact would be dependent on the nature and scale of the pollution event. In a worst-case scenario a significant pollution event is predicted to result in an impact significant at the local level (the level at which this receptor has been valued).

(vi) Invertebrates

Freshwater Pearl Mussel

There were no records, and no evidence from the survey, for this species within the zone of influence of the proposed road development. There was very little suitable habitat upstream and downstream of the River Feale crossing point and the habitat in the smaller tributary streams was unsuitable. Habitat in the streams draining to the Galey River catchment, and the main channel of the Galey River downstream of the proposed development, were also unsuitable habitat to support the species.

However, there is a pathway by which the proposed development could have indirect impacts on this species by virtue of the fact that the larval stage of the mussel's life-cycle relies upon salmonid fish species. As discussed in Section (ix) below, it is considered unlikely that the proposed development will have any significant impact on salmonid species and therefore, the risk of adverse effects to the freshwater pearl mussel population in the Feale and Galey catchment is negligible. Construction of the proposed road development is therefore predicted to have no significant impact on the freshwater pearl mussel.

Other Invertebrate Species

All recorded and known invertebrate species from the locality are common, widespread and are of least concern on the corresponding Irish Red Data List, where published (Nelson *et al.*, 2011). The permanent loss of existing habitats to the proposed road development during construction will result in the loss of suitable breeding and feeding sites for invertebrate species. Overall, the construction phase of the proposed development is predicted to result in an impact significant at the local level (the level at which this receptor has been valued), in relation to local invertebrate populations.

An accidental spillage or pollution event into a surface water feature would probably have a negative impact on aquatic invertebrate species; the magnitude and significance of such an impact would be dependent on the nature and scale of the pollution event. In a worst-case scenario a significant pollution event is predicted to result in an impact significant at the local level (the level at which this receptor has been valued). However, it is considered extremely unlikely that an impact of this magnitude would occur under normal circumstances.

(vii) Wintering Birds

Whooper swan

From the findings of the desk review and observations made during the field surveys, the local whooper swan population consistently use the following feeding sites in the Listowel area; Ballyouneen, Finuge, Lixnaw Canal, Ardcullen Marshes, Ballynagare Bridge and Cloneen Causeway. All of these sites are west of the proposed development with the closest (Finuge) to the proposed road development routinely used by *c*. 20% (mean value) of the River Cashen and Estuary flock. By comparison, the Ballyouneen site hosts the vast majority of the flock, with all other sites appearing to be utilised only occasionally by the birds.

The swans at Finuge were never observed feeding any closer than *c*.320 m from the proposed road development boundary; beyond 300 m, disturbance effects from general construction activities would not be expected (Rees *et al.,* 2005). In a report prepared for Humber INCA, Cutts *et al*. (2009) investigated the effects of disturbance on foraging and roosting waterbirds. Based on the findings of that study, in terms of a response to third party disturbance (*e.g.* human presence), minimal effects would be expected beyond 300m. In terms of construction noise, levels below 50dB would not be expected to result in any response from foraging or roosting birds. Noise levels between 50dB and 70dB would provoke a moderate effect/level of response from birds (*i.e*. birds becoming alert and some behavioural changes *e.g*. reduced feeding activity) but birds would be expected to habituate to noise levels within this range. Noise levels above 70dB would likely result in birds moving out of the affected zone, or leaving the site altogether. This is supported by the findings of Wright *et al*. (2010) which found that noise levels above 60dB resulted in behavioural responses, with birds abandoning the site in response to noise levels above 70dB. This was also consistent with observations made at Ballyouneen during the field surveys; where Whooper swans were not recorded within 300 m of the operating farm buildings and were disturbed by pedestrians at *c*.250 m.

Noise levels associated with typical construction activity have been calculated in accordance with the methodology set out in BS 5228: Part 1 (This standard sets out sound power levels for plant items normally encountered on construction sites, which in turn enables the prediction of noise levels. 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, excavation works, fill works, piling of structures, and general road works.

The following table presents calculations of indicative noise levels for typical noise sources associated with road construction works, at set distances from the construction activity, using the source data from BS 5228:2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1 Noise.

Calculations of indicative noise levels for typical noise sources associated with road construction works at set distances from the construction activity were calculated using the source data from BS 5228:2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1 Noise. The calculations assume that plant items are operating for 66% of the time to obtain a LA_{eq}, 1 hour value. Noise levels are presented in Table 6-20 for the individual items of plant at specific distances in addition to a cumulative level assuming all plant items associated with the individual phases are operating simultaneously, and at the same distance, for any one scenario. The calculations do not take account of any screening afforded by intervening structures, construction site hoarding *etc*. and therefore represent a "worst case" scenario.

Table 6-20 Noise values for various road construction works.

Site Clearance & Preparation	Calculated $L_{Aeq,T}$ (dB) at distance from works (m)							
	50m	100m	150m	200m	250m	300m	350m	400m
Pneumatic breaker C.1.6	67	61	58	55	53	52	50	49
Wheeled loader C2-26	63	57	54	51	49	48	46	45
Tracked excavator (loading dump truck) C1-10	69	63	60	57	55	54	52	51
Dozer C.2.10	64	58	55	52	50	49	47	46
Dump Truck (C2.30)	63	57	54	51	49	48	46	45
Combined L_{Aeq} from all works	**73**	**67**	**64**	**61**	**59**	**58**	**56**	**55**
Fill Works	**Calculated $L_{Aeq,T}$ (dB) at distance from works (m)**							
	50m	**100m**	**150m**	**200m**	**250m**	**300m**	**350m**	**400m**
Tracked excavator (loading dump truck) C1-10	69	63	60	57	55	54	52	51
Articulated dump truck (dumping rubble) C1-11	64	58	55	52	50	49	47	46
Wheeled loader C2-26	63	57	54	51	49	48	46	45
Dozer C.2.10	64	58	55	52	50	49	47	46
Dump Truck Tipping fill (C2.30)	63	57	54	51	49	48	46	45
Combined L_{Aeq} from all works	73	**66**	**63**	**60**	**59**	**57**	**56**	**54**
Piling Works	**Calculated $L_{Aeq,T}$ at distance from works (m)**							
	50m	**100m**	**150m**	**200m**	**250m**	**300m**	**350m**	**400m**
Crawler Mounted Rig (C3.22)	64	58	55	52	50	49	47	46
Tracked Excavator inserting metal cage, (C3.24)	58	52	49	46	44	43	41	40
Concrete Pump & Cement Mixer Truck (C4.24)	51	45	42	39	37	36	34	33
Diesel Generator (C4.76)	45	39	36	33	31	30	28	27
Angle Grinder (C4.93)	64	58	55	52	50	49	47	46
Combined L_{Aeq} from all works	**68**	**62**	**58**	**56**	**54**	**52**	**51**	**50**
Road Works	**Calculated $L_{Aeq,T}$ at distance from works (m)**							
	50m	**100m**	**150m**	**200m**	**250m**	**300m**	**350m**	**400m**
Tracked excavator (C2.21)	55	49	46	43	41	40	38	37
Dump Truck (C2.30)	63	57	54	51	49	48	46	45
vibration rollers (C5.20)	59	53	50	47	45	44	42	41
Asphalt Paver & Tipping Lorry (C.5.31)	61	55	52	49	47	46	44	43
Diesel Generator (C4.76)	45	39	36	33	31	30	28	27
Road Rollers (C5.19)	64	58	55	52	50	49	47	46
Combined L_{Aeq} from all works	**69**	**63**	**59**	**57**	**55**	**53**	**52**	**51**

None of the construction activities listed above would be expected to result in any more than a moderate level of disturbance effect on waterbirds at distances beyond 150m. At 300m, noise levels are below 60dB or, in most cases, are approaching the 50dB threshold. Low, or no, effects would be expected for those noise levels. Any landscape features, vegetation cover or buildings between the construction site and winter bird sites would contribute to further reducing the ambient noise at any given distance. 300m is considered to be a precautionary buffer in defining the zone of influence of disturbance effects associated with general construction activities. Therefore disturbance from general construction activities is not predicted to result in a significant impact at any geographic scale and is not predicted to adversely affect the species' conservation status.

The installation of the temporary piles required to facilitate the construction of the intermediate pier of the proposed new River Feale Bridge may result in a disturbance impact over a greater radius (akin to the *c.*800 m disturbance zone noted in Rees *et al.,* 2005 for airport bird scaring). However, even if these works were undertaken during the winter period when the swans were in residence, the installation of the piles will be undertaken over a matter of days and given the very brief duration of any potential disturbance effect, and the availability of several other suitable foraging sites in the locality, these works are not predicted to result in a significant impact at any geographic scale and are not predicted to adversely affect the species' conservation status.

All of the known feeding sites are located to the west of the proposed road development and when feeding at the Finuge site, the swans were observed flying into the site from the west (from the direction of Ballyouneen and the estuary) and after dark returning in that direction, in most instances. During the 2016/17 field season up to 59 whooper swans were observed to roost on a gravel bank within the River Feale. The number of birds roosting here was variable over the season and represented a small proportion of the total roosting flock. There are a variety of potential roost locations within the catchment. The roosting site in the River Feale is in excess of 300m from the proposed road development. Based on all the available information and survey observations, there are no regularly used flight paths for the species that cross the proposed road development. Construction of the proposed new River Feale Bridge will therefore, not pose any significant collision risk or disturbance effects along their commuting routes between feeding and roosting sites. Therefore there are no significant impacts predicted at any geographical scale to the local whooper swan population.

Golden Plover

Golden plover were recorded using the large agricultural field to the north of the proposed River Feale crossing on two occasions over the course of the field surveys. If taken in the context of the five-year mean or peak count numbers[23] of golden plover recorded in the Cashen Estuary, the peak count recorded from this field during field surveys represent |10.9% of the five-year mean and 8.5% of the peak count over the same five-year period. The low number of sightings and the variable numbers of birds recorded (varying between 60 and 170 individuals, recorded on three occasions, only two of which are in this location) would suggest that this field may only be used on occasion by the species. Golden plover feed on both cultivated land and grassland, of which there is an abundance of alternative suitable habitat in the locality. If undertaken in the winter, the construction of the proposed development would likely result in some disturbance to any wintering bird species in the vicinity. However, given the relatively low numbers recorded and the infrequent use of the field crossed by the proposed development, the

[23] The I-WeBS 5-year mean is based on available counts for the most recent 5 years covered (*i.e.* for the period 2010/11 - 2014/15) but excluding inaccurate counts.

resulting impact is predicted to be significant at the local level (the level at which this receptor has been valued) and is not predicted to adversely affect the species' conservation status.

Teal

Teal were occasionally recorded flying through the vicinity of the proposed crossing point of the River Feale during the winter period and are unlikely to use the stretch of river adjacent to the proposed crossing point during the construction period. Disturbance during bridge construction works, if carried out over the winter period, is predicted to result in an impact significant at the local level (the level at which this receptor has been valued), in relation to the local Teal population and which is not predicted to adversely affect the species' conservation status.

Snipe

Snipe were regularly observed in agricultural fields crossed by the proposed development during the winter period. The location of fields within which the species was recorded was very variable, with no locations showing consistent records. This, along with the widespread nature of Snipe observations during the field surveys (the species was recorded in many fields up to 2.5 km from the proposed development), would suggest that there is an abundance of alternative suitable habitat in the locality. Therefore, disturbance and displacement during the construction phase of the proposed development, if carried out over the winter period, is predicted to result in an impact significant at the local level (the level at which this receptor has been valued) and is not predicted to adversely affect the species' conservation status.

Black-headed Gull

Black-headed gull are included on the BoCCI Red-List for their breeding population. Although the species has been occasionally recorded during the winter period from the agricultural field to the north of the proposed crossing point of the River Feale, it was widely observed in alternative habitat in the locality during the field surveys. The impact of disturbance and displacement during the construction phase of the proposed development is predicted to have an impact significant at the local level (the level at which this receptor has been valued), in relation to the local population, and is not predicted to adversely affect the species' conservation status.

(viii) Breeding Birds

BoCCI Red List Species

There are three confirmed or potential barn owl nest sites in the Listowel area, which are within the zone of influence of the proposed development based on their proximity, the known territory size of the species, and confirmed barn owl sightings in the locality. Although the construction of the proposed development is extremely unlikely to result in any disturbance effects to the species (as barn owl are primarily active at night and the nearest roost site is 2.5 km away), it will result in the loss of available foraging habitat for the species. Given that the majority of the proposed development will affect urban and improved agricultural habitats, the amount of actual foraging habitat lost (and the associated loss of habitat for prey species) will be relatively minor when compared with the available habitat in the surrounding areas within the expected territory (according to Hardy *et al.* 2009 barn owl are known to forage up to 5 km from the nest site outside of the breeding season, and normally up to a kilometre during the breeding season). Disturbance associated with construction works is not predicted to result in any significant impact at any geographic scale and is not predicted to adversely affect the species' conservation status.

The habitat loss, in association with the associated loss of prey (small mammal) habitat, is predicted to result in an impact significant at the local level.

There are two meadow pipit territories in fields immediately to the south of the proposed development boundary, between the disused rail line, the Mill Stream Lower and the Ashfield housing estate. The loss of potential breeding habitat and the disturbance effects of construction activities are predicted to result in an impact significant at the local level (the level at which this receptor has been valued) and is not predicted to adversely affect the species' conservation status.

BoCCI Amber List Species

Kingfisher commuting or feeding along the River Feale may be subject to disturbance effects during construction of the proposed new River Feale Bridge. This is predicted to result in a significant impact at the local level but it is not predicted that it would adversely affect its conservation status.

Although there are no known hen harrier nesting sites within 6 km of the proposed development, there are records of sightings of this species in the Listowel area (Ruddock *et al.*, 2012). However, given the low suitability of the habitats affected by the proposed development for foraging hen harrier (predominantly urban and improved agricultural grassland) the habitat loss is predicted to result in a significant impact at the local level in a worst case scenario.

There are six known kestrel nesting sites within 10 km of the proposed development. The construction of the proposed development is unlikely to result in any significant disturbance effects to the species as they commonly hunt next to busy roadways and have been observed hunting next to active construction sites (pers. obs.) without negative impacts. Disturbance is predicted to result in a significant impact at the local level. Given that the majority of the proposed development will affect urban and improved agricultural habitats, the amount of actual foraging habitat lost to the proposed development will be relatively minor when compared with the surrounding areas (according to Hardy *et al.* 2009 kestrel territories can range from 1 km^2 to over 10 km^2 during the breeding season). The habitat loss will not result in a significant impact at any geographic scale and is not predicted to adversely affect the species' conservation status.

There are two skylark territories in the agricultural field crossed by the proposed development which lies to the north of the River Feale. The loss of potential breeding habitat and the disturbance effects of construction activities are predicted to result in an impact significant at the local level (the level at which this receptor has been valued), and is not predicted to adversely affect the species' conservation status.

There are also estimated to be eight or nine robin territories, three goldcrest territories, and one greenfinch territory in the vicinity of the offline section of the proposed development. The loss of potential breeding habitat is predicted to result in an impact significant at the local level (the level at which these receptors have been valued). The disturbance effects of construction activities are predicted to result in an impact significant at the local level.

Although the probable sand martin breeding site located *c.*20 m to the east of the proposed new River Feale Bridge will not be directly impacted by the proposed works, the nest site would be subject to disturbance effects if the bridge is being constructed during the breeding season. The disturbance would result in an impact significant at the local level (the level at which this receptor has been valued).

There are estimated to be 4-5 linnet territories located along the scrub and wet grassland fields next to the disused railway line. The habitat loss is predicted to result in an impact significant at the local level (the level at which this receptor has been valued). The disturbance to nesting linnet in adjacent habitat within the zone of influence of the construction works is predicted to result in an impact significant at the local level (the level at which this receptor has been valued).

There are no known territories of the following amber-listed species within the zone of influence of the proposed development; cormorant, grey heron, house martin, house sparrow, short-eared owl, snipe, starling, stock dove, swallow, and swift. However any of these species feeding within the vicinity of the zone of influence of the proposed development during construction would be subject to disturbance effects and an impact significant at the local level (the level at which these receptors have been valued) is predicted.

The construction phase of the proposed development is not predicted to have any perceptible impact on the conservation status of any amber listed breeding bird species locally.

BoCCI Green List Species

All of the green-listed bird species present will be impacted by habitat loss; including both potential and existing nesting habitat and foraging habitat. These are all common species in agricultural and urban/suburban habitats. The loss of breeding bird habitat (scrub, grassland, hedgerow, and treeline) is predicted to result in an impact significant at the local level (the level at which these receptors have been valued).

As a result of construction disturbance, any of these species feeding, or breeding, within the vicinity of the zone of influence of the proposed development will be subject to impacts significant at the local level (the level at which these receptors have been valued).

(ix) Fish

The construction phase impacts on the River Feale and Galey River are discussed above in Section 6.5.4 (a), under Designated Areas and in the NIS (Appendix 6.4). The construction phase impacts relating to the Ballygrenane Stream, Garryantanvally Stream and the Mill Stream Lower are discussed above in Section 6.5.4 (c) Habitats.

Disturbance to fish species as a result of construction activities at the proposed watercourse crossings is predicted to result in a significant impact at the local level.

The installation of structures will result in a temporary barrier to fish passage during the installation process. However, this will be of a very short duration (limited to the time it takes to install the structure) and there are existing barriers to fish movement that exist on the Mill Stream Lower, Ballygrenane Stream and the Garryantanvally Stream, in the form of flap valves. The barrier effect of installing the structures will result in a significant impact at the local level.

Surface water runoff and/or an accidental spillage or pollution event into any surface water feature has the potential to have a significant negative impact on water quality and consequently an impact on the fish species present downstream; a reduction in water quality can cause stress or mortality in adult and juvenile fish. The effects of frequent and/or prolonged siltation or pollution events in a river system have the potential to be extensive and far-reaching and can have significant impacts in the context of the wider ecosystem on predator species (*e.g.* otter) or on dependant species such as the freshwater pearl mussel (a species whose reproductive cycle is dependent on salmonid fish). Therefore, the magnitude and significance of such an impact would be dependent on the nature and scale of the pollution event. In a worst-case scenario it is predicted that a significant pollution event would result in an impact significant at the local level only. However, it is considered unlikely that a pollution event of such a magnitude would occur during construction and, given that the proposed development is within the lower reaches of the catchment, will not have far-reaching effects within the River Feale or Galey System systems.

(e) Summary of Construction Phase Impacts without Mitigation

Table 6-21 Summary of Construction Phase Impacts without Mitigation

Key Ecological Receptor	Ecological Valuation (as per NRA, 2009b)	Impact Type	Impact Characterisation	Geographic Scale of Impact
Designated Sites (Lower River Shannon cSAC only; potential for impacts to any other European Site has been ruled out.)				
Refer to Natura Impact Statement (NIS) for full discussion of impacts to European sites. These include habitat loss, habitat degradation due to the spread of invasive plant species, disturbance to qualifying interest species during construction, reduction in water quality, and effects on the existing hydrological regime and floodplain connectivity along the River Feale. In the absence of mitigation measures, some of these impact sources have the potential to result in significant effects on the Lower River Shannon cSAC.				
Habitats (Non-Designated Sites)				
Cashen River Estuary pNHA	National	Pollution risk	Probable, reversible impact, no greater than slight negative	Local
		Spread of Invasive plant species	Potential, long-term, significant negative impact	Local
		Otter	see section below	
		Whooper swan	see section below	
Rare and protected plant species Triangular club-rush	County importance	Pollution risk	Probable, indirect, reversible impact, no greater than slight negative	Local
Eroding/upland Rivers (FW1) Drainage Ditches (FW4)	Local Importance (Higher Value)	Habitat loss	Direct, permanent, slight to significant negative impact	Local
		Pollution risk	Potential significant negative impact	Local
		Spread of Invasive plant species	Probable, direct, long-term, significant negative impact	Local
Wet Grassland (GS4) Scrub (WS1) Hedgerows (WL1) Treelines (WL2)	Local Importance (Higher Value)	Habitat loss	Direct, permanent, moderate negative impact	Local
Fauna				
Badger	Local Importance (Higher Value)	Habitat loss	Near-certain, short-term, slight to moderate negative impact	Local
		Disturbance		Local
		Severance		Local

Key Ecological Receptor	Ecological Valuation (as per NRA, 2009b)	Impact Type	Impact Characterisation	Geographic Scale of Impact
Otter	International importance	Disturbance to holts/couch sites	Near-certain, indirect, short-term, slight negative impact	Local
		Habitat loss/Severance	Near-certain, direct, temporary, slight negative impact	Local
		Disturbance (general)	Indirect, temporary, slight negative impact	Local
		Pollution risk	Indirect, significant negative impact - Indirect, slight negative impact	Local
Bat species	Local Importance (Higher Value)	Disturbance to bat roosts (buildings)	Indirect, temporary, slight negative impact	Local
		Loss of potential bat roosts (trees)	Unlikely direct, permanent, slight negative impact	Local
		Disturbance	Near-certain, short-term, imperceptible negative impact	Local
		Habitat loss	Near-certain, direct, permanent, significant negative impact	Local
Other mammal species	Local Importance (Higher Value)	Disturbance/ Habitat loss	Probable, permanent, slight negative impact	Local
Common Frog	Local Importance (Higher Value)	Disturbance/ Habitat loss	Near-certain, significant negative impact	Local
		Pollution risk	Potential for a probable, short-term, significant negative impact	Local
Freshwater pearl mussel	International Importance	Pollution risk	Near-certain, neutral impact	None
Other invertebrate species	Local Importance (Higher Value)	Habitat loss	Probable, direct, permanent, slight negative impact	Local
		Pollution risk	Potential for a probable, short-term, significant negative impact	Local
Whooper swan	National Importance	Disturbance from general construction activities	Near-certain, indirect, temporary, imperceptible negative impact	Local
		Disturbance from pile driving	Near-certain, indirect, temporary, slight negative impact	Local
		Collision risk	Near-certain, neutral impact	None
Other wintering birds - Golden Plover, Snipe, Black-headed gull,	Local Importance (Higher Value)	Disturbance	Probable, indirect, short-term, slight negative impact	Local

Key Ecological Receptor	Ecological Valuation (as per NRA, 2009b)	Impact Type	Impact Characterisation	Geographic Scale of Impact
Teal, Mallard				
Barn owl	National Importance	Disturbance	Near-certain, neutral impact	Local
		Habitat loss	Probable, direct, short-term, moderate negative impact	Local
Meadow pipit	Local Importance (Higher Value)	Habitat loss/ Disturbance	Probable, indirect, short-term, moderate negative impact	Local
Breeding birds – Amber listed birds throughout	Local Importance (Higher Value)	Habitat loss	Probable, direct, permanent, imperceptible – moderate negative impact	Local
		Disturbance	Near certain to probable, indirect, short-term, slight to moderate negative impact	Local
Breeding birds – Green listed birds throughout	Local Importance (Higher Value)	Habitat loss	Probable, direct, permanent, significant negative impact	Local
		Disturbance	Indirect, short-term, moderate negative impacts	Local
Atlantic Salmon Brown trout	International Importance National Importance	Habitat loss	Direct, permanent, significant negative impact	Local
		Disturbance	Probable, indirect, temporary, moderate negative impact	Local
		Barrier effect	Probable, direct, temporary, slight negative impact	Local
		Pollution risk	Near certain indirect, significant negative impact	Local
Lamprey species	International Importance	Habitat loss	Direct, permanent, significant negative impact	Local
		Disturbance	Probable, indirect, temporary, moderate negative impact	Local
		Barrier effect	Probable, direct, temporary, slight negative impact	Local
		Pollution risk	Near Certain indirect, significant negative impact	Local
European eel	Local Importance (Higher Value)	Habitat loss	Direct, permanent, significant negative impact	Local
		Disturbance	Probable, indirect, temporary, moderate	Local

Key Ecological Receptor	Ecological Valuation (as per NRA, 2009b)	Impact Type	Impact Characterisation	Geographic Scale of Impact
			negative impact	
		Barrier effect	Probable, direct, temporary, slight negative impact	Local
		Pollution risk	Near certain indirect, significant negative impact	Local

6.5.5 Operation Phase Impacts

(a) Designated Sites

The Natura Impact Statement (NIS), included in Appendix 6.4, has identified only one European site to which there is a potential source-pathway-receptor link between it and the proposed development (see Table 6-4): the Lower River Shannon cSAC. This site has also been highlighted as a KER in Table 6-19. In addition to the European sites, there is one nationally designated site considered to be a KER: the Cashen River Estuary pNHA.

The potential for impacts to any other designated sites have been ruled out due to their distance from the proposed development (*i.e.* no potential for direct impacts) and the absence of any pathways by which the proposed development could indirectly affect the sites.

The potential impacts of the proposed development, during operation, on the Lower River Shannon cSAC are discussed in detail in the NIS (Appendix 6.4). The NIS has concluded that there is no risk of the proposed development, with mitigation in place, resulting in adverse effects on the Lower River Shannon cSAC and its qualifying interests, either alone or in-combination with other impact sources.

The potentially significant operation related risks to the Lower River Shannon cSAC identified relate to water quality, the spread of invasive plant species, habitat severance and barrier effects to the movement of species, risk of road traffic collisions with wildlife, and the proposed lighting design and the potential effects these elements could have on the qualifying interests of the Lower River Shannon cSAC and their conservation objectives. Design and mitigation measures have been proposed in the NIS to ensure that these risks will be avoided or reduced during the operation of the proposed development such that there will be no adverse effect on the integrity of the Lower River Shannon SAC or its qualifying interests.

Following an examination, analysis and evaluation of the relevant information, in light of best scientific knowledge, including in particular the nature of the predicted impacts from the proposed development and with the implementation of the mitigation measures proposed there is no risk of adverse effects on the integrity of the Lower River Shannon SAC, either alone or in-combination with other plans or projects.

(i) Cashen River Estuary pNHA

Reduction in Water Quality

Given that the River Feale and the Galey River are the only link between the proposed development and the Cashen River Estuary pNHA, the main potential indirect impact likely to pose a risk to the conservation status of the site is a reduction in water quality as a result of contaminated road run-off or an accidental spillage or pollution event during operation.

There will be six new outfall points to surface water features from the road drainage network during 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. A Highways Agency Water Risk Assessment Tool (HAWRAT) assessment has been undertaken to assess the carriageway runoff from the proposed development on the receiving watercourses. Full details of this assessment are presented in Chapter 8, Hydrology, Geomorphology & Hydromorphology and Appendix 8.3 of the EIS but the key relevant findings are presented here. The toxicity thresholds which are used by the tool, have been designed to prevent adverse ecological effects in receiving waters. 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.

During the operation of the development, surface water runoff will be passed through a three stage train system of petrol/oil interceptor, attenuation pond, and constructed wetland prior to discharge (as described in Chapter 8, Hydrology, Geomorphology & Hydromorphology). The design of the treatment system has taken account of the size of the catchment drained, and the types of contaminants (grit, heavy metals, and hydrocarbons).

The results of the HAWRAT assessment show the % removal of pollutants required to achieve required water quality objectives and whether the proposed drainage designs achieve these removals. In each case it can be seen that the proposed drainage designs are adequate and that no additional measures are required. The HAWRAT results indicate that impacts to water quality in all receiving watercourses as a result of the operational phase would be considered to be either imperceptible, or neutral to negligible, due to the pollutant removal ability of the proposed drainage system. 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, and given the drainage design proposed (a three stage system of petrol/oil interceptor, attenuation pond and constructed wetland, as described in Chapter 8, Hydrology, Geomorphology & Hydromorphology) the operating water quality of the drainage outfalls will not have any perceptible impact on water quality in the receiving watercourses. Extreme flood events may temporarily affect the functioning of the attenuation and wetland elements of the treatment chain, but the petrol interceptor would continue to function as designed. However, given the increased dilution factor and flow rates associated with such events the predicted impact on water quality is predicted to be imperceptible.

A risk of hydrocarbon and other dangerous substance contamination exists as a result of accidental spillage by vehicles using the proposed development during the operational phase of the proposed development. The Highways Agency (HA) considers that in “circumstances where an outfall discharges within close proximity to (i.e. within 1 km) a protected area for conservation, or 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%". As is demonstrated in Chapter 8 of the EIS (Section 8.2.7(b)(ii) and Appendix 8.4 of the EIS), the probability of accidental spillage occurring has been calculated as being less than 0.5% in all cases. Therefore, the likelihood of a serous pollution incident is so low that it is not deemed necessary in accordance with the Highways Agency's guidance to further reduce the risk of a serious pollution incident through other measures. Given that all surface water run-off from the proposed development will be captured by the three stage system of petrol/oil interceptor, attenuation pond and constructed wetland, in the extremely unlikely event of an accidental spillage any hydrocarbons or other potential pollutants would pass through this system offering some level of protection to the receiving watercourses. The attenuation ponds and the constructed wetlands will also have a penstock valve to contain any accidental spillage. Given the extremely low likelihood and level of protection available through the design of the drainage system significant effects are not predicted.

Spread of Invasive Plant Species

Given the abundance of invasive plant species cover in the vicinity of the proposed development, there is a probability that these species will recolonize the vegetated areas within the CPO fence line post-construction (particularly Japanese knotweed along the River Feale corridor and along the disused rail line embankments). As such, there is a risk that routine maintenance works may inadvertently spread contaminated vegetation cuttings. The impact has the potential to result in an impact significant at the local level but if invasive plant species were spread within the Lower River Shannon SAC or the Cashen River Estuary pNHA the significance of the impact could be at up to international or national geographic scale.

(b) Flora

The known mapped location of the Flora Protection Order species, triangular club-rush, is *c.*7.4 km downstream (according to the National Biodiversity Data Centre online database) and the only potential indirect impact likely to pose a risk to the conservation status of the species is a reduction in water quality as a result of contaminated road run-off or an accidental spillage or pollution event during operation.

The drainage design proposed will consist of the three stage system of oil/petrol interceptor, initial attenuation pond with fore bay, and a constructed wetland (as described in Chapter 8, Hydrology, Geomorphology & Hydromorphology) through which all road run-off and drainage will pass.

The likelihood of a serous pollution incident is so low that it is not deemed necessary in accordance with the Highways Agency's guidance to further reduce the risk of a serious pollution incident through other measures. Given that all surface water run-off from the proposed development will be captured by the three stage system of petrol/oil interceptor, attenuation pond and constructed wetland, in the unlikely event of an accidental spillage any hydrocarbons or other potential pollutants would pass through this system offering some level of protection to the receiving watercourses.

Therefore, it is extremely unlikely that a pollution event would occur of a magnitude that would have any perceptible impact on water quality in the habitat of the species downstream. Given the extremely low likelihood and level of protection available through the design of the drainage system significant effects on this species are not predicted.

(c) Habitats

Reduction in Water Quality

The drainage design proposed will consist of the three stage system of oil/petrol interceptor, initial attenuation pond with fore bay, and a constructed wetland (as described in Chapter 8, Hydrology, Geomorphology & Hydromorphology) through which all road run-off and drainage will pass.

The likelihood of a serous pollution incident is so low that it is not deemed necessary in accordance with the Highways Agency's guidance to further reduce the risk of a serious pollution incident through other measures. Given that all surface water run-off from the proposed development will be captured by the three stage system of petrol/oil interceptor, attenuation pond and constructed wetland, in the extremely unlikely event of an accidental spillage any hydrocarbons or other potential pollutants would pass through this system offering some level of protection to the receiving watercourses.

There will be six outfall points to surface water features from the road drainage network during operation. However, given the drainage design proposed (as described in detail in Chapter 8, Hydrology, Geomorphology & Hydromorphology) it is extremely unlikely that the normal operating water quality of the drainage outfalls, even in the unlikely event of a pollution incident, would have any perceptible impact on water quality in the receiving watercourses. Extreme flood events may temporarily affect the functioning of the attenuation and wetland elements of the treatment chain, but the petrol interceptor would continue to function as designed. However, given the increased dilution factor and flow rates associated with such events the predicted impact is predicted to be imperceptible. During both normal and extreme flood conditions, the operation of the proposed development will not result in any significant impacts on water quality in receiving watercourses nor on associated habitats.

Spread of Invasive Plant Species

Given the abundance of invasive plant species cover in the vicinity of the proposed development, there is a probability that these species will recolonize the vegetated areas within the CPO fence line post-construction (particularly Japanese knotweed along the River Feale corridor and along the disused rail line embankments). As such, there is a risk that routine maintenance works may inadvertently spread contaminated vegetation cuttings. The impact has the potential to be significant at the local level but if invasive plant species were spread within the Lower River Shannon cSAC or the Cashen River Estuary pNHA the significance of the impact could be at the international or national geographic scales.

Effects of a Reduction in Air Quality

Emissions from car exhausts, and the deposition of particulate matter and heavy metals produced by engine, brake and tyre wear, can contribute to increased deposition of pollutants such as oxides of nitrogen (NO_x), particulate matter (PM) and heavy metals (HM) in the vicinity of the road carriageway. This can affect the ecosystems and vegetation present, influencing plant growth rates and species composition, diversity, and abundance.

In terms of NO_x, by 2032 it is predicted that at a distance of 10 m from the road the proposed development will lead to an increase on NO_x concentration levels of at most 6.8µg/m^3, to a total concentration of 14.4 µg/m^3, which is still well below the limit value of 30 µg/m^3 for the protection of vegetation (National Roads Authority, 2011). Similarly the dry deposition rate of predicted for the year 2032 at 10 m from the road is predicted to be 0.35KG(N)/ha/yr, which is well below the critical load of 5 KG(N)/ha/yr defined for all habitat types in Guidelines for the *Treatment of Air Quality during the Planning and Construction of National Road Schemes*. These values drop off rapidly at increased distance from the road (see Table 8-16 of the Air Quality and Climate chapter of the EIS).

In terms of PM and HM, the predicted concentrations will be below the ambient air quality standards. There is likely to be some increases on soil concentrations of elements of PM and HM within the immediate vicinity of the road side that will result in some localised effects to vegetation. However, it is unlikely to result in any significant changes to species composition or diversity.

Overall, air quality effects are not predicted to result in any significant impact at any geographic scale.

(d) Fauna

(i) Badger

Habitat Severance/Barrier Effect
The territories of the badger groups on either side of the River Feale will be severed by the proposed development. However, the clear span bridge design proposed for the proposed new River Feale Bridge, which includes bankside access underneath, will maintain an accessible link between both sections of the badger groups' territories. The agricultural underpasses (ST11, ST18, and ST24) will also serve to maintain connectivity within each of the badger territories during operation (Eldridge & Wynn, 2011).

Initially habitat severance will result in a significant impact at the local level but is predicted to reduce to a neutral impact in the short-term as the badgers habituate to using the mammal passage features.

Road Traffic Collisions
The introduction of a road into an agricultural landscape will probably increase the risk of road traffic collisions with badger as both affected badger territories will be severed by the proposed development.

Road collision impacts to the local badger population will result in an impact significant at the local level.

Light Spill
Nocturnal mammals, such as badger, are likely to be disturbed by the introduction of artificial light into established breeding and foraging areas (Rich & Longcore, 2005). None of the areas proposed for lighting along the proposed development are routinely used by foraging badgers and none of the sett locations will be affected. Lighting associated with the proposed development will not result in any significant impact on badger.

(ii) Otter

Habitat Severance/Barrier Effect
The two span bridge design over the River Feale will ensure that there is no physical severance along this river corridor which is used by otter. However, the installation of the structures on the minor watercourses has the potential to result in a permanent barrier impact to otter using these watercourses.

Habitat severance is predicted to result in an impact significant at the local level on those watercourses crossed by the proposed development where otter are present; particularly during periods of high water levels when passage through drainage pipes and structures is more difficult for aquatic species.

Road Traffic Collisions
The introduction of new bridges and structures along watercourses crossed by the proposed development will probably increase the risk of road traffic collisions with otter. Road collision impacts to the local otter population are predicted to result in an impactthe significance of which would be dependent on the number of individuals/population size at risk but could potentially be significant at county level.

Light Spill
Nocturnal mammals, such as otter, are likely to be disturbed by the introduction of artificial light into established breeding and foraging areas (Rich & Longcore, 2005). Lighting is not proposed specifically for any of the watercourse crossings along the proposed development and none of the potential holt locations will be affected by increased background light levels. The lighting design for the proposed development does however, include for lighting to extend for 60 m from each junction. The Mill Stream Lower is the only watercourse which is used by otter that falls within the zone of influence of this lighting. As the lighting proposed will be confined to lighting the road surface, and not the watercourse beneath, it is unlikely that it would result in any displacement effect in relation to otter movement along that watercourse. Lighting associated with the proposed development will not result in any significant impact on otter.

Reduction in Water Quality
Surface water runoff and the risk of accidental pollution events during operation has the potential to result in indirect, significant negative impacts to the water quality in receiving watercourses which can in turn have knock-on significant negative effects on semi-aquatic species such as otter; potentially at the county geographic scale.

The drainage design proposed will consist of the three stage system of oil/petrol interceptor, initial attenuation pond with fore bay, and a constructed wetland (as described in Chapter 8, Hydrology, Geomorphology & Hydromorphology) through which all road run-off and drainage will pass.

The likelihood of a serous pollution incident is so low that it is not deemed necessary in accordance with the Highways Agency's guidance to further reduce the risk of a serious pollution incident through other measures. Given that all surface water run-off from the proposed development will be captured by the three stage system of petrol/oil interceptor, attenuation pond and constructed wetland, in the extremely unlikely event of an accidental spillage any hydrocarbons or other potential pollutants would pass through this system offering some level of protection to the receiving watercourses.

During normal operating conditions, the operation of the proposed development will result in a neutral impact on water quality in receiving watercourses. During extreme flood events the impact is predicted to also be imperceptible. Therefore, there is no predicted significant impact on otter from a reduction in water quality.

(iii) Bats

Impacts to Bat Roosts
There are no bat roosts within the boundary of the proposed road development. The open-fronted barns were used as a night roost for a small number of pipistrelle bats during spring 2013 and areas next to the Greenville Road and its junction were also used used by pipistrelle bats for foraging and commuting by pipistrelle bats during spring 2013. These buildings as well as private dwellings at the Greenville Road junction and the proposed junction with the existing N69 were used by a small number of pipistrelle bats in summer 2016. These buildings are the only roosting features within the zone of influence of the proposed development affected by lighting. Given that the existing Greenville Road is adjacent to the structures, the low night-time traffic numbers likely on

the existing road, and the lighting design proposed for the Greenville Road junction (*i.e.* lighting will be directed onto the road and not into the adjacent building complex) the impact of the proposed development is predicted to be significant at the local level.

Habitat Loss/Severance/Barrier Effect

The impact of the severance of landscape features used by commuting and foraging bats is dependent on the species of bat effected and the magnitude of the severance effect (*e.g.* the gap present on a treeline used by commuting bats following the road construction). Given the gaps that will be present in landscape features used by bats along the proposed development (between *c*.30 and 60 m), and evidence that the species recorded there will cross gaps of this size (Abbott *et al.*, 2012) the impact is predicted to be significant at the local level.

Road Collisions

Where landscape features used by commuting and foraging bats are removed or severed by the proposed development there is an increased risk of bats being killed by road traffic. This is predicted to result in an impact significant at the local level.

Light Spill

Lighting has been shown to affect emergence at roost sites, the feeding behaviour of bats (either displacing bats or attracting insects away from unlit feeding areas), can increase predation risk or collisions with road traffic (where some species of bats are attracted into lit areas by the abundance of insects), and can result in a barrier effect to commuting routes to and from feeding/roosting sites (Bat Conservation Trust, 2007; Bat Conservation Ireland, 2010b; Patriarca *et. al.*, 2010). The lighting design for the proposed development does include for lighting to extend for 60 m from each junction. This will impact on bat foraging habitat at the following locations (see also Figures 6.1.18-6.1.22 in Volume 3): Proposed Roundabout 1 and Proposed Roundabout 2.

Three species of bat were recorded foraging at both these locations; common pipistrelle, soprano pipistrelle, and Leisler's bat. These particular bat species are less sensitive to light displacement impacts in foraging areas than many other bat species; e.g. *Myotis* species (Bat Conservation Trust, 2007 and Bat Conservation Ireland, 2010b). However, this may lead to an increased risk of road traffic collision.

In the case of the area surrounding Proposed Roundabout 1, approximately 50% of the recorded foraging area will be lit during operation; the remainder will be unaffected by both lighting and increased night-time traffic numbers given that there is an existing road on which traffic numbers will not increase significantly during operation. The retention of an unlit zone along the existing road (where it was noted during the surveys that a high percentage of the foraging activity occurred) and alternative foraging habitat in the immediate vicinity, in the form of mature treelines and hedgerows surrounding the farm buildings, will reduce the potential severity of this impact. The predicted impact of lighting on foraging bat species in this location is predicted to be a significant at the local level.

In the case of the area surrounding Proposed Roundabout 2, the introduction of lighting is not likely to significantly affect foraging activity given that the bats were observed foraging around the building complex and the area to the south along the river – which will be shielded from any road lighting by those buildings. There is no predicted significant impact of lighting on foraging bat species in this location.

(iv) Other Mammal Species

The introduction of a road into an agricultural landscape will probably increase the risk of road collisions with most small mammal species as territories will be severed by the proposed development. However with standard fencing in place, the carriageway will only be accessible to small mammal species (such as rodents) able to pass through the mesh. Given the agricultural underpasses and flood relief culverts included within the design, which will allow mammal species to pass underneath the proposed road carriageway, the impact is predicted to be significant at the local level.

Disturbance from the proposed development to mammal species, such as the Irish hare, that use fields crossed by the proposed development, is predicted to result in a significant impact at the local level, immediately following operation but would be expected to reduce over time to an imperceptible impact.

(v) Amphibians

The presence of the six attenuation ponds and constructed wetlands will provide additional habitat for amphibian species locally. This is considered to be a positive impact significant at the local level, given the absence of any existing significant wetland features within the boundary, or vicinity, of the proposed development.

(vi) Invertebrates

The drainage design proposed will consist of the three stage system of oil/petrol interceptor, initial attenuation pond with fore bay, and a constructed wetland (as described in Chapter 8, Hydrology, Geomorphology & Hydromorphology) through which all road run-off and drainage will pass.

The likelihood of a serous pollution incident is so low that it is not deemed necessary in accordance with the Highways Agency's guidance to further reduce the risk of a serious pollution incident through other measures. Given that all surface water run-off from the proposed development will be captured by the three stage system of petrol/oil interceptor, attenuation pond and constructed wetland, in the extremely unlikely event of an accidental spillage any hydrocarbons or other potential pollutants would pass through this system offering some level of protection to the receiving watercourses.

During normal operating conditions, the proposed development will not result in any significant impacts on water quality in receiving watercourses. During extreme flood events the impact is also predicted to be imperceptible. Therefore, given the extremely low likelihood and level of protection available through the design of the drainage system significant effects on the aquatic environment and associated invertebrate species (*e.g.* Freshwater pearl mussel) from a reduction in water quality are not predicted.

(vii) Wintering Birds

Disturbance/Displacement

During operation, the proposed development will be more than 300 m from the area used by feeding whooper swans at the Finuge Bridge site and as such disturbance from road traffic will not result in any significant impact at any geographic scale.

The operation of the proposed development will probably result in the displacement of snipe from habitat immediately adjacent to the road. From observations made during the surveys, the highest numbers of snipe were recorded from the fields *c.*150 m north of the disused rail line (between the Forge Road and the R553), with only occasional birds observed in fields between the Greenville Road and proposed Roundabout 1. In relation to the area between the Forge Road and the R553; the realigned Sive walk will only be *c*.30 m closer to these fields than it is at present and given the buffer zone present and the screening of the proposed development from these fields by the existing network of

small fields and hedgerows, these fields are likely to continue to be used by wintering snipe. In relation to the area between Greenville Road and proposed Roundabout 1; as only small numbers were recorded infrequently in these fields and there is abundant suitable alternative habitat outside of the zone of influence of the proposed development, the impact will not be significant. Overall, disturbance during operation will result in an impact significant at the local level.

The flocks of other wintering birds observed locally do not appear to be faithful to any particular site (particularly fields within the zone of influence of the proposed development) and were observed using many of the larger agricultural fields from Listowel to Finuge Bridge, and other areas further afield. Disturbance to other wintering bird species locally is predicted to be an impact significant at the local level.

Road/Traffic Collisions

All of the known whooper swan feeding sites are located to the west of the proposed development and when feeding at the Finuge site, the swans were observed flying into the site from the west (from the direction of Ballyouneen and the estuary) and after dark returning in this direction. Based on all the available information and survey observations, there are no regularly used flight paths for the species that cross the proposed development. There are no other wintering bird species present within the zone of influence of the proposed development that are likely to be at high risk from collision with the proposed new River Feale bridge or at high risk from collisions with road traffic. The risk of road/traffic collisions from the operation of the proposed development on wintering birds will not result in any significant impact at any geographic scale.

(viii) Breeding Birds

Road/Traffic Collisions

There are two known barn owl nest sites and one potential nest site in the Listowel area, which are within the zone of influence of the proposed development based on their proximity, the known territory size of the species, and confirmed barn owl sightings in the locality (see Appendix 6.9). Available published material relating to the potential impacts of road development on barn owl conclude that the presence of roads can have significant negative effects on the local population (Ramsden, 2001). The risk of road collisions affecting the local barn owl population is predicted to result in a significant negative impact at least at a local level. However, this impact could be significant at a county scale depending on the size of the local barn owl population and whether or not it represents a significant proportion of the county, or national, population.

It is accepted that the proposed development will result in an increased risk of mortality from collisions with road traffic for most of the local bird species. However, there is no evidence to suggest that this will have any significant effect on local bird numbers in the short-term, as bird species would be expected to habituate to the presence of the road; particularly in such close proximity to the existing road network and urban areas around Listowel Town. The risk of road collisions affecting local breeding bird populations is predicted to result in an impact significant at the local level at first but would be expected to reduce to an imperceptible impact over the short to medium-term.

Disturbance/Displacement

Given that barn owl is primarily a nocturnal species, traffic numbers will be low at night along the proposed offline section of the proposed development, and the known nest sites are at a distance from the proposed development, there are no predicted significant impacts form disturbance effects on barn owl nest sites. Lighting proposed at junctions along the alignment of the proposed development will affect the character of those areas at night and will likely deter barn owl from feeding in the vicinity. However, given the relatively small impact zone of the lighting when compared with the home range of the species the impact is predicted at most to be significant at the local level.

For most local breeding bird species, the presence of the proposed development and the associated increases in background traffic noise will have some displacement effects in habitats next to the alignment, and will probably result in a reduction in the numbers of bird species in the immediate vicinity. This is predicted to result in an impact significant at the local level in the immediate vicinity of the road edge but is expected to reduce to an imperceptible impact with increasing distance from the road.

(ix) Fish

Reduction in Water Quality

The drainage design proposed will consist of the three stage system of oil/petrol interceptor, initial attenuation pond with fore bay, and a constructed wetland (as described in Chapter 8, Hydrology, Geomorphology & Hydromorphology) through which all road run-off and drainage will pass.

The likelihood of a serous pollution incident is so low that it is not deemed necessary in accordance with the Highways Agency's guidance to further reduce the risk of a serious pollution incident through other measures. Given that all surface water run-off from the proposed development will be captured by the three stage system of petrol/oil interceptor, attenuation pond and constructed wetland, in the extremely unlikely event of an accidental spillage any hydrocarbons or other potential pollutants would pass through this system offering some level of protection to the receiving watercourses.

During normal operating conditions, the operation of the proposed development is expected to result in a neutral impact on water quality in receiving watercourses. During extreme flood events the impact is aksi predicted to be imperceptible. Therefore, given the extremely low likelihood and level of protection available through the design of the drainage system significant effects on the fish from a reduction in water quality are not predicted.

Habitat Severance/Barrier Effect

The structures have been designed in consultation with IFI and the design criteria set out in *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes* (National Roads Authority**,** 2005a) and the *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (Inland Fisheries Ireland, 2016) and will maintain fish passage during the operation of the proposed development (Section 2.2); resulting in a neutral impact.

(e) Summary of Operation Phase Impacts without Mitigation

Table 6-22 Summary of Operation Phase Impacts without Mitigation

Key Ecological Receptor	Ecological Valuation (as per NRA, 2009b)	Impact Type	Impact Characterisation	Geographic Scale of Impact
Designated Sites (Lower River Shannon cSAC only; potential for impacts to any other European Site has been ruled out.)				
Refer to Natura Impact Statement (NIS) for full discussion of impacts to European sites These include habitat loss, habitat degradation due to the spread of invasive plant species and a reduction in air quality, disturbance to Qualifying Interest species during construction, reduction in water quality, and effects on the existing hydrological regime and floodplain connectivity along the River Feale.				

Key Ecological Receptor	Ecological Valuation (as per NRA, 2009b)	Impact Type	Impact Characterisation	Geographic Scale of Impact
In the absence of mitigation measures, some of these impact sources have the potential to result in significant effects on the Lower River Shannon cSAC.				
Habitats (Non-Designated Sites)				
Cashen River Estuary pNHA	National	Pollution risk	Near-certain, neutral impact	None
		Spread of Invasive plant species	Indirect, significant negative impact	Local to National or International
		Otter	see section below	
		Whooper swan	see section below	
Rare and protected plant species Triangular club-rush	County importance	Pollution risk	Near-certain, neutral impact	None
Eroding/upland Rivers (FW1) Drainage Ditches (FW4)	Local Importance (Higher Value)	Pollution risk	Probable, indirect, imperceptible negative to neutral impact	None
		Spread of Invasive plant species	Indirect, significant negative impact	Local to National or International
		Air quality	Probable, indirect, slight negative impact	None
Wet Grassland (GS4) Scrub (WS1) Hedgerows (WL1) Treelines (WL2)	Local Importance (Higher Value)	Air quality	Probable, indirect, slight negative impact	None/Local
Fauna				
Badger	Local Importance (Higher Value)	Severance/ Barrier effect	Near-certain, direct, slight negative impact reducing to neutral in the short-term	Local/ None
		Road Traffic Collisions	Probable, direct, long-term, significant negative impact	Local
		Light spill	Near-certain, neutral impact	None
Otter	International importance	Severance/ Barrier effect	Probable, direct, permanent, significant negative impact	Local
		Road Traffic Collisions	Probable, direct, long-term, significant negative impact	Local to County
		Light spill	Near-certain, neutral impact	None
		Pollution risk	Near-certain, neutral impact	None
Bat species	Local Importance	Bat roosts	Permanent, slight	(Unlikely)
	(Higher Value)		negative impact at one night root site	Local
		Habitat loss/Severance / Barrier effect	Probable, direct, slight negative impact	Local
		Road Traffic Collisions	Probable, direct, significant negative impact	Local
		Light spill	Probable, permanent, slight - moderate negative impact	Local
Other mammal species	Local Importance (Higher Value)	Road Traffic Collisions	Probable, direct, slight negative impact	Local
		Disturbance	Probable, temporary, moderate negative impact reducing to imperceptible over time	None/Local
Common Frog	Local Importance (Higher Value)	Habitat Creation	Probable, permanent, significant positive impact	Local
Invertebrate species (including Freshwater Pearl Mussel)	International Importance to Local Importance (Higher Value)	Pollution risk	Near-certain, neutral impact	None
Whooper swan	National Importance	Disturbance/ Displacement	Near-certain, neutral impact	None
		Road Traffic Collisions	Near-certain, neutral impact	None
Other wintering birds - Golden Plover, Snipe, Black-headed gull, Teal, Mallard	Local Importance (Higher Value)	Disturbance	near-certain, permanent, slight negative to imperceptible impact	Local
		Road Traffic Collisions	Near-certain, imperceptible impact	Local
Barn owl	National Importance	Road Traffic Collisions	probable, direct, long-term, significant negative impact	Local/County
		Disturbance (nest sites)	Near-certain, neutral impact	None
		Displacement (lighting)	Near-certain, indirect, permanent, slight negative impact	Local
Breeding birds (general)	National Importance to Local Importance (Higher Value)	Road Traffic Collisions	probable, significant negative impact at first; reducing to an imperceptible negative impact,	None/Local

Key Ecological Receptor	Ecological Valuation (as per NRA, 2009b)	Impact Type	Impact Characterisation	Geographic Scale of Impact
			over the short to medium-term	
		Disturbance/ Displacement	probable, indirect, permanent, moderate negative impact, in the immediate vicinity of the road edge; near-certain to reduce to an imperceptible and neutral impact with increasing distance from the road	Local
Fish species (Lamprey, Atlantic Salmon, Brown Trout, Eel)	International Importance to Local Importance (Higher Value)	Pollution risk	Near-certain, neutral impact or during extreme flood events probable, indirect, imperceptible negative impact.	None
		Severance/ Barrier effect	Near-certain, neutral impact	None

6.6 Proposed Mitigation and Avoidance Measures

6.6.1 Construction- Phase Mitigation

(a) Designated Sites

The mitigation measures as they relate to the protection of the Lower River Shannon cSAC during construction are detailed in the NIS (Appendix 6.4) and are described in summary below. No mitigation is required for any other European sites as there is no potential for impacts to arise on any other European sites.

Mitigation required to address potential construction impacts specific to the Lower River Shannon cSAC include:

- *Measures to Minimise Habitat Loss within the cSAC – the on the ground working area within the cSAC will be clearly delineated and fenced off at the outset of works and maintained for the duration of the construction programme to minimise the on the ground working area within the cSAC boundary. No works on the grond within the cSAC boundary will be undertaken outside of this clearly delineated zone. No Annex I or qualifying interest habitats exist within the delineated zone.*
- *Mitigation Measures to Reduce the Potential for Impacts to Water Quality in Receiving Watercourses - prior to commencement of construction, the contractor will implement a range of measures through a detailed Erosion and Sediment Control Plan (dESCP) based on the preliminary ESCP contained in Appendix 8.5 to ensure protection of the receiving water environment.*
- *Monitoring during Construction for Impacts to Water Quality in Receiving Watercourses – this will be carried out as outlined in the preliminary ESCP contained in Appendix 8.5. This monitoring programme will be required at the pre-construction and construction stage to monitor water quality up and downstream of the proposed crossing points (River Feale, WF0, WF1, WF4 and WF5) to confirm the baseline water quality conditions prior to the construction. The construction stage monitoring results will be compared with those results established in pre-construction monitoring to allow the contractor to demonstrate the success of the mitigation measures employed. In the event that monitoring indicates a reduction in water quality, works in the vicinity of the River Feale will cease, sampling will be immediately undertaken and an investigation of the potential cause will be undertaken by the contractor, see Appendix 8.5.*
- *Mitigation Measures to Control and Prevent the Spread of Invasive Plant Species - all invasive plant species will be permanently removed from the working area at the construction stage in accordance with the Guidelines on the Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads (National Roads Authority, 2010) ensuring that any established populations present within the boundary of the proposed development are not caused to spread in undertaking works. An Outline Invasive Species Management Plan has been prepared (see Appendix 6.8) and will be implemented sufficiently far in advance of the proposed construction works commencing so as to allow time to adequately control all invasive species populations within the zone of influence of the proposed development, having regard to the specific timing/seasonal constraints that apply in relation to each individual species. As species may spread, or their distribution change, between the habitat surveys carried out for this EIS and the commencement of construction works, the implementation of the Outline Invasive Species Management Plan will include a pre-construction re-survey within the CPO boundary. In accordance with the NRA guidance (NRA, 2010) this survey will include accurate 1:5,000 scale mapping for the precise location of invasive species. The pre-construction surveys will be undertaken by suitable experts with competence in identifying the species concerned.*

(i) Cashen River Estuary pNHA

Mitigation Measures to Reduce the Potential for Impacts to Water Quality in Receiving Watercourses

Prior to commencement of construction, the contractor will implement a range of measures through a detailed Erosion and sediment Control Plan (dESCP) based on the preliminary ESCP contained in Appendix 8.5 to ensure protection of the receiving water environment.

A water quality monitoring programme will be implemented by the contractor as detailed in the preliminary ESCP contained in Appendix 8.5.

These measures are based on the following best practice guidelines to ensure that water bodies are adequately protected during construction work:

- *Construction Industry Research and Information Association CIRIA C648: Control of water pollution from linear construction projects: Technical guidance (Murnane et al. 2006);*
- *CIRIA C648: Control of water pollution from linear construction projects: Site guide (Murnane et al. 2006);*
- *DMRB HD33/06: Surface and sub-surface drainage systems for highways. Design Manual for Roads and Bridges. Volume 4:2, (The Highways Agency, 2006);*
- *Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes (National Roads Authority, 2005a); and*
- *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (Inland Fisheries Ireland, 2016).

The construction contractor will implement the following mitigation measures, via the detailed Erosion and Sediment Control Plan, (see also the Preliminary Erosion and Sediment Control Plan in Appendix 8.5):

- *A temporary impervious barrier will be installed to ensure that all works associated with the bridge pier construction at the River Feale are protected against the 1:100 year return period flood event to ensure that there is no hydraulic connectivity between the temporary works and the River Feale during construction (see Appendix 6.4 NIS Figure 8: River Feale Temporary Works);*
- *Suite of measures to prevent the release of sediment over baseline conditions[24] to the River Feale, Galey River (or their tributaries) during the construction work. Baseline conditions will be established in accordance with details provided in Chapter 8 Hydrology, Geomorphology & Hydromorphology and more specifically the preliminary ESCP contained in Appendix 8.5. These measures will include but not be limited to silt fences, silt curtains, settlement lagoons, filter materials, and stockpile seeding;*
- *Suite of measures to minimise the release of sediment from the newly excavated attenuation and constructed wetland areas to the River Feale, Galey River (or their tributaries) These measures will include but not be limited to silt fences, silt curtains, settlement lagoons, filter materials, and stockpile seeding;*
- *Suite of measures to minimise the displacement and subsequent erosion and release of soft sediment during bridge and structure installation works. These measures will include but not be limited to silt fences, silt curtains, settlement lagoons, filter materials, and stockpile seeding;*
- *Suite of measures to handle, store and re-use where feasible material removed from the bank of the River Feale;*
- *Provision of exclusion zones and barriers (sediment fences) between earthworks, stockpiles and temporary surfaces and watercourses to prevent sediment washing into watercourses, or into drainage features that are connected to watercourses;*
- *Temporary construction of surface drainage and sediment control measures will be in place before earthworks commence;*
- *Pouring of cement based materials 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 discharges to watercourses, or to drainage features that are connected to watercourses. Mixer washings and excess concrete will not be discharged to any surface water or drainage features;*
- *No storage of hydrocarbons or any polluting chemicals will occur within 50 m of a 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 trained in the emergency procedures;*
- *Implementation of measures to minimise waste and ensure correct handling, storage and disposal of waste (most notably wet concrete, pile arisings and asphalt);*
- *Response measures for potential pollution incidents;*
- *Methods to stabilise watercourse banks that have been cleared of vegetation;*
- *Maintenance of machinery to be used in-stream; and*
- *Removal and replacement of stream bed material in diverted watercourses;*

[24] Baseline suspended sediment levels in the River Feale will be established as outlined in Chapter 8 Hydrology, Hydromorphology and Geomorphology.

Monitoring During Construction to Reduce the Potential for Impacts to Water Quality in Receiving Watercourses

The Local Authority shall employ an Environmental Assurance Officer (EAO) who will be based on-site for the duration of the construction works and will form part of the Employer's Site Representative Team. The EAO shall have suitable environmental qualifications. The Local Authority will ensure that the EAO is delegated sufficient powers under the construction contract so that he/ she will be able to instruct the contractor to stop works and to direct the carrying out of emergency mitigation/ clean-up operations. The EAO will also be responsible for consultation with environmental bodies including the NPWS and IFI. The EAO shall be responsible for carrying out regular Audits of the Contractor's EOP on behalf of the Local Authority

Full details of the monitoring programme to be carried out are outlined in Appendix 8.5 in the pESCP and these will be required at the pre-construction and construction stage.

Pre-construction water quality monitoring will be undertaken once a week for a 6 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 proposed crossing points (River Feale, WF0, WF1, WF4 and WF5) to confirm the baseline water quality conditions prior to the construction. For turbidity, pH, DO and temperature samples will be taken *in situ*, samples for TSS and hydrocarbons will be sent to an accredited laboratory for analysis.

Weekly during construction the contractor will monitor the levels of TSS, turbidity, pH, temperature, DO and hydrocarbons at locations to be agreed with Kerry County Council upstream and downstream 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 River Feale Bridge; and*
- *Construction works within and adjacent to watercourses including provision of culverts and watercourse realignments.*

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 addition, real-time telemetric monitoring will be used by the contractor to measure turbidity upstream and downstream of the River Feale Bridge. The turbidity level recorded downstream shall not exceed the upstream level by 10%. In the event of an exceedance, an investigation will be carried out to determine the cause and contact will be made with the Kerry Water Services and the Irish Water Environment Division immediately. These results will be compared by the contractor to the weekly turbidity results and reported to KCC.

In addition, daily visual inspections of the surface drainage and sediment control measures and the watercourses will be undertaken by the contractor and these inspections shall be recorded and reported to the EAO. 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.*

In the event that such indicators are observed in the River Feale and if the EAO directs 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.

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

- *Contact will be made with the Kerry Water Services and/ or Irish Water, the NPWS and IFI.*
- *Works capable of generating sediment into the watercourse shall be stopped immediately.*
- *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 be having on water quality so 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 values established. Further requirements in relation to monitoring are outlined in the pESCP contained in Appendix 8.5.

Mitigation Measures to Control and Prevent the Spread of Invasive Species

The mitigation strategy in relation to invasive plant species is based on the *Guidelines on the Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads* (National Roads Authority, 2010a) with the objectives of permanently removing all invasive plant species from the working area and preventing the spread of any established populations present with the boundary of the proposed development.

An Outline Invasive Species Management Plan has been prepared (see Appendix 6.8) and will be implemented sufficiently far in advance of the proposed construction works commencing so as to allow time to adequately control all invasive species populations within the zone of influence of the proposed development, having regard to the specific timing/seasonal constraints that apply in relation to each individual species. The Outline Invasive Species Management Plan will need to be revised and finalised by the appointed contractor once precise methods of control identified in the Outline Invasive Species Management Plan are determined. The final Invasive Species Management Plan assist the construction contractor in implementing the specific mitigation measures required in relation to individual invasive plant species.

As species may have spread, or their distribution may have changed, between the habitat surveys carried out for this EIS and the commencement of construction works, the implementation of the Outline Invasive Species Management Plan will include a pre-construction re-survey within the CPO boundary. In accordance with the NRA guidance (NRA, 2010) this survey will include accurate 1:5,000 scale mapping for the precise location of invasive species. The pre-construction surveys will be undertaken by suitable experts with competence in identifying the species concerned.

(b) Flora

The mitigation measures required to avoid any impacts on the FPO species triangular club-rush, located downstream of the proposed crossing point of the River Feale, relate to the protection of water quality in the River Feale during construction. These mitigation measures are detailed in Section 6.6.1 (a) above and in Chapter 8 Hydrology, Geomorphology & Hydromorphology.

(c) Habitats

Measures to Reduce the Potential for Impacts on Treelines, Hedgerows and Scrub to be retained

Any trees, hedgerows or scrub adjacent to, or within, the development boundary which are to be retained shall be afforded adequate protection during the construction phase in accordance with the *Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub Prior to, During and Post Construction of National Road Schemes* (National Roads Authority, 2006b), as follows:

- All trees along the proposed development boundary that are to be retained, both within and adjacent to the development boundary (where the root protection area of the tree extends into the proposed road development boundary), will be fenced off at the outset of works and for the duration of construction to avoid structural damage to the trunk, branches or root systems of the trees. Temporary fencing will be erected at a sufficient distance from the tree so as to enclose the root protection area (RPA) of the tree. In general the RPA covers an area equivalent to a circle with a radius 12 times the stem diameter (measured at 1.5 m above ground level for single stemmed trees, or above the root flare for multi-stemmed trees);
- Where fencing is not feasible due to insufficient space, protection for the tree/hedgerow will be afforded by wrapping hessian sacking (or equivalent) around the trunk of the tree and strapping stout buffer timbers around it.
- The area within the RPA will not be used for vehicle parking or the storage of materials (including soils, oils and chemicals). The storage of hazardous materials (e.g. hydrocarbons) or concrete washout areas will not be undertaken within 10 m of any retained trees, hedgerows and treelines;
- A qualified arborist shall assess the condition of, and advise on any repair works necessary to, any trees which are to be retained or that lie outside of the proposed development boundary but whose RPA is impacted by the works. Any remedial works required will be carried out by a qualified arborist;
- A buffer zone of at least 5 m will be maintained between construction works and retained hedgerows to ensure that the root protection areas are not damaged.

Mitigation Measures to Reduce the Potential for Impacts to Aquatic Habitats

The mitigation measures required to prevent indirect impacts to the aquatic environment are as detailed in Section 6.6.1 (a) above and in Chapter 8 Hydrology, Geomorphology & Hydromorphology.

Mitigation Measures to Control and Prevent the Spread of Invasive Species

The mitigation measures required to control and prevent the spread of invasive plant species are as described above in Section 6.6.1(a) above and detailed in the Outline Invasive Species Management Plan in Appendix 6.8.

(d) Fauna

(i) Protected Mammals – Badger and Otter

The mitigation measures described below follow the recommendations set out in the *Guidelines for the Treatment of Badgers during the Construction of National Road Schemes* (National Roads Authority, 2006c), the *Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes* (National Roads Authority, 2008b) and *Design Manual for Roads and Bridges: Volume 10: Environmental Design and Management. Section 4: Nature Conservation: Part 4, HA 81/99; Nature Conservation Advice in Relation to Otters* (Highways Agency, 2001b)

The hedgerow/treelines which contain badger setts S2, S3, S4, S4a and S22 are to be retained (see ecology mitigation figures 6.1.29 – 6.1.33) and as such, their permanent removal as a result of construction activities will not occur. The mitigation measures that apply in relation to each badger sett within the zone of influence of the proposed development are provided inTable 6-23 below.

Table 6-23 Mitigation Measures relating to Badger Setts within the zone of influence of the Proposed Development

Sett No.	Mitigation Measures
S2 S3 S4 S4a S15 S22	*Along CPO boundary* Non-interference zone of 30 m, extended to 50 m during the breeding season (December to June inclusive) if the sett is active, to be established using temporary fencing at the outset of works (accompanied by appropriate signage). The fencing shall be of a post and rail type (or equivalent) and of a sufficient durability to maintain the exclusion zone throughout the construction period. No heavy machinery shall be used within 30 m of Badger setts at any time. Lighter machinery (generally wheeled vehicles) shall not be used within 20 m of a sett entrance. No works shall be undertaken within 50 m of active setts during the breeding season. Neither blasting nor pile driving shall be undertaken within 150 m of active setts during the breeding season (December to June inclusive). A licence has been applied for from the NPWS to monitor the setts (see Appendix 6.7 for licence application), and to install the fence line and permit works within the distance bands described above. Works within the distance bands described above will only be carried out during daylight hours so as not to disturb foraging Badgers. If the sett requires exclusion (or temporary exclusion for the duration of the construction period) and removal this will be undertaken under license from the NPWS – see Appendix 6.7 – and in accordance with the methodology detailed in the *Guidelines for the Treatment of Badgers during the Construction of National Road Schemes* (National Roads Authority, 2006c). If the sett is active then it shall not be removed within the breeding season (December to June inclusive). Any works to close or excavate setts must be undertaken under licence from the NPWS

The mitigation measures that apply in relation to the potential otter holt site within the zone of influence of the proposed development are provided in Table 6-24 below.

The hedgerow/treeline which contains the potential otter holt is to be retained (see ecology mitigation figures 6.1.29 – 6.1.33) and as such, its permanent removal as a result of construction activities will not occur.

Table 6-24 Mitigation Measures relating to potential Otter holts within the zone of influence of the Proposed Development

Holt No.	Mitigation Measures
H4	*Along CPO boundary* Non-interference zone of 20 m, extended to 150 m if the holt/couch is in use by a breeding female or where cubs are present, to be established using temporary fencing at the outset of works (accompanied by appropriate signage). The fencing shall be of a post and rail type (or equivalent) and of a sufficient durability to maintain the exclusion zone throughout the construction period. A derogation licence has been applied for from the NPWS to monitor the potential holt sites, and to install the fence line and permit works within the distance bands described above (refer to Appendix 6.7). Works within the distance bands described above will only be carried out during daylight hours so as not to disturb foraging otters. A period of monitoring (of at least five days) will be required in order to determine the status of the potential holt. In the event that a holt will be directly affected and require removal, the following procedure will apply. If inactive, the holt can be hard blocked for the duration of the construction works, or removed immediately. If active, otter may be deterred from using the area during construction and if the holt is abandoned (following a period of monitoring as above) the procedure described above for inactive holts can be followed. If breeding otter or cubs present then no exclusion procedures can be undertaken until the holt has been abandoned. All works will be undertaken in accordance with the methodology detailed in the *Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes* (National Roads Authority, 2008b) and the *Design Manual for Roads and Bridges: Volume 10: Environmental Design and Management. Section 4: Nature Conservation: Part 4, HA 81/99; Nature Conservation Advice in Relation to Otters* (Highways Agency, 2001b) and any works to close or excavate holts must be undertaken under derogation licence from the NPWS.

(ii) Bats

Measures to Avoid Impacts on Trees with Bat Roosting Potential

The following mitigation measures are proposed in relation to those trees identified as having the potential to support roosting bats:

Trees with Features of High to Moderate Suitability for Roosting Bats:

Only one tree impacted by the proposed development is considered to have high or moderate suitability for roosting bats, with obvious potential roosting features present. Bats could occupy suitable roosting features at any time prior to the commencement of works. Therefore there is an inherent risk that bats could be affected by the proposed works.

Tree felling will be undertaken during the period May to September as during this period bats are capable of flight and can avoid the risks of tree felling if proper measures are undertaken. If trees are to be felled during this period a dawn and dusk detector survey will be carried out on the night immediately preceding the felling operation to ensure that there are no bats present. If there is any indication that there is a maternity roost present, then the trees will not be felled from June through to mid-August to ensure that breeding populations of bats are protected.

Such trees will be felled using heavy plant to push over the tree. In order to ensure the optimum warning for any roosting bats that may still be present, the tree will be pushed lightly two to three times, with a pause of approximately 30 seconds between each nudge to allow bats to become active. The tree will then be pushed to the ground slowly and will remain in place until it is inspected by a bat specialist.

If the tree is to be felled by chainsaw, it is important to ensure that the rate of fall is not accelerated by the use of a chain and vehicle (e.g. tractor). It is unlikely that a bat would survive such a heavy impact. Where possible the tree shall be felled in sections with a bat specialist present to check the tree sections on the ground for bats prior to removal or mulching.

Trees with Features of Low Suitability for Roosting Bats:
These trees are considered to have some features present, which may have limited potential to support roosting bats. These trees will be control felled using heavy plant to push over the tree. Where this is not possible and trees must be felled with a chainsaw, it is important to ensure that the rate of fall is not accelerated by the use of a chain and vehicle (e.g. tractor), as it is unlikely that a bat would survive such a heavy impact. Once these trees are on the ground, they will be left *in-situ* for a period of at least 24 hours to allow any bats that may be present to escape.

Where remedial works (*e.g.* pruning of limbs) is to be undertaken to trees considered suitable for roosting bats, the affected sections of the tree will be checked by a bat specialist for potential roost features before removal. For limbs high in the tree canopy, this will necessitate the lowering of the limb to the ground (with the potential roost feature intact) for inspection by the bat specialist before it is cut up or mulched. If bats are found to be present, they will be removed by a bat specialist licenced to handle bats and released in the area the next night.

If a bat roost is confirmed, and will be removed by the proposed works, then appropriate alternative roosting sites will be provided in the form of bat boxes erected on suitable trees in the vicinity. The type and siting of any bat boxes required will be determined by the bat specialist at that time.

Removal of any confirmed bat roosts must be undertaken under derogation licence from the NPWS.

(iii) Other Mammal Species

Implementation of mitigation for breeding birds (see Section 6.6.1 (d) vii below) will avoid vegetation removal during March-August inclusive. This mitigation will simultaneously avoid the majority of the main breeding season for most small mammal species (Hayden & Harrington, 2001).

(iv) Amphibians

Measures to Reduce the Potential for Impacts to Common frog
If works to clear the drainage ditches are to begin during the season where frogspawn/tadpoles may be present (February – July) a pre-construction survey will be undertaken to determine whether breeding amphibians are present. If found to be present, the species will be removed by hand net and translocated to the nearest available habitat that is suitable, under licence from the NPWS. There is an abundance of suitable receptor habitat in the immediate locality in the form of field boundary drainage ditches and the bog complex which lies *c.* 600m to the north-west. This will be monitored and reported to the NPWS.

Mitigation measures to protect water quality in receiving surface water drainage features during construction are detailed in Section 6.6.1 above and in Chapter 8 Hydrology, Geomorphology & Hydromorphology.

(v) Invertebrates

Measures to Reduce the Potential for Impacts to the Freshwater Pearl Mussel
As a host for the juvenile stage of the freshwater pearl mussel's lifecycle, impacts to salmonid fish species through a reduction in water quality in the River Feale and Galey River catchments are the only likely indirect impact pathways by which the proposed development could have any impact on freshwater pearl mussel populations within the those catchments. Mitigation measures to protect water quality during construction are detailed in Section 6.6.1 (a) above and in Chapter 8 Hydrology, Geomorphology & Hydromorphology.

(vi) Wintering Birds

As no significant impacts to wintering birds are predicted as a result of the construction of the proposed development, no mitigation measures are required.

(vii) Breeding Birds

Measures to Reduce the Potential for Impacts on Breeding Birds
Vegetation (*e.g.* hedgerows, trees, scrub and grassland) will not be removed, between the 1st March and the 31st August, to avoid impacts on nesting birds. Although the *Wildlife Acts* provide an exemption from this seasonal restriction to vegetation removal for approved road construction, there is no exemption provided for the destruction of nest sites. Where the construction programme does not allow this seasonal restriction to be observed, then these areas will be inspected by a suitably qualified ecologist for the presence of breeding birds prior to clearance. Where nests are present, a licence may be required for removal of vegetation containing these nests. Areas found not to contain nests must be cleared within 3 days of the survey, otherwise repeat surveys will be required.

With regards to sand martins, which were observed nesting within the vicinity of the proposed crossing of the River Feale at Finuge, it is proposed that substantive works commence at the river between 1st October and 28th February. Where this seasonal restriction cannot be adhered to (*e.g.* due to elevated water levels), it is proposed that a licence application will be submitted to the NPWS to permit the temporary obstruction of the sand martin nests and the remaining area of suitable nesting habitat along the bank of the River Feale. The temporary obstruction of the nests and suitable habitat would commence outside of the bird breeding season to avoid directly impacing on breeding birds.

(viii) Fish

Measures to Reduce the Potential for Impacts on Fish Species
The following measures will be implemented to mitigate the potential for impacts to fish species:

- maintaining water quality in the surface water network;
- maintaining fish passage at the proposed crossing points of watercourses (with regard to the design of both temporary installations and permanent structures);and

- maintaining or in the case of realigned sections of stream/river channel, reinstating, the existing profile and character of the river channel at each of the proposed crossing points (substrate, gradient, riparian vegetation *etc*.)

All works will be carried out in accordance with the requirements of IFI as set out in *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (Inland Fisheries Ireland, 2016).

Instream works will only be carried out during the period July to September (inclusive). Any instream works outside of this period must be agreed in writing with IFI.

The realignments proposed for the Mill Stream Lower (200 m section) and the Ballygrenane Stream (45 m section) will be designed in accordance with the requirements of IFI.

Mitigation measures to protect water quality during construction are detailed in Section 6.6.1 (a) above and in Chapter 8 Hydrology, Geomorphology & Hydromorphology and more specifically the preliminary ESCP contained in Appendix 8.5.

(e) Summary of Construction Phase Mitigation

Table 6-25 Summary of Construction Phase Mitigation

Key Ecological Receptor	Ecological Valuation (as per NRA, 2009b)	Construction Impact Type	Geographic Scale of Impact	Construction Phase Mitigation Measure
Designated Sites (Lower River Shannon cSAC only; potential for impacts to any other European Site has been ruled out.)				
Refer to section 6.6.1(a) for summary of mitigation measures relating to impacts to the Lower River Shannon cSAC and to Appendix 6.4 Natura Impact Statement (NIS) for full details.				
Habitats (Non-Designated Sites)				
Cashen River Estuary pNHA	National	Pollution risk	Local	Detailed measures to protect water quality in receiving watercourses – see Section 6.6.1 (a) and Chapter 8 Hydrology, Geomorphology & Hydromorphology and more specifically the preliminary ESCP contained in Appendix 8.5.
		Spread of Invasive plant species	Local	Implementation of Invasive Species management Plan
		Otter	Local	See below
		Whooper swan	Local	See below
Rare and protected plant species Triangular club-rush	County importance	Pollution risk	Local	Detailed measures to protect water quality in receiving watercourses – see Section 6.6.1 (a) and Chapter 8 Hydrology, Geomorphology & Hydromorphology and more specifically the preliminary ESCP contained in Appendix 8.5.
Eroding/upland Rivers (FW1) Drainage Ditches (FW4)	Local Importance (Higher Value)	Habitat loss	Local	Measures to protect all vegetation to be retained both within and outside of the proposed development boundary
		Pollution risk	Local	Detailed measures to protect water quality in receiving watercourses – see Section 6.6.1 (a) and Chapter 8 Hydrology, Geomorphology & Hydromorphology and more specifically the preliminary ESCP contained in Appendix 8.5.
		Spread of Invasive plant species	Local	Implementation of Invasive Species Management Plan
Wet Grassland (GS4) Scrub (WS1) Hedgerows (WL1) Treelines (WL2)	Local Importance (Higher Value)	Habitat loss	Local	Landscape planting Measures to protect all vegetation to be retained both within and outside of the proposed development boundary
Fauna				
Badger	Local Importance (Higher Value)	Habitat loss	Local	Sett exclusions/removals to be undertaken in accordance with the restrictions and working methods set out in National Roads Authority, 2006c and under licence from NPWS as necessary.
		Disturbance	Local	Non-interference zones to prevent disturbance to setts not directly affected by the proposed development
		Severance	Local	None
Otter	International importance	Disturbance to holts/couch sites	Local	Non-interference zones to prevent disturbance to setts not directly affected by the proposed development. Any exclusions/removals to be done under derogation licence from NPWS as necessary.
		Habitat loss/Severance	Local	None
		Disturbance (general)	Local	Non-interference zones to prevent disturbance to setts not directly affected by the proposed development
		Pollution risk	Local	Detailed measures to protect water quality in receiving watercourses –

Key Ecological Receptor	Ecological Valuation (as per NRA, 2009b)	Construction Impact Type	Geographic Scale of Impact	Construction Phase Mitigation Measure
				see Section 6.6.1 (a) and Chapter 8 Hydrology, Geomorphology & Hydromorphology and more specifically the preliminary ESCP contained in Appendix 8.5.
Bat species	Local Importance (Higher Value)	Disturbance to bat roosts (buildings)	Local	None
		Loss of potential bat roosts (trees)	Local	Specific tree felling methodologies proposed for trees with potential bat roosting features. Any removals of any confirmed bat roosts to be done under derogation licence from NPWS as necessary.
		Disturbance	Local	None
		Habitat loss	Local	Landscape planting (Figures 6.1.29-6.1.33 in Volume 3)
Other mammal species	Local Importance (Higher Value)	Disturbance/ Habitat loss	Local	None
Common Frog	Local Importance (Higher Value)	Disturbance/ Habitat loss	Local	Translocation of affected populations required where habitat is impacted, under licence from NPWS. Attenuation ponds/constructed wetlands to provide additional habitat
		Pollution risk	Local	Detailed measures to protect water quality in receiving watercourses – see Section 6.6.1 (a) and Chapter 8 Hydrology, Geomorphology & Hydromorphology and more specifically the preliminary ESCP contained in Appendix 8.5.
Freshwater pearl mussel	International Importance	Pollution risk	Neutral	Detailed measures to protect water quality in receiving watercourses – see Section 6.6.1 (a) and Chapter 8 Hydrology, Geomorphology & Hydromorphology and more specifically the preliminary ESCP contained in Appendix 8.5.
Other invertebrate species	Local Importance (Higher Value)	Habitat loss	Local	None
		Pollution risk	Local	Detailed measures to protect water quality in receiving watercourses – see Section 6.6.1 (a) and Chapter 8 Hydrology, Geomorphology & Hydromorphology and more specifically the preliminary ESCP contained in Appendix 8.5.
Whooper swan	National Importance	Disturbance from general construction activities	Local	None
		Disturbance from pile driving	Local	None
		Collision risk	Neutral	None
Other wintering birds - Golden Plover, Snipe, Black-headed gull, Teal, Mallard	Local Importance (Higher Value)	Disturbance	Local	None
Barn owl	National Importance	Disturbance	Local	None
		Habitat loss	Local	Landscape planting
Meadow pipit	Local Importance (Higher Value)	Habitat loss/ Disturbance	Local	Landscape planting
Breeding birds – Amber listed birds throughout	Local Importance (Higher Value)	Habitat loss	Local	Landscape planting
		Disturbance	Local	None
Breeding birds – Green listed birds throughout	Local Importance (Higher Value)	Habitat loss	Local	Landscape planting
		Disturbance	Local	None
Atlantic Salmon Brown trout	International Importance National Importance	Habitat loss	Local	Stream realignments will be designed in accordance with the requirements of IFI
		Disturbance	Local	Seasonal working restriction to May to September.
		Barrier effect	Local	Structures designed in accordance with the requirements of IFI to allow passage.
		Pollution risk	Local	Detailed measures to protect water quality in receiving watercourses – see Section 6.6.1 (a) and Chapter 8 Hydrology, Geomorphology & Hydromorphology and more specifically the preliminary ESCP contained in Appendix 8.5.
Lamprey species	International Importance	Habitat loss	Local	Stream realignments will be designed in accordance with the requirements of IFI
		Disturbance	Local	None
		Barrier effect	Local	Structures designed in accordance with the

Key Ecological Receptor	Ecological Valuation (as per NRA, 2009b)	Construction Impact Type	Geographic Scale of Impact	Construction Phase Mitigation Measure
				requirements of IFI to allow passage.
		Pollution risk	Local	Detailed measures to protect water quality in receiving watercourses – see Section 6.6.1 (a) and Chapter 8 Hydrology, Geomorphology & Hydromorphology and more specifically the preliminary ESCP contained in Appendix 8.5.
European eel	Local Importance (Higher Value)	Habitat loss	Local	Stream realignments will be designed in accordance with the requirements of IFI
		Disturbance	Local	None
		Barrier effect	Local	Structures designed in accordance with the requirements of IFI to allow passage.
		Pollution risk	Local	Detailed measures to protect water quality in receiving watercourses – see Section 6.6.1 (a) and Chapter 8 Hydrology, Geomorphology & Hydromorphology and more specifically the preliminary ESCP contained in Appendix 8.5.

6.6.2 Operation- Phase Mitigation

(a) Designated Sites

The mitigation measures as they relate to the protection of the Lower River Shannon cSAC during operation are detailed in the NIS (Appendix 6.4) and are described in summary below. No mitigation is required for any other European sites as there is no potential for impacts to arise on any other European sites.

The mitigation required to address potential operation impacts specific to the Lower River Shannon cSAC include:

- *Mitigation Measures to Reduce the Potential for Impacts to Water Quality in Receiving Watercourses - potential impacts to water quality have been addressed by 'Mitigation by Design' using a three stage drainage system of an oil/petrol interceptor, attenuation pond, and constructed wetland to treat carriageway runoff at all outfall locations (as detailed in Chapter 8, Hydrology, Geomorphology & Hydromorphology). No further mitigation is proposed.*
- *Measures to Avoid the Spread of Invasive Plant Species - if invasive species are found to be present within the scheme's landtake area, vegetation in the affected area shall be treated in-situ to remove the plant species. If maintenance must be carried out before the invasive species is eradicated, then contaminated material will be dealt with in accordance with the handling and disposal measures described in the Guidelines on the Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads (National Roads Authority, 2010a) or, in the case of species not covered under this guidance, the accepted published best practice methods available at the time.*
- *Measures to Protect Otter - to avoid otter road casualties, otter passage facilities (within structures raised ledges with minimum of clearance of 150mm over high water mark or separate dry 600mm pipes) will be provided at watercourses used by otter. Underpasses will be constructed in accordance with the Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes (National Roads Authority, 2008) and the Design Manual for Roads and Bridges: Volume 10: Environmental Design and Management. Section 4: Nature Conservation: Part 4, HA 81/99; Nature Conservation Advice in Relation to Otters (Highways Agency, 2001b). The locations where Otter passage facilities will be provided are shown on the ecology mitigation measures drawings (Figures 6.29-6.33: Ecology Mitigation Measures). Otter-resistant fencing will be required to guide Otters to the underpasses and will be installed in accordance with the specification outlined in the NRA guidance (National Roads Authority, 2008) and at the request of the NPWS will include the 45-degree overhang specified by the UK Highways Agency, (2001a). In accordance with the recommendations described in the Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes (National Roads Authority, 2008), quarterly monitoring of the effectiveness of the mitigation measures will be undertaken in the first year after the completion of construction works.*
- *Mitigation Measures to Minimise the Effects of Flow Restriction across the Floodplain during Extreme Flood Events (1% plus climate change) - flood relief culverts have been included in the road embankments leading up to the proposed new River Feale Bridge to minimise the obstruction to floodplain flow and water levels in localised areas (NIS Figures 4.1-4.5: Overall Scheme Plan).*
- *The mitigation measures required to avoid any impacts on the freshwater pearl mussel populations in the River Feale and Galey River catchments, relate to the protection of water quality in receiving watercourses. Potential impacts to water quality have been addressed by 'Mitigation by Design' using a three stage drainage system of an oil/petrol interceptor, attenuation pond, and constructed wetland to treat carriageway runoff at all outfall locations (as described in Chapter 8, Hydrology, Geomorphology & Hydromorphology). No further mitigation is proposed.*

Wintering Birds - As no significant impact to wintering birds are predicted as a result of the operation of the proposed development, no mitigation measures are required.

(i) Cashen River Estuary pNHA

Mitigation Measures to Reduce the Potential for Impacts to Water Quality in Receiving Watercourses

Potential impacts to water quality have been addressed by 'Mitigation by Design' using a three stage drainage system of an oil/petrol interceptor, attenuation pond, and constructed wetland to treat carriageway runoff at all outfall locations (as detailed in Chapter 8, Hydrology, Geomorphology & Hydromorphology). No further mitigation is proposed.

(b) Flora

The mitigation measures required to avoid any impacts on the FPO species triangular club-rush, located downstream of the proposed crossing point of the River Feale, relate to the protection of water quality in the River Feale during operation. Potential impacts to

water quality have been addressed by 'Mitigation by Design' using a three stage drainage system of an oil/petrol interceptor, attenuation pond, and constructed wetland to treat carriageway runoff at all outfall locations (as described in Chapter 8, Hydrology, Geomorphology & Hydromorphology). No further mitigation is proposed.

(c) Habitats

Mitigation Measures to Reduce the Potential for Impacts to Water Quality in Receiving Watercourses

Potential impacts to water quality have been addressed by 'Mitigation by Design' using a three stage drainage system of an oil/petrol interceptor, attenuation pond, and constructed wetland to treat carriageway runoff at all outfall locations (as detailed in Chapter 8, Hydrology, Geomorphology & Hydromorphology). No further mitigation is proposed.

Measures to Avoid the Spread of Invasive Plant Species

Given the abundance of invasive plant species cover in the vicinity of the proposed development, there is a probability that these species will recolonise the vegetated areas within the CPO fence line post-construction (particularly Japanese knotweed along the River Feale corridor and along the disused rail line embankments). As such, there is a risk that routine maintenance works may inadvertently spread contaminated vegetation cuttings.

If found to be present vegetation in the affected area shall be treated *in-situ* to remove the plant species, using stem-injection techniques where adjacent to watercourses to avoid contamination of watercourses. If maintenance must be carried out before the invasive species is eradicated, then contaminated material will be dealt with in accordance with the handling and disposal measures described in the *Guidelines on the Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads* (National Roads Authority, 2010a) or, in the case of species not covered under this guidance, the accepted published best practice methods available at the time. The full control measures are detailed in the Outline Invasive Species Management Plan in Appendix 6.8.

(d) Fauna

(i) Protected Mammals – Badger and Otter

Measures to Protect Badger

Badgers typically follow the same pathways between setts, feeding areas and latrines. To avoid badger road casualties mammal underpasses will be provided at strategic locations along the alignment of the proposed development, see Table 6-26. Underpasses will be constructed in accordance with the *Guidelines for the Treatment of Badgers during the Construction of National Road Schemes* (National Roads Authority, 2006c). Where engineering constraints conflict with the recommended locations, underpasses can be moved to the nearest most suitable location, but not more than *c.*250 m away. The locations where badger passage facilities will be provided are listed below in Table 6-26 and are shown on Figures 6.1.29-6.1.32 in Volume 3.

Table 6-26 Locations of Mammal Passage Facilities along the Proposed Development

Ref. No.	Structure Ref. No.	Species and Description
MU1	Accommodation Track 1	Badger Farm access track will allow for badgers to pass underneath the road
MU2	Proposed Structure ST13	Badger and otter Raised mammal ledge incorporated into structure or a dedicated 600 mm concrete pipe on the south bank of the stream, sited a minimum of 150mm above the high water mark
MU3	Proposed new River Feale Bridge	Badger and otter Clear span bridge will provide bankside mammal passage along the southern river bank
MU4	Proposed new River Feale Bridge	Badger and otter Clear span bridge will provide bankside mammal passage along the northern river bank
MU5	Proposed Structure ST18	Badger Farm access track will allow for Badgers to pass underneath the road
MU6	Proposed Structure ST24	Badger Farm access track will allow for Badgers to pass underneath the road
MU7	Proposed Structure ST27	Badger and otter Raised mammal ledge incorporated into structure or a dedicated 600 mm concrete pipe on the south bank of the stream, sited 150mm above flood water levels
MU8	Proposed Structure ST33A	Badger Raised mammal ledge incorporated into structure or a dedicated 600 mm concrete pipe on the west bank of the drain, sited 150mm above flood water levels
MU9	Proposed Structure ST39	Badger and otter Raised mammal ledge incorporated into structure or a dedicated 600 mm concrete pipe on the east bank of the drain, sited 150mm above flood water levels

Mammal-resistant fencing will be required to guide badgers to the underpasses and will be installed in accordance with the specification outlined in the guidance listed in Section 6.2.1 (a)(ii) and will include badger proofing of emergency access roads and other similar access points, where located along areas where badger fencing is to be installed. The locations where mammal-resistant fencing is to be installed are shown on Figures 6.1.29-6.1.33 in Volume 3.

In accordance with the recommendations described in the *Guidelines for the Treatment of Badgers during the Construction of National Road Schemes* (National Roads Authority, 2005), quarterly monitoring of the effectiveness of the mitigation measures will be undertaken in the first year after the completion of construction works.

Measures to Protect Otter

Otters use many of the watercourses crossed by the road development. To avoid otter road casualties, otter passage facilities (within strucutres raised ledges with a minimum clearance of 150mm above high water mark, or separate dry 600 mm pipes) will be provided at watercourses used by otter. Underpasses will be constructed in accordance with the *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes* (National Roads Authority, 2008b). The locations where otter passage facilities

will be provided are listed above in Table 6-26 and are shown on Figures 6.1.29-6.1.33 in Volume 3.

Otter-resistant fencing will be required to guide otters to the underpasses and will be installed in accordance with the specification outlined in *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes* (National Roads Authority, 2008b) and at the request of the NPWS will include the 45-degree overhang specified by the UK Highways Agency, (2001a).

In accordance with the recommendations described in the *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes* (National Roads Authority, 2008b), quarterly monitoring of the effectiveness of the mitigation measures will be undertaken in the first year after the completion of construction works. Further recommendations may be required pending the findings of these monitoring surveys.

(ii) Bats

Measures to Reduce the Impact of Habitat Loss on Bats

Where important commuting or foraging landscape features are being removed, planting using native species will be used to replace the vegetation cover lost and to reconnect those landscape features severed by the proposed development that are used by bats.

Planting of native shrubs around the attenuation ponds and constructed wetlands will serve to make these new habitat areas more attractive to feeding bats, providing alternative feeding sites to those being lost as a result of site clearance. Where the ponds and wetland areas are at grade with the proposed road surface, a screen of vegetation will be planted to minimise the displacement effects of traffic headlights (having regard to health and safety requirements such as sightlines on bends).

To reduce the risk of mortality from collisions with road traffic planting of native tree and shrub species will be used to guide bats to safe crossing points along the proposed development. These will take the form of proposed structures or hop-overs (a line of planted trees and shrub, of at least 3 m height and with gaps of no greater than 30 cm between foliage, to force bats up and over the road where commuting routes are severed by the proposed development).

Areas where replacement or supplementary planting is required for bats is detailed on Figures 6.1.29-6.1.33 in Volume 3 and are shown on the landscape drawings (Figures 11.1.5 to 11.1.7).

Measures to Reduce the Effects of Lighting on Bats

Artificial light can create a barrier to commuting bats and can displace bats from important feeding areas. As such, lighting will be kept to a minimum along the proposed development, designed to meet the lowest light levels permitted under health and safety standards, and confined to areas where it is required for health and safety reasons.

The proposed new River Feale Bridge and the surrounding river corridor will not be lit.

Where lighting is required, directional lighting (using accessories such as cowls, louvres and shields) shall be used to focus light onto areas where it is needed and minimise the amount of light spill into habitats adjacent to the finished road surface.

In areas where a lighting impact is likely (Proposed Roundabout 1 and Proposed Roundabout 2) landscape planting will serve to replace the vegetation being lost and reduce the effects of any light spill.

(iii) Other Mammal Species

The proposed accommodation tracks and the mammal passage facilities described in Section 6.6.2 (d) (i) above, and for small mammal species (e.g. rodents) the proposed flood relief culverts, will serve to facilitate passage for all other small mammals along the length of the proposed development and maintain connectivity between severed habitats.

(iv) Amphibians

The mitigation measures required to avoid any impacts on amphibian species located downstream of the proposed watercourse and drainage ditch crossing points, relate to the protection of water quality in receiving watercourses. Potential impacts to water quality have been addressed by ‘Mitigation by Design’ using a three stage drainage system of an oil/petrol interceptor, attenuation pond, and constructed wetland to treat carriageway runoff at all outfall locations (as described in Chapter 8, Hydrology, Geomorphology & Hydromorphology). No further mitigation is proposed.

(v) Invertebrates

The mitigation measures required to avoid any impacts on the freshwater pearl mussel population in the River Feale and Galey River catchments, relate to the protection of water quality in receiving watercourses. Potential impacts to water quality have been addressed by ‘Mitigation by Design’ using a three stage drainage system of an oil/petrol interceptor, attenuation pond, and constructed wetland to treat carriageway runoff at all outfall locations (as described in Chapter 8, Hydrology, Geomorphology & Hydromorphology). No further mitigation is proposed.

(vi) Wintering Birds

As no significant impacts to wintering birds are predicted as a result of the operation of the proposed development, no mitigation measures are required.

(vii) Breeding Birds

Measures to Reduce the Potential Impact of Disturbance

Planting of woodland, hedgerow and grassland habitats along the proposed development as detailed in the landscape drawings (Figure 11.1.5 to 11.1.7) will provide compensatory habitat for some bird species, but many species may not nest within the vicinity of a road development due to drowning out of bird song by traffic noise. A total of 20 nest boxes will be erected by an ecologist in suitable locations away from the busy junctions/roadways. A total of 20 nest boxes will be erected by an ecologist on trees away from the busy junctions/roadways. The siting and type of nest boxes will be decided on by an ecologist at locations where trees will be planted along the proposed development; as shown on the Landscape and Visual Assessment drawings, See figure 11.1.6-11.1.9.

Measures to Reduce the Risk of Barn Owl Mortality from Road Traffic

Specific mitigation measures for barn owls have not been regularly implemented in motorway/dual carriageway schemes in Europe, and there is also a subsequent lack of comprehensive evidence on the effectiveness of suggested measures. Measures to reduce the risk of barn owl mortality from road traffic here focus on deflecting flight paths of barn owls, and discouraging barn owls from coming into contact with roads or from hunting along road verges. Following implementation of these measures, a schedule of monitoring is proposed for a period of two years to assess mortality along the proposed route, and breeding success of barn owl within the 5km of the proposed development.

In areas where there is a high probability that barn owls will regularly attempt to cross the proposed development , lines of closely spaced (approximately 2 m centres) trees, greater than 3 m in height, will be planted along the top of the road embankments; outside of the safety barrier and clear zone as shown on Figures 6.1.28 – 6.1.33 (and refer to typical cross-section sketches in Appendix 9.10). The intention of this mitigation measure is to deflect the flight path of barn owls above the height of traffic.

Sections along the proposed development where the road is on embankment, will be planted with dense low growing scrub cover (*e.g.* native species such as hawthorn, blackthorn, gorse etc.), while grass verges will be maintained short through an intensive mowing regime. Both of these measures are proposed to discourage barn owls from foraging near the road.

All mitigatory planting will be in place at the earliest feasible stage during construction to ensure that the mitigation is implemented before opening of the road.

The locations where planting will be used to reduce the risk of barn owl mortality from road traffic are shown on Figures 6.1.29-6.1.33 in Volume 3 and on the landscape drawings (Figures11.1.5 to 11.1.7). Refer to typical cross-section sketches in Appendix 6.10.

Following implementation of all mitigation measures and completion of construction of the proposed development, the following monitoring measures are proposed:

- Surveys will be undertaken of roadside planting schemes at the end of years one and two with the objective of identifying and replacing failed plantings.
- A road casualty survey to record barn owl mortalities along the proposed route will be conducted once per week for a period of two years by a suitably qualified and experienced ornithologist. The bypass route will be driven at a steady pace in both directions so that all sections and both sides of the route will be covered. Where noted, all barn owl mortalities will be assigned to either the “breeding” season (March to July) or “non-breeding” season (August to January). Location details of the casualty will be recorded, including a 10-digit GPS co-ordinate, position on the route (central median, hard shoulder, or verge) and orientation (southbound, northbound, eastbound, and westbound). The age class of the bird will be determined and classed as either “pre-breeding” if first or second calendar year recovered before March, or “adult” if the bird is second calendar year recovered later than March or older. The adjacent habitat feature will be noted. This methodology is in line with that utilised for *Barn Owl population status and the extent of road mortalities in relation to the Tralee Bypass* (O’Clery *et al.,* 2016);
- Monitoring to determine activity and breeding status of all active sites within 5km of the proposed development over two breeding seasons (March to July). This will be carried out concurrently with the road casualty survey, and will involve visits to known and potential nesting sites to determine brood size and breeding success. Where accessible, nests will be visited in order to ring owlets (subject to an appropriate licence from the NPWS).

A report summarising the findings of the above monitoring will be submitted at the end of year two to the the NPWS. The report may include further recommendations pending survey outcomes.

(e) Summary of Operation Phase Mitigation

Table 6-27 Summary of Operation Phase Mitigation

Key Ecological Receptor	Ecological Valuation (as per NRA, 2009b)	Operation Impact Type	Geographic Scale of Impact	Operation Phase Mitigation Measure
Designated Sites (Lower River Shannon cSAC only; potential for impacts to any other European Site has been ruled out.)				
Refer to section 6.6.2(a) for summary of mitigation measures relating to impacts to the Lower River Shannon cSAC and to Appendix 6.4 Natura Impact Statement (NIS) for full details.				
Cashen River Estuary pNHA	National	Pollution risk	None	‘Mitigation by Design’ water treatment system using three stage system of petrol interceptor, attenuation pond and constructed wetland. See also Chapter 8 Hydrology, Geomorphology & Hydromorphology
		Spread of Invasive plant species	Local to National or International	Implementation of Invasive Species management Plans
		Otter	see section below	
Rare and protected plant species Triangular club-rush	County importance	Pollution risk	None	‘Mitigation by Design’ water treatment system using three stage system of petrol interceptor, attenuation pond and constructed wetland. See also Chapter 8 Hydrology, Geomorphology & Hydromorphology
Eroding/upland Rivers (FW1) Drainage Ditches (FW4)	Local Importance (Higher Value)	Pollution risk	None	‘Mitigation by Design’ water treatment system using three stage system of petrol interceptor, attenuation pond and constructed wetland. See also Chapter 8 Hydrology, Geomorphology & Hydromorphology
		Spread of Invasive plant species	Local to National or International	Implementation of Invasive Species management Plans
		Air quality	None	None
Wet Grassland (GS4) Scrub (WS1) Hedgerows (WL1) Treelines (WL2)	Local Importance (Higher Value)	Air quality	None	None
Fauna				
Badger	Local Importance (Higher Value)	Severance/ Barrier effect	None/Local	Mammal underpass facilities (Figures 6.1.29-6.1.33 in Volume 3)
		Road Traffic Collisions	Local	Mammal fencing tied into proposed mammal underpasses
		Light spill	None	No
Otter	International importance	Severance/ Barrier effect	Local	Mammal underpass facilities (Figures 6.1.29-6.1.33 in

Key Ecological Receptor	Ecological Valuation (as per NRA, 2009b)	Operation Impact Type	Geographic Scale of Impact	Operation Phase Mitigation Measure
				Volume 3)
		Road Traffic Collisions	Local to County	Otter fencing tied into proposed mammal underpasses
		Light spill	None	Landscape planting to shield watercourses from lighting
		Pollution risk	None	'Mitigation by Design' water treatment system using three stage system of petrol interceptor, attenuation pond and constructed wetland. See also Chapter 8 Hydrology, Geomorphology & Hydromorphology
Bat species	Local Importance (Higher Value)	Bat roosts	(Unlikely) Local	None
		Habitat loss/ Severance/ Barrier effect	Local	Landscape planting, including "hop-overs" (Figures 6.1.29-6.1.33 in Volume 3)
		Road Traffic Collisions	Local	Landscape planting, including "hop-overs" (Figures 6.1.29-6.1.33 in Volume 3)
		Light spill	Local	Landscape planting to shield bat habitat from lighting
Other mammal species	Local Importance (Higher Value)	Road Traffic Collisions	Local	Mammal fencing tied into proposed mammal underpasses
		Disturbance	None/Local	None
Common Frog	Local Importance (Higher Value)	Habitat creation	Local	'Mitigation by Design' water treatment system using three stage system of petrol interceptor, attenuation pond and constructed wetland. See also Chapter 8 Hydrology, Geomorphology & Hydromorphology
Invertebrate species (including freshwater pearl mussel)	International Importance to Local Importance (Higher Value)	Pollution risk	None	'Mitigation by Design' water treatment system using three stage system of petrol interceptor, attenuation pond and constructed wetland. See also Chapter 8 Hydrology, Geomorphology & Hydromorphology
Whooper swan	National Importance	Disturbance/ Displacement	None	None
		Road Traffic Collisions	None	None
Other wintering birds - Golden Plover, Snipe, Black-headed gull, Teal, Mallard	Local Importance (Higher Value)	Disturbance	Local	None
		Road Traffic Collisions	Local	None
Barn owl	National Importance	Road Traffic Collisions	Local to County	Landscape planting to discourage feeding along verges and "hop-overs" to deflect birds from road level (Figures 6.1.29-6.1.33 in Volume 3 and refer to typical cross-section sketches in Appendix 9.10) Monitoring of mitigation features, barn owl road mortalities and breeding success over two years following completion of construction.
		Disturbance (nest sites)	None	None
		Displacement (lighting)	Local	None
Breeding birds (general)	National Importance to Local Importance (Higher Value)	Road Traffic Collisions	Local	None
		Disturbance/ Displacement	None/Local	Landscape planting will provide additional habitat Nest boxes will be erected
Fish species	International Importance to Local Importance (Higher Value)	Pollution risk	None	'Mitigation by Design' water treatment system using three stage system of petrol interceptor, attenuation pond and constructed wetland. See also Chapter 8 Hydrology, Geomorphology & Hydromorphology
		Severance/ Barrier effect	None	None

6.7 Residual Impacts

6.7.1 Construction

With implementation of mitigation as outlined above and shown on Figures 6.1.29 – 6.1.33 in Volume 3, there will be no residual impacts above the local level as presented in Table 6-28.

Table 6-28 Summary of Residual Impacts during Construction after Mitigation

Key Ecological Receptor	Ecological Valuation (as per NRA, 2009b)	Construction Impact Type	Geographic Scale of Impact	Residual Impact after Mitigation
Designated Sites (Lower River Shannon cSAC only; potential for impacts to any other European Site has been ruled out.)				
The impacts of the proposed development, during construction, on the Lower River Shannon cSAC are discussed in detail in the NIS (Appendix 6.4). The NIS has concluded that with the implementation of mitigation there will be no adverse effects on the Lower River Shannon SAC and its qualifying interests, either alone or in-combination with other impact sources. The potentially significant construction related risks to the Lower River Shannon cSAC identified relate to water quality, the spread of invasive plant species, installation of watercourse structures, and the potential effects these elements could have on the qualifying interests of the Lower River Shannon cSAC and their conservation objectives. Mitigation measures have been proposed in the NIS to ensure that these risks will be avoided or reduced during the construction of the proposed development such that there will be no significant effect on the Lower River Shannon cSAC or its qualifying interests.				
Habitats (Non-Designated Sites)				
Cashen River Estuary pNHA	National	Pollution risk	Local	Non-significant
		Spread of Invasive plant species	Local	Non-significant
		Otter	Local	Non-significant
		Whooper swan	Local	Non-significant
Rare and protected plant species Triangular club-rush	County importance	Pollution risk	Local	Non-significant
Eroding/upland Rivers (FW1) Drainage Ditches (FW4)	Local Importance (Higher Value)	Habitat loss	Local	Local
		Pollution risk	Local	Non-significant
		Spread of Invasive plant species	Local	Non-significant
Wet Grassland (GS4) Scrub (WS1) Hedgerows (WL1) Treelines (WL2)	Local Importance (Higher Value)	Habitat loss	Local	Local
Fauna				
Badger	Local Importance (Higher Value)	Habitat loss	Local	Non-significant
		Disturbance	Local	Non-significant
		Severance	Local	Non-significant
Otter	International importance	Disturbance to holts/couch sites	Local	Non-significant
		Habitat loss/Severance	Local	Non-significant
		Disturbance (general)	Local	Non-significant
		Pollution risk	Local	Non-significant
Bat species	Local Importance (Higher Value)	Disturbance to bat roosts (buildings)	Local	Non-significant
		Loss of potential bat roosts (trees)	Local	Non-significant
		Disturbance	Local	Non-significant
		Habitat loss	Local	Local
Other mammal species	Local Importance (Higher Value)	Disturbance/ Habitat loss	Local	Local
Common Frog	Local Importance (Higher Value)	Disturbance/ Habitat loss	Local	Non-significant
		Pollution risk	Local	Non-significant
Freshwater pearl mussel	International Importance	Pollution risk	Neutral	Non-significant
Other invertebrate species	Local Importance (Higher Value)	Habitat loss	Local	Local
		Pollution risk	Local	Non-significant
Whooper swan	National Importance	Disturbance from general construction activities	Local	Local
		Disturbance from pile driving	Local	Local
		Collision risk	None	Non-significant
Other wintering birds - Golden Plover, Snipe, Black-headed gull, Teal, Mallard	Local Importance (Higher Value)	Disturbance	Local	Local
Barn owl	National Importance	Disturbance	Local	Non-significant
		Habitat loss	Local	Local
Meadow pipit	Local Importance (Higher Value)	Habitat loss/ Disturbance	Local	Local
Breeding birds – Amber listed birds throughout	Local Importance (Higher Value)	Habitat loss	Local	Local
		Disturbance	Local	Local
Breeding birds – Green listed birds throughout	Local Importance (Higher Value)	Habitat loss	Local	Local
		Disturbance	Local	Local
Atlantic Salmon Brown trout	International Importance National Importance	Habitat loss	Local	Local
		Disturbance	Local	Local
		Barrier effect	Local	Non-significant
		Pollution risk	Local	Non-significant
Lamprey species	International Importance	Habitat loss	Local	Local
		Disturbance	Local	Local
		Barrier effect	Local	Non-significant
		Pollution risk	Local	Non-significant
European eel	Local Importance (Higher Value)	Habitat loss	Local	Local
		Disturbance	Local	Local
		Barrier effect	Local	Non-significant
		Pollution risk	Local	Non-significant

6.7.2 Operation

With implementation of mitigation as outlined above and shown on Figures 6.1.29-6.1.33 in Volume 3, there will be no residual impacts above the local level as presented in Table 6-29. Many impacts will be non-significant following the creation of landscaped areas and/or the attenuation ponds and constructed wetlands.

Table 6-29 Summary of Residual Impacts during operation after mitigation

Key Ecological Receptor	Ecological Valuation (as per NRA, 2009b)	Operation Impact Type	Geographic Scale of Impact	Residual Impact after Mitigation
Designated Sites (Lower River Shannon cSAC only; potential for impacts to any other European Site has been ruled out.)				
The potential impacts of the proposed development, during operation, on the Lower River Shannon cSAC are discussed in detail in the NIS (Appendix 6.4). The NIS has concluded that there is no risk of the proposed development resulting in adverse effects on the Lower River Shannon cSAC and its qualifying interests, either alone or in-combination with other impact sources. The potentially significant operation related risks to the Lower River Shannon cSAC identified relate to water quality, the spread of invasive plant species, habitat severance and barrier effects to the movement of species, risk of road traffic collisions with wildlife, and the proposed lighting design and the potential effects these elements could have on the qualifying interests of the Lower River Shannon cSAC and their conservation objectives. Design and mitigation measures have been proposed in the NIS to ensure that these risks will be avoided or reduced during the operation of the proposed development such that there will be no significant effect on the Lower River Shannon SAC or its qualifying interests.				
Habitats (Non-Designated Sites)				
Cashen River Estuary pNHA	National	Pollution risk	None	Non-significant
		Spread of Invasive plant species	Local to National or International	Non-significant
		Otter	None	Non-significant
Rare and protected plant species Triangular club-rush	County importance	Pollution risk	None	Non-significant
Eroding/upland Rivers (FW1) Drainage Ditches (FW4)	Local Importance (Higher Value)	Pollution risk	None	Non-significant
		Spread of Invasive plant species	Local to National or Internatioanl	Non-significant
		Air quality	Local	Non-significant
Wet Grassland (GS4) Scrub (WS1) Hedgerows (WL1) Treelines (WL2)	Local Importance (Higher Value)	Air quality	None	Non-significant
Fauna				
Badger	Local Importance (Higher Value)	Severance/ Barrier effect	None/Local	Non-significant
		Road Traffic Collisions	Local	Non-significant
		Light spill	None	Non-significant
Otter	International importance	Severance/ Barrier effect	Local	Non-significant
		Road Traffic Collisions	Local to County	Non-significant
		Light spill	Local	Non-significant
		Pollution risk	None	Non-significant
Bat species	Local Importance (Higher Value)	Bat roosts	None	Non-significant
		Habitat loss/ Severance/ Barrier effect	(unlikely) Local	Non-significant
		Road Traffic Collisions	Local	Non-significant
		Light spill	Local	Non-significant
Other mammal species	Local Importance (Higher Value)	Road Traffic Collisions	Local	Non-significant
		Disturbance	None/Local	Local
Common Frog	Local Importance (Higher Value)	Habitat creation	Local	Local positive
Invertebrate species (including Freshwater Pearl Mussel)	International Importance to Local Importance (Higher Value)	Pollution risk	None	Non-significant
Whooper swan	National Importance	Disturbance/ Displacement	None	Non-significant
		Road Traffic Collisions	None	Non-significant
Other wintering birds - Golden Plover, Snipe, Black-headed gull, Teal, Mallard	Local Importance (Higher Value)	Disturbance	Local	Local
		Road Traffic Collisions	Local	Non-significant
Barn owl	National Importance	Road Traffic Collisions	Local to County	Non-significant
		Disturbance (nest sites)	None	Non-significant
		Displacement (lighting)	Local	Non-significant
Breeding birds (general)	National Importance to Local Importance (Higher Value)	Road Traffic Collisions	Local	Local
		Disturbance/ Displacement	None/Local	Local
Fish species	International Importance to Local Importance (Higher Value)	Pollution risk	None	Non-significant
		Severance/ Barrier effect	None	Non-significant

6.8 Difficulties Encountered in Compiling Information

There were no difficulties encountered when compiling the desktop data or in undertaking the field surveys; all surveys were undertaken during the optimal season.

6.9 Cumulative Impacts and Impact Interrelations

Consideration was given to all existing or proposed projects that could act in combination with the proposed development to impact on Key Ecological Receptors. Available planning sources were analysed for details of any relevant existing or proposed residential, retail, industrial, recreational or other projects or activities. Zoning for the localities around the proposed development were also examined to assess the likely existing and future development pressures on the locality. Zonings relevant to different sources of impact are discussed in their relevant section below.

6.9.1 Water Quality

Chapter 8 Hydrology, Geomorphology & Hydromorphology, and Chapter 7 Geology, Soils and Hydrogeology have concluded that impacts to surface and groundwater will be imperceptible after mitigation. There is no potential for cumulative impacts.

6.9.2 Habitat Loss

In the *Listowel Town Development Plan, 2009 – 2015* (Listowel Town Council, 2009), the lands between the R553 and the Greenville Road (as far west as Islandganniv Place) are zoned as either “residential low density” or “educational”. If these lands are developed, there will be a cumulative loss of locally valuable habitats in this area along with the associated potential for the spread of invasive plant species locally.

6.10 References

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7 Geology, Soils and Hydrogeology

7.1 Introduction

This chapter considers and assesses the geological (including soils and contaminated land) and hydrogeological environment and the likely significant potential impacts associated with both the construction and operation of the proposed development.

7.2 Soils and Geology and Contaminated Land

7.2.1 Introduction

This section describes the existing geological environment and the likely significant potential impacts on geology and soils associated with both the construction and operation of the proposed development. Geology and soils determine the environmental characteristics of a region as geology has an influence on landform and provides the parent material from which soils are created. Bedrock strata are often significant in terms of providing a source of groundwater abstraction used for domestic, agricultural and industrial water supply. The study area encompassed an overall width of 500 m, i.e. 250 m from the centre line of the proposed development.

The assessment of the geology and soils of the proposed development has been undertaken with reference to the following:

- *Environmental Impact Assessment of National Road Schemes – A Practical Guide Revision 1, (NRA, 2008);*
- *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA, 2008);*
- *Geological Survey of Ireland (GSI) online geological mapping;*
- *Ordnance Survey Ireland Online Historical Mapping and Aerial Photography;*
- *Environmental Protection Agency (EPA) Online Databases;*
- *Common Implementation Strategy for the Water Framework Directive (2000/60/EC); and*
- *Environment Agency (England and Wales) (2004) Model Procedures for the Management of Land Contamination (CLR11) guidance.*

This section also presents a preliminary assessment of the potential impacts of the proposed development on existing land quality and the potential implications of the existing land quality on both the construction and the operational phases from the proposed development. This assessment considers the potential for additional contamination sources to be introduced during construction and/or operation of the proposed development that may potentially cause contamination of the sub-surface and impact on the identified receptors.

Potential impacts of the proposed development on human health and surface water and groundwater have been assessed using the conceptual site model (CSM) which assesses the potential sources, receptors, and pathways. Appropriate mitigation measures have been recommended to address potential pollutant linkages. In terms of risk, the 'Source-Pathway-Receptor' (SPR) linkage is used to aid classification of the likelihood of identified potential land contamination sources to have any impact on identified receptors via a plausible pathway, as the presence of contamination does not necessarily mean that there is a risk of harm to a receptor. Instead a complete SPR pollutant linkage must be established before the existence of an unacceptable risk can be confirmed.

(i) Ground Investigation

The information on ground conditions is based on the ground investigation data produced by Causeway Geotech Ltd. (April 2014). The ground investigation comprised 13 cable percussion boreholes (BH101 – BH111S), two cable percussion boreholes with rotary core follow on (BH103D and BH104D) completed to depths of 29.4 metres below ground level (mbgl) and 22.45 mbgl respectively, two rotary open hole boreholes (BH104AD and BH107AD), completed to depths of 9.5 mbgl and 10 mbgl respectively and 41 trial pits (TP01 – TP41) excavated to depths between 2.3 mbgl and 4.5 mbgl. The exploratory hole locations are shown on Figure 7.1.4 to 7.1.8.

Groundwater monitoring standpipes were installed in all the boreholes, with data loggers installed in eight boreholes (BH102S, BH103S, BH103D, BH104S, BH104D, BH108D, BH109 and BH102) to monitor groundwater levels and variation at the site (see Section 7.3 Hydrogeology for more details).

Laboratory chemical analysis for contamination assessment was undertaken on selected soil and groundwater samples taken along the proposed development, particularly where earthworks are proposed. Sixteen soil samples were tested from the boreholes (8 samples) and trial pits (8 samples). Groundwater samples were also collected from boreholes and the groundwater chemical analysis results are discussed in detail within Section 7.3: Hydrogeology.

The soil samples were tested for metals, Total Petroleum Hydrocarbons (TPH) with aliphatic and aromatic split, Poly Aromatic Hydrocarbons (PAH), Methyl Tert-Butylether (MBTE), Benzene, Toluene, Ethylbenezene, m&p Xylene, o Xylene (BTEX) and Inorganics.

7.2.2 Description of the Existing Environment

(a) Soils and Geology

Near Surface Soils (Natural and Man-made) on the soil map produced by Teagasc and the EPA and obtained from GSI online maps, the soil within the proposed development comprises made ground to the east of the proposed development in Listowel associated with urban development. The northern section of the proposed development is dominated mainly by acidic, shallow, poorly drained peat, while the southern section of the proposed development is predominantly sands and gravels.

(i) Overburden Geology

Based on the information obtained from the GSI, the overburden geology within the proposed development includes alluvial deposits associated with the River Feale, glacial till derived from the sedimentary rocks, and rocks outcropping or close to the surface. Alluvial deposits are unconsolidated river deposit generally consisting of silts and clay, but which may also contain sands and gravels. In Listowel, the alluvium comprises yellow clay, grit, quartz pebbles and boulders.

The northern half of the study area is predominantly covered by flat peat bog. Peat is an unconsolidated brown to black organic material comprising a mixture of decomposed and undecomposed plant matter that has accumulated in a water-logged environment.

The ground investigation encountered topsoil, peat deposits, made ground, alluvial deposits and glacial till at the site.

Topsoil, including occasional peaty topsoil, was encountered in most of the ground investigation trial pit locations at thicknesses ranging between 0.1 m – 0.6 m. Peat deposits were encountered below the topsoil in nine locations (TP22 – TP26, TP28, TP29, TP40 and TP41) at thickness ranging between 0.1 m and 1.49 m, see Figure 7.1.4 to 7.1.7 for trial pit locations.

Made ground, which comprised slightly sandy very gravelly silt and gravelly fine to coarse sand, was encountered in two locations , TP16 and TP27, at thicknesses of 0.2 m and 0.6 m respectively, and was associated with the old railway embankment in TP27. No olfactory evidence of contamination was observed within the made ground or other locations during the ground investigation.

Alluvial deposits which comprised gravelly sandy silt and sandy silt over sands and gravels, was encountered in most locations at depths ranging from 0.1 mbgl and 6.10 mbgl. The maximum thickness recorded is approximately 5.9 m.

Glacial till was encountered in most of the locations at depths ranging from 0.15 mbgl to 19 mbgl. The maximum thickness recorded is approximately 18.8 m. Occasional limestone boulders were encountered within the glacial till in some locations (BH105D, BH106, BH107D, and BH108D).

(ii) Bedrock Geology

The names of the geological formations underlying the study area have been obtained from the GSI 1995 geological mapping. The bedrock geology underlying the site consists predominantly of Visean Limestones (undifferentiated). To the east of Listowel there is a section of Clare Shale formation and Shannon Group (consisting of mudstone, silt stone and mudstone).

The ground investigation for the proposed development encountered bedrock geology in two locations (BH103D and BH104D), located to the south of the proposed River Feale bridge at depths of 12 mbgl and 19 mbgl respectively. The boreholes terminated at depths of 29.4 m and 22.45 m respectively. This comprised very strong, fine grained Limestone.

(iii) Economic Geology

No active mines or quarries have been recorded along the proposed development or within 1 km of the proposed development.

(iv) Geological Heritage

Based on the consultation undertaken with GSI, there are no sites of geological heritage within the study area.

(b) Characteristics of the Proposed Development of Relevance

The proposed development comprises the construction of embankments and structures with a height up to approximately 8 m. The proposed development has minimal requirement for cuttings, with less than 0.5 m depth along the main line and a short section of cutting to approximately 5.5 m for the proposed underpass ST11.

A bridge, which is proposed to be piled, will be constructed over the River Feale and one of the bridge piers is located within the Lower River Shannon SAC.

Excavations will be required including those associated with the provision of drainage works, culverts and realignments.

Reconstructive and resurfacing works on the online section will be undertaken from approximate chainage 5,100 m to 7,000 m. It will be necessary to remove the existing surface as part of this work. It is anticipated that approximately 150mm of the surface will be removed and that, as none of this material will be reusable, it will generate approximately 3,400m^3 of material that requires disposal.

A large volume of imported fill material will be required for the proposed development particularly for the construction of road embankments. It is anticipated that approximately 200,000 m^3 of fill material will be required, most of which will be imported from off-site sources. It is anticipated that most excavated material will be suitable for re-use within the proposed development either as road embankment or landscaping materials (further details of which are provided in Chapter 13: Waste Management). Unacceptable/unsuitable waste materials generated as part of the proposed development will be disposed off-site at suitable waste facilities.

Materials including petrol and cement will be stored temporarily on site within the contractors' compounds.

(c) Land Contamination: Conceptual Site Model (CSM) and Risk Assessment

The potential land contamination issues that could impact on the proposed road development have been assessed in the context of the environmental setting by developing a conceptual site model (CSM) which utilises the source-receptor-pathway model to identify if pollutant linkages exist within the study area. The potential sources, receptors and pathways identified are described below.

Furthermore, a generic quantitative risk assessment (GQRA) has been undertaken to assess the potential risks to human receptors (human health) from the proposed development. This has been undertaken by comparing the soil chemical analysis results of the recent ground investigation with commercial/industrial end use Generic Assessment Criteria (GAC) and Soil Guideline Values (SGV) to indicate possible risks.

The GACs were mostly developed using the UK Environment Agency (EA)/DEFRA Contaminated Land Exposure Assessment (CLEA) model. The SGVs used are published by the EA/DEFRA. GACs are calculated using the CLEA methodology and published by authoritative sources (LQM/CIEH 2nd Edition July 2009 and EIC/AGS/CL:AIRE GAC December 2009). The published Category 4 Screening levels (C4SL) have been adopted for screening lead levels in the absence of a published lead SGV.

With respect to asbestos risk assessment, the guidance CIRIA C733 (2014) 'Asbestos in Soil and Made Ground: A Guide to Understanding and Managing Risks' has been used.

With respect to risks to surface and groundwater features, the results of the recent groundwater chemical analyses have been compared against the European Communities Environmental Objectives (Groundwater) Regulations 2010, S.I. No. 9/2010 (see Section 7.3: Hydrogeology for details).

The identified risks with respect to human health and environmental receptors are discussed below.

(i) Potential Contamination sources

Historical and Current Land Use: The following potential contamination sources have been identified within the scheme and off-site within 500 m of the scheme (see Figures 2.1.1 – 2.1.5 for the location of the features listed below).

- Potential soil contamination associated with runoff and accidental fuel spillage from the existing roads network;
- Dismantled railway tracks located to the north of the proposed development; and
- An industrial estate (Clievragh) located approximately 170 m north west of the R552 Junction.

During the ground investigation, potential existing contamination sources were identified from made ground at two locations (TP16 and TP27), see Figure 7.1.4 and Figure 7.1.7. The chemical analysis results for soil samples retrieved from these two locations and the remaining locations investigated indicate the presence of metals below SGVs and hydrocarbons (PAHs and TPHs) below the laboratory method detection limit (MDL). The soil analysis results and risk assessment summary table is presented in Appendix 7.1.

Based on the chemical analysis results for all the soil samples retrieved within and adjacent to the proposed development and the potential existing sources identified above, no contamination was recorded within the soil above GACs / SGVs in any of the locations investigated.

(ii) Potential Receptors

The potential receptors likely to be affected by potential land contamination sources are described below.

Human Receptors: This includes construction workers, road users and future maintenance workers.

Surface & Groundwater Receptors:

- *Groundwater: The GSI National Vulnerability Map indicates that the majority of the area is underlain by an aquifer with a low degree of vulnerability. Some areas within the north of the proposed development (Roundabout 3) are underlain by an aquifer with a moderate vulnerability and areas to the east, at the existing John B. Keane Road are underlain by an aquifer with a moderate to high vulnerability. Other groundwater resources include six Private Water Supply (PWS) abstractions located between 40 m and 120 m from the proposed development see Section 7.3: Hydrogeology for full details; and*
- *Surface waters: The major watercourse in the vicinity of the study area is the River Feale, there is also a number of minor surface water courses/drainage ditches, see Chapter 8: Hydrology, Geomorphology and Hydromorphology for full details.*

The groundwater level monitoring undertaken at seven boreholes between August 2013 and January 2014 indicates that groundwater levels are relatively shallow in the study area at around 0.5 mbgl. The majority of the groundwater samples recorded no contaminants of concern above the European Communities Environmental Objectives (Groundwater) Regulations 2010, S.I. No 9/2010, however, concentrations of petroleum hydrocarbons were recorded at 250 ug/L in BH104s and 14 ug/L in BH102, which is above the S.I. No. 9/2010 - European Communities Environmental Objectives (Groundwater) Regulations 2010 limit of 0.075 ug/l see Section 8.3: Hydrogeology.

Infrastructures Receptors: Underground structures including pipes, conduits and piles are planned as part of the proposed development which may be subjected to aggressive ground conditions and/or ground gas accumulation within confined spaces which may be created during the construction phase of the proposed development.

Sensitive Designated Sites: Lower River Shannon cSAC: One of the bridge piers will be located within the cSAC. Consultation has been undertaken with relevant regulatory authorities for the proposed work within the SAC, see Chapter 6: Flora and Fauna.

(d) Potential Pathways

The ground investigations did not record contamination in soil at the locations investigated above the SGVs or GACs used (see Section 7.2.2 (c) above and the soil analysis summary table (Appendix 7.1) for details). However, it is possible that unforeseen land contamination may be encountered during the construction works. Also, the proposed development could introduce new contamination to the soil or groundwater through accidental spillage of construction materials, and/or importation of contaminated construction materials and fill materials for the proposed embankments. There is also potential for ground gases to be present within confined spaces (e.g. access shafts, pits, enclosed drains, sewers, manholes and culverts).

Given the above, the potential pathways that could be created during the construction and operational phases include:

- *Construction workers' direct contact with unidentified contaminated soils and groundwater during the construction phase through dermal absorption, ingestion or inhalation;*
- *Construction workers inhalation of toxic or asphyxiant ground gases during work in confined spaces and the potential for the ignition of accumulated explosive gases in confined spaces; and*
- *Inhalation of wind-blown contaminated dust by off-site users.*

The potential pathways for Surface & Groundwater exposure to identified contamination sources include:

- *Surface runoff of accidentally spilled construction materials including fuels, lubrication oils and dissolved free phase contaminants into main river courses including the River Feale or other minor surface water courses (including drains, Mill Stream and Coolnaleen Stream) and the Lower River Shannon SAC;*
- *Migration of dissolved/free phase contaminants from source to shallow groundwater (potentially enhanced via the creation of pathways via piling activities) followed by onward migration of dissolved/free phase contaminants to the bedrock aquifer and the private water supplies (PWS); and*
- *Migration of dissolved/free phase contaminants through groundwater to surface watercourses.*

The following pathways are considered potentially relevant to Infrastructure Receptors:

- *There is potential for the foundations of infrastructure associated with the proposed development to come in contact with aggressive ground conditions*

such as sulphate in soils. Sulphate in soil may cause degradation of concrete structures; and

- *Due to the presence of peat and alluvial deposits within the proposed development, there is potential for ground gases to be present on site and the accumulation of toxic, asphyxiant or explosive ground gases within infrastructure.*

7.2.3 Appraisal Method used for Assessment of Impacts

The importance/sensitivity of the geological interest of the study area has been assessed using the criteria set out in Table 7-1 below. These criteria have been adapted from the 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (NRA, 2008).

Table 7-1 Soil and Geology Criteria for Rating Site Attributes

Importance	Criteria
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale*.
High	Attribute has a high quality significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying route is significant on a local scale*.
Medium	Attribute has a medium quality significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying is moderate on a local scale*.
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying route is small on a local scale*.

* Relative to the total volume of inert soil disposed of and/or recovered

The assessment of the magnitude of predicted impacts on solid and drift geology has been based on the criteria defined in Table 7-2 and the combination of sensitivity and magnitude are used to derive the impact significance as detailed in Table 7-3. These criteria have been adapted from the 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' (NRA, 2008).

Table 7-2 Magnitude of Impacts

Magnitude of Impact	Criteria
Large Adverse	Results in loss 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
Minor Beneficial	Results in minor improvement of attribute quality
Moderate Beneficial	Results in moderate improvement of attribute quality
Major Beneficial	Results in major improvement of attribute quality

Table 7-3 Rating of Significant Environmental Impacts

Importance of Attribute	Magnitude Impact			
	Negligible	Small	Moderate	Large
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

7.2.4 Predicted Impacts of the Proposed Development

(a) Soils and Geology

(i) Construction Phase Impacts

During the construction works, the removal of overburden geology particularly within cutting areas, proposed at approximately 5.5 mbgl at the location of the proposed underpass ST11 (in the southern portion of the proposed development) may impact on the protective cover of the underlying aquifer at the site (if mitigation is not undertaken) see Section 7.3: Hydrogeology for assessment in terms of hydrogeology.

Local groundwater flow and levels may be impacted in areas of cut. This may affect other groundwater bodies being supported by the groundwater including the PWSs located near the proposed development (see Section 7.3: Hydrogeology section for details on PWS).

Based on the consultation with GSI and the ground investigation carried out for the proposed development, no karst features have been identified within the proposed development, however, since part of the bedrock within the study area is made of limestone, karst features may be present. As such, there is a potential risk of encountering karst features at the site during construction. Based on the information obtained from the GSI, uncontrolled drainage, (i.e. surface water runoffs (natural drainage), use of soak-aways or soak pits), can trigger previously dormant karst activity such as ground stability problems. The potential impacts of karst features on the proposed development during construction (if encountered) include possible ground stability/engineering constraints. The magnitude of impact has been assessed as Negligible and the significance as Imperceptible on the basis that karst features are not present on site.

Peat deposits were encountered in nine locations, namely TP22 – TP26, TP28, TP29, TP40 and TP41. Alignment Section C, Culverts 5 -7 and Pond A5 are proposed within these locations. The presence of peat deposits in these locations may pose some geotechnical constraints including excessive settlement depending on the proposed loads at these locations. The soils at these locations are likely to be highly compressible, and may exhibit poor consolidation properties. Ground improvement solutions may be required in this location when designing any structures for these areas (this will be assessed further during the detailed design stage by a Geotechnical Engineer). The magnitude of impact with regards to potential excessive settlement is assessed as Moderate Adverse and the significance of impact as Slight.

No site of geological heritage, sites or features of high or medium geological importance will be affected by the proposed development. There are also no active mines or quarries recorded within 1 km of the proposed development.

(ii) Operational Phase Impacts

Due to the excavation and removal of soil materials during construction, there is potential for the superficial geology to be exposed to the surface following construction, particularly in areas of cuttings. The sensitivity of the superficial geology at the site is assessed as low, the magnitude of impact has been assessed as Small Adverse as impact will be limited to the few localised cutting locations and other areas of the proposed development will remain unaffected. The significance of impact is assessed as Imperceptible.

The long term impacts of karst features on the proposed development following development (if encountered during construction and unmitigated by design) include the possibility of subsidence. It should be noted that no karst features have been identified; within the proposed development area, therefore the magnitude of impact is assessed as Negligible and significance as Imperceptible.

(b) Land Contamination (Made Ground)

(i) Construction Phase Impacts (Pre-Mitigation)

Risk to human health: Construction workers (assessed to have high importance) could be at risk of coming into direct contact with any contaminated soil and groundwater at the site as well as inhalation of ground gases (if encountered) when working in confined spaces. The magnitude of impact has been assessed as Negligible as no contamination above assessment criteria was found during the ground investigation. However, this could increase to Moderate Adverse if significant contamination is encountered during construction. The overall significance of impact has been assessed as Negligible (assuming no significant contamination will be encountered) and Moderate to Significant (assuming significant contamination is encountered during construction including asbestos and ground gases) and no mitigation is implemented.

Risk to Surface and Groundwater: Risk to groundwater including private water supplies are dealt with in detail in Section 7.3: Hydrogeology and potential risk to surface waters including the River Feale are dealt with in detail in Chapter 8: Hydrology, Geomorphology and Hydromorphology.

A detailed summary of the impacts associated with land contamination (Pre-Mitigation) is presented in Appendix 7.2.

(ii) Operational Phase Impacts (Pre-Mitigation)

On completion of the works, it is expected that the presence of bitumen macadam on the road will provide a protective cover for the soil underneath the site and therefore will reduce any human receptor (future maintenance workers, future site users and off-site users) exposure to possible soil contamination that may have been encountered during construction. It should be noted that no contamination was recorded within the soil above GACs / SGVs in the locations investigated. The magnitude of impact to human receptors (maintenance workers) has been assessed as Negligible and significance as Imperceptible.

There is potential for accidental spillages and contaminated runoffs to occur during the operation of the proposed development, potentially leading to surface and groundwater pollution. Potential impacts to groundwater including private water supplies are dealt with in detail in Section 7.3: Hydrogeology and potential risk to surface waters are dealt with in detail in Chapter 8: Hydrology, Geomorphology and Hydromorphology.

7.2.5 Proposed Mitigation and Avoidance Measures

For all aspects of the construction phase of the proposed development, the contractor is required to produce a site and work specific Environmental Operating Plan (EOP) for all construction activities. This will be produced in line with the 'Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan (NRA 2007)'. In line with this guidance, the contractor will also be required to maintain a construction and demolition waste management plan.

(a) Soils and Geology

(i) Construction Phase Mitigation

Ground engineering solutions will be required where peats and compressible soils are present to avoid excessive settlement.

(ii) Operational Phase Mitigation

There are no significant operational phase impacts on the soils and geology which require mitigating as all impacts are assessed as being Imperceptible.

(b) Land Contamination (Made Ground)

(i) Construction Phase Mitigation

It should be noted that no contamination was recorded within the soil and groundwater at the site above assessment criteria and no asbestos was identified. Notwithstanding, there is a possibility of encountering potential contamination (including asbestos) during construction, particularly in areas not previously investigated. Also, there is a possibility that the proposed construction works will introduce new contamination to the site through various sources including importation of contaminated fill materials and accidental spillage of construction materials. Given the above, the following mitigation measures are recommended:

Mitigation of Risk to human health

Construction workers at the site could be exposed directly (dermal contact, ingestion, inhalation) to any contaminants present within the soil. To mitigate the risk to human health the contractor will apply best practice control measures such as correct use of Personal Protective Equipment (PPE), adoption of good working practices and health and safety risk assessments.

To mitigate the risk to human health from contaminated land if any significant areas of suspect contamination are identified through visual or olfactory evidence during the construction works, then representative samples will be taken by a suitably qualified person and sent for laboratory analysis, in order to determine the risk to receptors and the potential for reuse within the proposed development or disposal off site. If significant contamination is found where ground works cannot be avoided, then the material will be taken off-site (for disposal in an appropriate waste treatment facility) and replaced with clean material prior to any groundwork commencing. The contractor will produce an EOP detailing the response procedure to be undertaken in the event of encountering significant land contamination.

Based on the ground investigation findings, asbestos was not detected in any of the locations. However, the potential to encounter asbestos cannot be ruled out if contaminated material is encountered. To mitigate the risk to human health from exposure to asbestos prior to the construction works, a response procedure will be developed in the event that suspected asbestos is identified during construction works.

To prevent the importation of contaminated and unsuitable fill materials to the site, representative sampling of imported materials and materials excavated from the site (other than materials known to be uncontaminated) for re-use within the proposed development, will require chemical contamination testing for a range of soil and soil leachate analytical suites and assessed against the limit values for surface and

groundwater features and human health. For materials to be acceptable for either importation to site or re-use of excavated materials within the proposed development, the chemical testing results must be below the specified limits for risk to human health and surface and groundwater features.

There is potential for construction workers to encounter and inhale ground gases when undertaking works in potential confined spaces particularly in areas where peat and alluvial deposits are present. To mitigate the risk to human health from exposure to ground gases a procedure for working in confined spaces will be developed by the contractor as part of the health and safety risk assessment process for the works.

To mitigate the risk to human health with respect to the risks to off-site users from any contamination present within the surface, this will be minimised by the use of dust suppression techniques during ground works, keeping surrounding roads as clean as possible and not allowing materials to be tracked onto public areas from the site, see Chapter 9 Air Quality and Climate for further details.

Mitigation of Risks to Surface and Ground Waters

Mitigation measures for potential impacts to groundwater (including PWS) are provided in Section 7.3: Hydrogeology and for surface waters are provided within Chapter 8: Hydrology, Geomorphology and Hydromorphology.

A detailed summary of the impacts associated with land contamination (Post-Mitigation) is presented in Appendix 7.3.

(ii) Operational Phase Mitigation

Mitigation of Risk to human health

On completion of works, most of the exposed ground surface within the proposed development is anticipated to be covered with hardstanding thereby preventing the exposure of future maintenance workers and offsite road users to any contamination beneath the site. It should be noted that the ground investigation undertaken at the site did not record contamination in soil at the locations investigated above the SGVs or GACs used.

Maintenance works are anticipated to be carried out periodically along the route during operation and may require occasional work in confined spaces. No significant risk associated with ground gases are expected, however the potential for maintenance workers to encounter and inhale ground gases when undertaking works in confined spaces such as culverts cannot be completely ruled out. To mitigate the risk to human health from exposure to ground gases during maintenance a procedure for working in confined spaces should be developed by the maintenance contractor as part of the health and safety risk assessment process.

Mitigation of Risks to Surface and Groundwater features

Mitigation measures for groundwater including private water supplies are provided in Section 7.3: Hydrogeology and for Surface waters are provided with in Chapter 8: Hydrology, Geomorphology and Hydromorphology.

7.2.6 Residual Impacts

(a) Soils and Geology

Once all the mitigation measures have been implemented, the impact of the proposed development on soils and geology will be Negligible and significance Imperceptible.

(b) Land Contamination (Made Ground)

Subject to the implementation of the mitigation measures, the impacts of land contamination on the proposed development with respect to human health and surface and groundwater features will be Negligible and significance Imperceptible.

7.2.7 Difficulties Encountered in Compiling Information

No difficulties were encountered.

7.2.8 Cumulative Impacts and Impact Interrelations

Cumulative impacts are considered to be negligible following implementation of mitigation measures based on the generally low levels of contamination detected and anticipated. The assessment of impacts of geology and soils including land contamination on the proposed development has potential interaction with other disciplines including waste management, hydrogeology, hydrology, geotechnical and to some extent air quality. Reference should be made to the relevant chapters of this EIS for further information.

7.3 Hydrogeology

7.3.1 Introduction

This section describes the baseline groundwater conditions and considers and assesses the potential impact of the construction and operational phases of the proposed development on the groundwater environment, including groundwater receptors such as groundwater supplies and surface water bodies potentially supported by groundwater.

(a) Statutory Overview

The Water Framework Directive (WFD); Article 4(1) (b) of the Directive 2000/60/EC and the Groundwater Directive; 2006/118/EC of the European Parliament and of the Council state that Member States shall implement the measures necessary to prevent or limit the input of pollutants in groundwater and to prevent the deterioration of all status of groundwater bodies.

To achieve the environmental objectives of the EC Directives, the Minister for the Environment, Heritage and Local Government of Ireland made the European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No.9 of 2010), which came into operation on 27th January 2010. Within the context of the proposed development, under the above regulations the local authority is required “to take all reasonable steps to prevent or limit, as appropriate, the input of pollutants into groundwater and prevent the deterioration of the status of all bodies of groundwater”.

(b) Baseline Data Gathering

The hydrogeological baseline assessment considered the following sources of information:

- *Ordnance Survey of Ireland;*
- *N69 Listowel Bypass Constraints Report (Kerry County Council, August 2007);*
- *Online maps and data of the Geological Survey of Ireland (GSI) (consulted March-April 2014);*
- *Ground investigation data produced by Causeway Geotech Ltd. (April 2014);*
- *Land owner consultation on Private Water Supply followed by site surveys and sampling (Jacobs, 2013);*
- *NRA Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes(NRA, 2009); and*
- *NRA Environmental Impact Assessment of National Road Schemes (NRA, 2008).*

The information on ground and groundwater conditions for the proposed development is based on the findings of the ground investigation data produced by Causeway Geotech Ltd. (April 2014). This ground investigation comprises of:

- *Thirteen percussion boreholes;*
- *Two percussion boreholes with rotary core follow on;*
- *Two rotary open hole boreholes (BH105AD and BH107AD);*
- *A standpipe installation in each borehole; and*
- *Forty-one trial pits.*

7.3.2 Description of the Existing Environment

(a) Aquifer Classification

In accordance with TII guidance (NRA 2009) the study area encompasses an overall width of 500 m, i.e. 250 m from the centre line of the proposed development.

Based on the GSI online mapper the proposed development is underlain by a Regionally Important Karstified Limestone Aquifer comprised of Dinantian aged Pure Unbedded Limestones, except for the most north-eastern part of the study area which lies into Namurian Undifferentiated bedrock described as of Local Importance, as shown on Figure 7.1.1 and Figure 7.1.2.

The GSI National Vulnerability Map indicates that the majority of the study area is described as having low vulnerability to groundwater contamination with the exception of the area immediately south of the proposed development's at Coolnaleen Lower/Upper, when classified as having a moderate to extreme degree of vulnerability with rock at or near surface or karst, as shown on Figure 7.1.3.

The GSI National Draft Gravel Aquifer Map does not define any shallow superficial aquifers along the proposed development.

No karst features have been identified in the study area.

(b) Private Groundwater Supplies and Public Supply Source Protection Area

Groundwater does not supply Listowel's public water supply. The study area is served by the Dromin Water Works north of the existing N69 which is connected to the main Kerry County Council water supply.

The nearest large industrial groundwater abstraction is for the Listowel Dairy & Food Ingredients Plant and the abstraction is located 2 km away from the proposed development outside the study area.

A PWS survey including consultation with landowners in the vicinity of the proposed development was undertaken in March 2013 using a questionnaire and house call approach. A number of private water supplies (W02 to W08) were identified within a distance of 250 m either side of the centreline of the proposed development as summarised in Table 7-4 and as shown on Figure 7.1.4 – 7.1.8. It should be noted that the consultation did not cover chainage 5,300 to 7,000 because this area is urbanised and expected to be fed by mains supply.

The GSI online mapper was also consulted for records of any private water supply wells along the proposed development. Four wells were identified, however, based on landowner consultation along the proposed development no other private groundwater supply is understood to be active other than the ones identified in Table 7-4. Therefore it is possible that the old wells recorded by GSI are either disused or located outside the study area.

The GSI online mapper does not show any Public Supply Source Protection Area within the vicinity of the proposed development.

Table 7-4 List of private water supplies within 250 m from the proposed route centreline.

Well ID	Type of supply	Total Depth (m)	Use	Connection to mains water supply	Approx. Distance from Proposed Development Centreline (m)
W02	Well	43	Operating Well – Can provide drinking water supply to property but mainly used for agriculture including pasture.	Yes	120
W03	Well	-	Operating Well – Used for agriculture only.	Yes	120
W05	Well	4.5	Operating Well – Only water supply to this property. The well supplies drinking water to the house and is used by the farm (agricultural including pasture). The supply is anticipated to be sourced from drift aquifer based on depth information and local geology.	No	40
W06	Well	-	Operating Well – Used only for pasture agriculture.	Yes	20
W07	Well	6	Disused Well – Potential for domestic use in the future. The supply is anticipated to be sourced from drift aquifer based on depth information and local geology.	Yes	20
W08	Well	40	Operating Well – Can provide drinking water supply to property and is currently used for the garden.	Yes	40

Inspection of the GSI well database did not disclose any information on the use or yield of the wells listed in Table 7-1 . Based on the consultation with the landowners all wells aside from W07, are known to be in current and continual use without running dry.

Although consultation was attempted for 121 properties of both residential and business premises in the study area, no response was received from 77 properties. Therefore, it is possible that Table 7-1 does not include all the operating private water supplies (wells and springs) within the study area.

PWSs W02 to W08 were surveyed and sampled in July and December 2013. The majority of the well's water samples were taken directly from the tap with the exception of W07, which was sampled using low-flow purging and sampling. The water samples were submitted within 24 hours to an accredited laboratory for chemical analysis. The results of the analyses are presented in Appendix 7.4.

The analysis of the PWS' found that those used for domestic purposes (W05, W07 and W08) exceeded the European Communities (Drinking Water) (No. 2) Regulations, 2007 (S.I. No. 278 of 2007) for a number of analytes during the July and December 2013 sampling as indicated in Table 7-5. A low concentration of hydrocarbons at W07 (currently disused) was recorded in July 2013 but was not present in December 2013. The highest relative exceedance of EC (Drinking Water) Regulations was found in W08 where manganese was recorded above the EC (Drinking Water) Regulations value of 50ug/l at 1730 ug/l during both sampling periods. W07 is a disused well and therefore not considered as an attribute in the risk assessment.

Table 7-5 Summary of the private groundwater supplies above the Drinking Water Regulation .

Analyte	Units	Drinking Water Regulations 2007	Jul-13	Dec-13	Jul-13	Dec-13	Jul-13	Dec-13
			W05	W05	W07	W07	W08	W08
pH	pH units	>6.5 - <9.5	6.3	No Exceed -ances	-	-	-	-
Aluminium	mg/l	0.2	-		0.504	-	-	-
Iron	ug/l	200	-		297	<230	-	-
Manganese	ug/l	50	-		-	-	1730	1730
Turbidity	NTU	1	-		12.2	-	3.52	1
Aliphatic EPH >C16 - C35	ug/l	0	-		12	-	-	-
Aliphatic EPH >C10 - C44	ug/l	0	-		12	-	-	-
EPH >C10 - C44	ug/l	0	-		12	-	-	-
Aliphatic VPH/EPH >C5 - C44	ug/l	0	-		12	-	-	-
VPH/EPH >C5 - C44	ug/l	0	-		12	-	-	-
Clostridium Perfringens	cfu/ 100 ml	0	-		3	-	1	16
E-Coli Coliforms	cfu/ 100 ml	0	-		>100	-	-	-
Total Coliforms	cfu/ 100 ml	0	-		>100	-	-	-

- = N Note: "-" indicates no exceedence of the Drinking Water Regulations 2007 limits

None of the private groundwater supplies used exclusively for agricultural purposes exceeded the European Communities (Drinking Water) Regulations, see Appendix 7.4.

(c) Groundwater Dynamics

The information stated below on groundwater dynamics at the proposed development are based on the findings of the 2014 ground investigations. Groundwater monitoring standpipes were installed in six boreholes (BH103D, BH104S, BH104D, BH108D, BH109 and BH102S) and six months of groundwater level monitoring data was obtained between August 2013 and January 2014, with the results summarised in Table 7-6 below. Hydraulic conductivity values were obtained from rising head tests carried out during the intrusive ground investigation programme in March 2013 in three boreholes (BH102, BH104D and BH107D). The location of the monitoring boreholes is shown in Figure 7.1.4 – 7.1.7.

Table 7-6 Summary of groundwater level information from Causeway Geotech 2014 groundwater monitoring

Borehole ID	Response zone (mbgl)	Response Zone Lithology	Ground Level mAOD	Borehole Logs July 19th - July 22nd 2013		Levellogger Groundwater Monitoring						Comments
				GW level (mbgl)	GW level (mAOD)	GW level 04/09/13 (mbgl)	GW level 04/09/13 (mAOD)	GW level 08/01/14 (mbgl)	GW level 08/01/14 (mAOD)	Max* (mbgl)	Min* (mbgl)	
BH101	4.2 - 10.2	Stiff Sandy Clay overlying Gravel	9.83	0.05	9.78	**No level loggers installed in boreholes**						Artesian groundwater on 21/06/13 - 0.1 m above ground surface
BH102S	1.8 - 4.8	Silty Gravely Clay overlying Gravel overlying very stiff sandy clay	10.51	0.61	9.9	-	10.01	0	10.51	-0.1	0.5	The Max (mbgl) of -0.1 m is only above ground level during short intermittent periods.
BH103D	19 - 24	Limestone - partially weathered	9.64	-	-	0.2	9.44	-0.5	10.14	-0.6	0.4	Overlain by very stiff clay which could act as confining layer The Max (mbgl) of -0.6 m above ground level during for the majority of the monitoring period.
BH103S	-	Sandy gravelly Clay	9.64	-	-	**No level loggers installed in boreholes**						
BH104S	1 - 5	Gravel	8.67	3.25	5.42	3.25	5.42	2	6.67	1	3.25	Overlain by silt
BH104D	12 - 17	Limestone - partially weathered	8.75	-	-	2.75	6	1.5	7.25	0.75	2.75	Overlain by 11 m of very stiff clay
BH105S	1 - 5	Silt overlying cobbles overlying silt overlying gravelly clay	9.36	3.18	6.18	**No level loggers installed in boreholes**						Water strike at top of clay horizon (3.7 mbgl)
BH105D	5.8 - 6.3	Silt overlying Limestone boulders	9.36	3.45	5.91							Overlain by circa 6 m of silt
BH105AD	1 - 10	Sandy Clay overlying Gravel overlying gravelly clay overlying Gravel	9.36	-	-							-
BH106	5.5 - 7.5	Gravel	9.55	3.51	6.04							Overlain by sand and silt, with water strike in a horizon of boulders immediately above the gravel
BH107D	1.8 - 6.1	Gravel overlying sandy Clay Overlying Limestone boulder	7.82	3.31	4.51							Water level could be reflection of very local flows around small stream adjacent to BH107D
BH107AD	1 - 10	Sandy Clay overlying Gravel overlying gravelly Clay	7.82	-	-							-
BH108D	5.2 - 6.2	Stiff Sandy Clay overlying Limestone Boulder or possible bedrock	15.9	0.7	15.2	0.9	15	-0.1	16	-0.1	1	Overlain by clay
BH109	1 - 10	Stiff Gravelly clay	19.4	7.9	11.5	1.4	18	0	19.4	-0.1	1.5	-

Note: Negative mbgl indicates above ground level.

The groundwater monitoring in Table 7-6 suggests that an unconfined aquifer is present north of the River Feale and a confined aquifer overlain by groundwater containing superficial deposits is present south of the River Feale. This is outlined in the following two sections.

(i) North of the River Feale

Groundwater flow to the north of the River Feale is characterised by unconfined groundwater flow through clay and gravel deposits which are approximately 10 m thick. The superficial deposits aquifer shows a degree of hydraulic connectivity with the underlying confined limestone bedrock aquifer as indicated by BH104D and BH104S. North of the River Feale groundwater levels within the superficial deposits (BH104S) range between 5.42 mAOD and 6.67 mAOD below ground level and groundwater levels within the bedrock borehole (BH104D) varied between 6.0 mAOD and 7.25 mAOD above ground level over the six months of available monitoring. Groundwater both in drift and bedrock is likely to flow towards the River Feale and the Mill Stream (former River Feale course) as groundwater appears to follow the general topography.

(ii) South of the River Feale

South of the River Feale, the drift and bedrock aquifers also show a degree of hydraulic conductivity, but this area is characterised by sub-artesian and artesian groundwater conditions which seem to increase with depth. Groundwater levels recorded in BH103D screened in bedrock varied between 0.4 m below ground level and 0.6 m above ground level over the six months of available monitoring. The bedrock at BH103D is overlain by very stiff clay which could act as a confining layer creating a confined aquifer in the bedrock. The groundwater in superficial deposits is near or close to the surface, ranging between 0.5 m below ground level and 0.1 m above groundwater level as indicated by the water monitoring results at the shallow borehole BH102.

In boreholes comprising of clay and gravel response zones, the hydraulic conductivity is generally low ranging from 10^{-5} to10^{-6} m/s. This means the soils have a medium to low permeability for groundwater movement, which retards horizontal groundwater flow. This is corroborated by the GSI National Recharge Zone, which identifies the soil as having low permeability as presented in Figure 7.1.3.

(d) River Feale

The River Feale is designated a Salmonid water under S.I. No. 293 of 1988 — European Communities (Quality of Salmonid Waters) Regulations, 1988 and it is considered to be a Nationally important river system for Atlantic salmon and Brown trout. Water quality in the River Feale is classified by the EPA as being of good status (Q4) *c.*1.7 km upstream of the proposed crossing point (sampling station at Listowel Racecourse footbridge) and is classified as being of moderate status (Q3-4) at Scartleigh Weir, *c.*1.3 km downstream of the proposed crossing point. For further information on the ecological importance of the River Feale, see Chapter 6: Flora and Fauna.

The Base Flow Index (BFI) was used to determine the possible contribution of groundwater baseflow to the River Feale. The BFI is a measure of the proportion of the river runoff that derives from stored sources. BFI ranges from 0 meaning no groundwater baseflow, i.e. impermeable bedrock to 1 meaning high groundwater baseflow i.e. gravel. The BFI along the proposed development is measured to be 0.312. An index at this value indicates that groundwater baseflow contributes to some proportion to the River Feale.

(e) Habitats Potentially Supported by Groundwater

There are no groundwater supported habitats along the proposed route, see Chapter 6: Flora and Fauna.

(f) Groundwater Quality (Ground Investigations)

Groundwater sampling was undertaken using low-flow purging and sampling techniques in August 2013 from the following boreholes: BH101, BH102, BH103D, BH104S, BH104D, BH105BD, BH105S, BH106, BH107S, BH106, BH107S, BH108D, BH109 and BH110.

The water samples were submitted within 24 hours to an accredited laboratory for chemical analysis. The results of the analyses are presented in Appendix 7.5.

Concentrations of petroleum hydrocarbons were recorded at 250ug/L in BH104s and 14ug/L in BH102, which is above the S.I. No. 9/2010 - European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended) of 0.075 ug/l. However, soil analyses from the boreholes and test pits, detected no hydrocarbon chains above the method detection limit in the soil (See Section 7.2 Soils and Geology). These findings suggest that there are no detectable freephase hydrocarbons sitting on top of the shallow water table.

All other concentrations were found to be below the S.I. No. 9/2010 - European Communities Environmental Objectives (Groundwater) Regulations 2010.

7.3.3 Appraisal Method used for Assessment of Proposed Impacts

The method used for assessing the impacts is based on "*Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*" (NRA, 2009).

(a) Matrix of Impacts

(i) Importance

The importance or sensitivity of groundwater in the study area was determined using the criteria set out in Table 7-7 below

Table 7-7 Criteria for Rating Importance of Hydrogeology Attributes

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

(ii) Magnitude

The magnitude of impacts was determined using the criteria set out in Table 7-8 below.

Table 7-8 Criteria for Rating the Magnitude of Impacts

Magnitude of Impact	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

No beneficial impacts on groundwater are usually produced by road schemes. This is also the case in relation to the proposed development.

(iii) Significance

The significance of impacts was determined using the criteria set out in Table 7-9 below.

Table 7-9 Criteria for Rating the Significance of Impacts. of the Proposed Development

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

(b) Attribute importance

Table 7-10 summarises the importance of the attributes within the study area based on the NRA *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*.

Table 7-10 Attribute Importance within the Study Area

Attribute	Attribute Importance	Rationale
Superficial Aquifer	Medium	No shallow aquifer has been defined by GSI National Draft Aquifer Map. However some PWS usage is understood to be sourced from this aquifer.
Bedrock	Very High	Regionally Important Aquifer
River Feale	Extremely High	River Feale has SAC status
PWS – Drinking & Agriculture	Medium	Private water supply usage is considered of medium value at local scale
Ballygrenane Stream	Medium	Value on a local scale due to connectivity with the wider River Feale and Lower Shannon SAC.

(c) Potential Construction Phase Proposed Impacts

During construction, the following activities have been identified as potentially impacting groundwater or groundwater fed attributes.

(i) Construction of Pilings

The two abutments and intermediate pier for the bridge over the River Feale will be piled approximately 12-15 m below ground level to bedrock, based on the bridge design.

Piling can potentially adversely impact upon the shallow groundwater regime (and indirectly in the deeper bedrock groundwater) through the following mechanisms:

- *Mobilization of potential contaminants into the shallow groundwater through preferential pathways created by the driving of piles;*
- *Displacement into the shallow groundwater of potentially contaminated solid materials (i.e. from the shallow soil or made ground) during piles driving;*
- *Pollution of the groundwater regime and associated receptors, in particular the River Feale potentially in hydraulic connection, as a result of the injection of pressurized concrete, cement or grout; and*
- *Local groundwater flow disturbance.*

No contaminants were found from environmental samples taken within the encountered strata of 41 trial pits along the proposed development, see Section 7.1: Soils and Geology. However the potential risk cannot be ruled out. Potential impacts on the drift and bedrock aquifers are assessed as Small Adverse, resulting in a potential significance of Significant/Moderate for bedrock and Slight for drift.

Potential groundwater flow disturbance is expected to be very localised and of imperceptible significance to the aquifers and River Feale.

(ii) Cuttings

The proposed development has few cuttings and most are of maximum approximate depth of 0.5 m along the mainline. The only potential significant cutting is 6 m long and approximately 5 m deep for the proposed underpass ST11. ST11 is not expected to intercept the bedrock as the superficial layer in the area is at least 10 m deep.

The underpass ST11 is located near to PWS W02 and W03.

Ballygrenane Stream is located approximately 100 m from ST11 (see Figure 8.1.2).

The potential significance of impacts without mitigation of underpass ST11 cutting on groundwater is detailed in Table 7-11.

Table 7-11 Rationale and method used to appraise the significance of construction impacts upon groundwater and groundwater fed attributes from cutting activities

Attribute	Rationale	Importance	Magnitude	Significance of Impact
Superficial Aquifer	The cutting for underpass ST11 may cause a temporary local groundwater lowering in the locality of the underpass because the groundwater level in the superficial aquifer is at or near the surface level.	Medium	Small Adverse	Slight
Ballygrenane Stream	The stream is located approximately a 100 m from the cutting ST11. ST11 may cause a temporary local groundwater lowering in the locality of the underpass. This may in turn reduce the amount of groundwater feeding into the stream and lower its water levels temporarily.	Medium	Small Adverse	Slight
PWS – W02	The underpass ST11 is located 120 m from the PWS W02. W02 is 42 m from the proposed development and is expected to abstract from the bedrock aquifer.	Medium	Negligible to none	Imperceptible to none
PWS – W03	The underpass ST11 is located 120 m from the PWS W03, which is of unknown depth. To cover a worse-case scenario, W03 is assumed to be shallow for the purpose of this assessment and sourced from the drift aquifer.	Medium	Small Adverse	Slight
PWS – W05, W06 and W08	Wells W05, W06 and W08 are located over 1 km form the underpass ST11, north of the River Feale.	Medium	None	None

(iii) Preloading of Earthwork Embankments

The proposed development consists of a number of embankments, e.g.. the embankment created for the bridge over the River Feale. The construction of embankments may result in localised compaction of superficial deposits. However, in groundwater flow terms, this would result in localised impacts of small adverse magnitude of proposed impact on drift aquifer; which will result in a Slight significance of impact.

No potential impact is expected on bedrock groundwater and groundwater feed attributes.

(iv) Accidental Spillages and Contaminated Runoff

During the construction phase there is the risk of accidental spillage of fuels from vehicle and construction plant, or potentially contaminated runoff from materials imported or reworked on site (i.e. remobilisation of residual pollutants in made ground or shallow alluvium), which could infiltrate into the ground and pollute the underlying groundwater, which is shallow and therefore highly vulnerable to pollution.

Accidental spillages on surface water receptors are assessed in Chapter 8.

The potential significance of impacts without mitigation of accidental spillages or contaminated runoff on groundwater is detailed in Table 7-12 below.

Table 7-12 Rationale and method used to appraise the significance of construction impacts upon groundwater and groundwater fed attributes from accidental spillages and contaminated runoff

Attribute	Rationale	Importance	Magnitude	Significance of Impacts
Superficial Aquifer	Groundwater level is shallow in various parts of the proposed development.	Medium	Moderate Adverse	Moderate
Bedrock Aquifer	The bedrock aquifer has a degree of protection from the drift cover.	Very High	Small Adverse	Significant / Moderate
PWS – W02	PWS W02 draws water from the bedrock aquifer and is located 120 m form the proposed development's centreline	Medium	Small Adverse	Imperceptible to none
PWS – W03	The depth of PWS W03 is unknown. To cover the worse-case scenario, W03 is assumed to be shallow for the purpose of this assessment and sourced from the drift aquifer. This supply is located 120 m away from the proposed development's centreline.	Medium	Small Adverse	Slight
PWS – W05	PWS W05 is located in the superficial aquifer and is located 20 m from the proposed development. The quality of shallow private water supplies located nearby to the proposed development could be adversely impacted (indirect impacts) to pollution to the superficial aquifer	Medium	Moderate Adverse	Moderate

Attribute	Rationale	Importance	Magnitude	Significance of Impacts
PWS – W06	The depth of PWS W06 is unknown. To cover the worse-case scenario, W06 is assumed to be shallow for the purpose of this assessment and sourced from the drift aquifer. W06 is located 20 m from the proposed development	Medium	Medium	Moderate
PWS – W08	PWS W08 draws water from the bedrock aquifer. W08 is located 40 m away from the proposed development's centreline	Medium	Negligible to none	Imperceptible to none

(d) Operational Impacts

Most impacts identified during the construction phase are likely to remain applicable during the operational phase, but the magnitude of impact is expected to be lesser.

During operation, the following additional activity has been identified as potentially impacting groundwater or groundwater fed attributes.

(i) Road Runoff

Without mitigation measures, there is a risk that the proposed road drainage system could act as a potential source of contamination. An unlined drainage system composed of the surface water channel's attenuation ponds and constructed wetlands would act as areas of preferential infiltration.

Without mitigation the significance of these potential impacts upon attributes are outlined in Table 7-13.

Table 7-13 Rationale and method used to appraise the significance of operational impacts upon groundwater and groundwater fed attributes from dispersion of contaminants from road drainage ponds and constructed wetlands

Attribute	Rationale	Importance	Magnitude	Significance of Impacts
Superficial Aquifer	A degree of infiltration into the ground and is expected from the attenuation ponds and wetlands.	Medium	Moderate Adverse	Moderate
Bedrock	*The bedrock aquifer has a degree of protection from the drift cover.*	Very High	Small Advert	Significant/Moderate
PWS – W02	PWS W02 draws water from the bedrock aquifer *and is located >250 m from an attenuation ponds.*	Medium	Negligible to none	Imperceptible to none
PWS – W03	The depth of PWS W03 is unknown. To cover the worse-case scenario, W03 is assumed to be shallow for the purpose of this assessment and sourced from the drift aquifer. This	Medium	Moderate Adverse	Moderate
	supply is located 90 m from an attenuation ponds			
PWS – W05	PWS W05 is located in the superficial aquifer and is located c.150 m from an attenuation pond	Medium	Moderate Adverse	Moderate
PWS – W06	The depth of PWS W06 is unknown. To cover the worse-case scenario, W06 is assumed to be shallow for the purpose of this assessment and sourced from the drift aquifer. W06 is located about 290 m from an attenuation pond.	Medium	Negligible to none	Imperceptible to none
PWS– W08	PWS W08 draws water from the bedrock aquifer. W08 is located >500 m from the attenuation ponds.	Medium	Negligible to none	Imperceptible to none

(e) 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 other than the current existing conditions.

7.3.4 Proposed Mitigation and Avoidance Measures

(a) Construction

The construction mitigation measures will aim to reduce the significance of impacts to imperceptible. During construction, the following mitigation measures will be implemented to mitigate or ameliorate potential impacts upon groundwater or groundwater fed attributes.

(i) Piling

To avoid impacts to groundwater or groundwater fed attributes from piling activities piling will be completed in accordance with Environment Agency (England and Wales) (2001) Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. Although no contamination has been identified in the areas to be piled based on the available ground investigation date and desk study undertaken, the below mitigation measures are included in the event of encountering contamination not identified during the ground investigation works:

- *A piling risk assessment will be developed by the Contractor;*
- *In the event of potential contamination being found, remediate shallow groundwater prior to piling;*
- *Immobilise or remediate potential contaminants in soil through which piles pass;*
- *Isolate potential contamination around piles from groundwater flow and infiltration (e.g. surface cover, in ground barriers);*
- *Use of bentonite during boring or driving;*
- *Grout pile or stone column after installation;*
- *Use of a permanent or temporary casing; and*
- *Use piles with pointed or convex butt ends or driving shoes.*

(ii) Cutting

In the unlikely event of intercepting contaminated groundwater in cutting areas, contaminated groundwater will not be discharged on site and will be tankered off site to an appropriate facility.

(iii) Preloading of Earthwork Embankments and Construction of Piled Sections

No mitigation measure is required.

(iv) Accidental Spillages and Contaminated Runoff

To mitigate the potential impact form accidental spills and contaminated runoff all works will comply with the following guidelines:

- *CIRIA (2002). Control of Water Pollution from Construction Sites - Guide to good Practice; and*
- *Working at Construction and Demolition Sites: PPG6 – Pollution Prevention Guidelines (available at http://www.environment-agency.gov.uk).*

In addition:

- *Temporary construction surface drainage and sediment control measures will be in place before earthworks commence;*
- *Groundwater intercepted at the proposed underpass ST11 will be tested and if found to be contaminated will be tankered off site to a licenced facility;*
- *No storage of hydrocarbons or any toxic chemicals will occur within 50 m of a 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 procedure;*
- *Measures will be taken to minimise waste and ensure correct handling, storage and disposal of waste (most notably wet concrete, pile arisings and asphalt), as detailed further in Chapter 13 Waste Management; and*
- *Other mitigation measures relating to the protection of the surface water environment are covered in Chapter 8: Hydrology, Geomorphology and Hydromorphology.*

(v) Private Water Supply

In addition to the mitigation measures proposed, the water quality of wells PWS W03, W05 and W06 will be monitored and analysed monthly for quality purposes by the contractor prior to the commencement of and during the construction works to ensure no detrimental affects to these supplies. The groundwater quality during construction will be compared to the EIS and pre-construction monitoring result on a monthly basis by the contractor in the form of analysis by a suitably qualified hydrogeologist. This assessment will be undertaken and sent to the client representative on a monthly basis for review. Any operational well (PWS W03, W05 and W06) whose quality has been deemed to be adversely impacted by the construction activities will be replaced or connection to the mains water supply will be provided by the contractor, subject to agreement with the landowner.

(b) Operation

(i) Road Runoff

To avoid impact to groundwater resources from road runoff during the operation of the proposed development:

- *The road drainage network will be lined in its entire length. Oil interceptors will be installed before the construction of the attenuation ponds on all six outfalls;*
- *The attenuation ponds and the constructed wetlands will be lined and have a penstock valve to contain any accidental spillage;*
- *A contaminant spill emergency plan will be put in place to contain, remove or remediate any catastrophic spill before it reaches any groundwater or surface water receptor. Emergency equipment/spill kits to facilitate the implementation of such plan will be made available in secured locations within the area; and*
- *The water quality of wells PWS W03, W05 and W06 will be analysed monthly as carried out during the construction phase during the first year of the proposed developments operation.*

(c) Residual Impacts

The residual impacts associated with the proposed development after adherence to the mitigation measures during construction phase are summarised in Table 7-14.

Table 7-14 Residual impact after mitigation measures

	Attributes	Activity	Significance Pre Mitigation	Significance of Impact Post Mitigation
,Construction				
	Superficial aquifer	Piling - quality	Significant/Moderate	Imperceptible
	Bedrock aquifer		Slight	Imperceptible
	Aquifers and River Feale	Piling - flow	Imperceptible	Imperceptible
	Superficial aquifer	Cutting	Slight	Slight
	Ballygrenane Stream		Slight	Slight
	PWS – W02		Imperceptible to none	Imperceptible to none
	PWS – W03		Slight	Slight
	PWS – W05, W06, and W08		Slight	Slight
	Superficial aquifer	Embankment	Slight	Slight
	Superficial aquifer	Accidental Spillages and Runoff	Moderate	Imperceptible
	Bedrock Aquifer		Significant / Moderate	Imperceptible
	PWS – W02		Slight	Slight
	PWS – W03		Slight	Imperceptible
	PWS – W05		Moderate	Imperceptible
	PWS – W06		Moderate	Imperceptible

	Attributes	Activity	Significance Pre Mitigation	Significance of Impact Post Mitigation
	PWS – W08		Imperceptible to none	Imperceptible to none
Operation				
	Superficial aquifer	Accidental Spillages and Runoff	Moderate	Imperceptible
	Bedrock		Moderate	Imperceptible
	PWS – W02		Imperceptible to none	Imperceptible to none
	PWS – W03		Moderate	Imperceptible
	PWS – W05		Moderate	Imperceptible
	PWS – W06		Imperceptible to none	Imperceptible to none
	PWS– W08			

7.3.5 Difficulties Encountered in Compiling Information

Although the consultation was attempted for 121 properties of both residential and business premises in the study area, no response was received from 77 properties. Therefore, it is possible that Table 7-1 does not include all the operating private water supplies (wells and springs) within the study area.

7.3.6 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.

8 Hydrology, Geomorphology & Hydromorphology

8.1 Introduction

This chapter considers and assesses the existing hydrological, geomorphologic and hydromorphological environment and the likely significant potential impacts associated with both the construction and operation of the proposed development.

The potential impacts on various hydrological 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);*
- *The construction and operation of the proposed River Feale bridge crossing;*
- *Installation of culverts over watercourses associated with the offline sections of the proposed development and side road junctions;*
- *Watercourse crossings and realignments required as a result of the proposed development;*
- *Increased flood risk as a result of reducing the conveyance of the existing watercourse and floodplain network, reducing the volume of flood storage available on the watercourse floodplains and/or increasing runoff rates and volume; and*
- *Construction work in or adjacent to watercourses.*

8.2 Hydrology Water Quality Assessment

This section describes the existing hydrological environment and the likely significant potential impacts on water quality associated with both the construction and operation of the proposed development.

8.2.1 Introduction

The following section details the guidelines and legislation of relevance to this assessment. In addition, details of the desk studies, field surveys and consultation undertaken are also provided.

(a) Guidance & Legislation

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);*
- *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).*

The EU Water Framework Directive (2000/60/EC) established a framework for the protection of both surface and ground waters. 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 by 2015. This is currently being achieved through the implementation of River Basin Management Plans (RBMPs). The RBMP of relevance to this assessment (the Shannon RBMP 2009-2015) was adopted in 2009 and includes a programme of measures required to facilitate the achievement of the Water Framework Directive (WFD) objectives.

The programme of measures to be implemented includes full implementation of existing legislation including the Bathing Water Quality Regulations (including the development of Bathing Water Management Plans), Water Pollution Acts, Water Services Act, 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 RBMP is currently underway and the second consolidated RBMP25 is currently out for public consultation.

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

- *SI No. 722 of 2003, European Communities (Water Policy) Regulations, as amended;*
- *SI 792 of 2009, European Communities Environmental Objective (Surface Water) Regulations 2009 as amended;*
- *SI 350 of 2014, European Union (Water Policy) Regulations 2014;*
- *The EU Floods Directive 2007/60/EC;*
- *SI 122 of 2010 European Communities (Assessment and Management of Flood Risks) Regulations;*
- *SI 81 of 1988, European Community Environmental (Quality of Surface Water Intended for Human Consumption) Regulations 1984 as amended; and*
- *SI 293 of 1988, European Communities (Quality of Salmonid Waters) Regulations 1988.*

(b) Desk Study

A desk study was carried out to collate the available information on the hydrology of the study area (250 m beyond the landtake boundary of the proposed development). The following data sources were referred to during this assessment:

- *Ordnance Survey of Ireland (current and historic mapping);*
- *Environmental Protection Agency:*
  - *Water Quality Monitoring Database and Reports; and*
  - *EPA flow and water level measurements (EPA Hydronet System).*
- *Water Framework Directive Ireland Database (http://www.wfdireland.ie/);*
- *The Shannon River Basin District Management Plan (SWRBDMP) and the Feale Water Management Unit (WMU) Action Plan;*
- *National Parks and Wildlife Service (designated sites);*

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

- *Kerry County Council Development Plan 2009 - 2015;*
- *Listowel Town Development Plan 2009-2015;*
- *Inland Fisheries Ireland (IFI);*
- *Office of Public Works (OPW); and*
- *The Shannon Catchment Flood Risk Assessment and Management Study (CFRAMS) (OPW ongoing).*

(c) 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 during February and June 2013 within the proposed development footprint and extended as required to include other relevant hydrological aspects. Visual inspections were made of the River Feale and the minor watercourses and drainage ditches in the study area.

Surveys in June 2013 included the assessment of the baseline hydromorphology (physical form) and basic flow and sediment dynamics of the River Feale and the minor watercourses and drainage ditches in the study area.

As part of the CFRAM Study, topographical and bathymetric surveys of the River Feale were undertaken. Information obtained from these surveys was made available for the purpose of the Flood Risk Assessment (FRA) for the proposed development. To supplement the existing topographical information further topographical surveys were undertaken at the minor watercourses in the study area in May 2013.

(d) Baseline Water Quality Monitoring

Baseline water quality monitoring was undertaken in line with TII guidance in February and June 2013. Water quality samples were taken at ten locations; see Figure 8.1.1. In situ sampling provided results for the following suite of parameters:

- *Temperature;*
- *pH;*
- *Conductivity;*
- *Dissolved Oxygen (DO); and*
- *Transparency.*

The following physico-chemical parameters were analysed for collected samples in an internationality accredited laboratory[26]:

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

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

8.2.2 Consultation

Consultation on the hydrological impact assessment was undertaken with the following organisations:

- *The National Parks and Wildlife Service (NPWS);*
- *The Office of Public Works (OPW);*
- *Water Service Department of Kerry County Council and Irish Water; and*
- *Inland Fisheries Ireland (IFI).*

A meeting was held with the NPWS in May 2013 to discuss the scope of the ecological assessment for the N69 Listowel Bypass and River Feale crossing options. At this meeting the NPWS recommended that a "Train" system of drainage should be adopted for the proposed development i.e. an oil interceptor, attenuation pond and constructed wetland in series.

A meeting was held with the IFI in August 2013 to discuss the proposed development and the River Feale bridge crossing. At this meeting the IFI recommended that a forebay should also be included in the drainage design. Further consultation was carried out with the IFI in May 2014 on the overall proposed development design.

The OPW were consulted throughout the development of the Flood Risk Assessment for the proposed development. At a meeting with the OPW in March 2013 the OPW granted Kerry NRDO use of Shannon CFRAMS Modelling Information for the proposed development.

Kerry NRDO liaised with Water Service Department of Kerry County Council and Irish Water during the development of the proposed design.

See Chapter 6: Flora and Fauna and Appendix 6.1 for consultation undertaken as part of the terrestrial and aquatic ecological impacts assessment.

8.2.3 Description of the Existing Environment

(a) Study Area

In line with the '*NRA Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes',* 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 study area lies within the Shannon River Basin District, Hydrometric Area 23 within the Feale Water Management Unit. The catchment of this hydrometric area is drained by the River Feale with all associated watercourses entering tidal water in the Cashen / Feale Estuary, north-west of Listowel.

(b) Major Surface Waterbodies

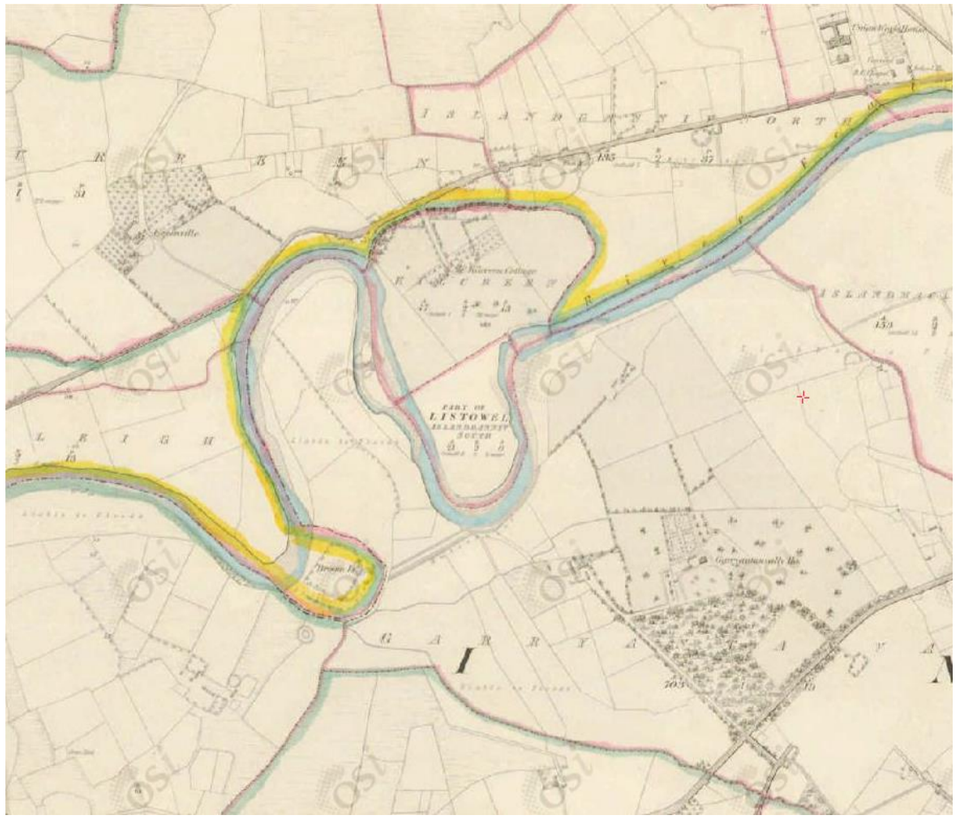
The main surface water feature within the study area is the River Feale (SH_23_2941[27]); as shown in Figure 8.1.1 to 8.1.6. The Feale rises in the mountains of north Cork and flows for approximately 74 km through the towns of Abbeyfeale and Listowel before entering the sea at Ballybunion. The catchment area is 1,165 km^2 and the river derives its flow principally from runoff. It is typically a fast flowing spate river subject to flooding (O'Reilly, 2004).

[27] WFD Water body code

The main tributaries of the Feale are the Galey (42 km) and the Brick (11 km) which enter the river downstream of Listowel; the Smearlagh (22.5 km), Oolagh (12.5 km), and Allaghan (23 km) which enter downstream of Abbeyfeale; and the Owveg (11 km), Clydagh (9.5 km), Breanagh (5.5 km) and Caher (4 km) which join the upper reaches of the Feale. The Smearlagh River joins the River Feale immediately to the east of Listowel Town. The river is tidal up to Finuge Bridge to the west of the study area. Drainage works were undertaken on the main channel of the River Feale downstream of Listowel during the 1970's. The river is embanked in its lower reaches.

The current route of the River Feale west of Listowel is not the historical route; it is noted that there were two bends in the river through the townlands of Kilgreen, Islandglaniv and Garryvantanvally. The historical route of the River Feale through the site is shown in blue in Image 8-1 below. It is thought that the River Feale was realigned to allow the reclamation of land in the 1840s.

Image 8-1 Historical Route of the River Feale



In addition to the works mentioned above, the River Feale catchment area was the subject of a comprehensive arterial drainage scheme carried out by the Commissioners of Public Works (now the OPW) between 1951 and 1959. As part of these works, the river channel was deepened and a number of informal flood embankments were constructed at various sections of the River Feale, including sections within the study area site. From discussions with the OPW, it is thought that the embankments were constructed from the dredged materials (boulder clay, silts and gravel) from the river deepening works.

(c) Minor Surface Water features

There are nine minor watercourses in the study area none of which are classed as WFD water bodies. WF2 to WF10 are classified as EPA 1st order streams. Mill Steam Upper (WF0) and Mill Stream Lower (WF1) are not classified as either WFD waterbodies or EPA streams, see Figure 8.1.1.

Table 8-1 Minor Watercourses in the Study Area

No.	Water Feature	Description of Minor Watercourses
WF0	Mill Stream Upper	• Located north of the River Feale and joins the Mill Stream Lower at Kilcreen.
WF1	Mill Stream Lower	• The mill stream follows the path of the historical River Feale and enters the River Feale at Scartleigh.
WF2	Finuge	• Lies south west of the study area and enters the River Feale at Finuge.
WF3	Coolnaleen - Lower	• Lies south west of the study area and enters the Ballygrenane before it enters the River Feale at Coolnaleen
WF4	Ballygrenane	• Lies south of the study area and enters the River Feale at Finuge
WF5	Garryantanvally	• Lies south of the study area and flows east to west to join the Ballygrenane Stream before it enters the River Feale at Finuge
WF6	Islandganniv - North	• Lies south of the study area and flows east to west to enter the River Feale at Garryantanvally.
WF7	Kilcreen	• Lies in the south of the study area and flows north to enter the river Feale at Islandmacloughry.
WF8	Dromin Lower	• Lies to the east of the study area in the townland of Dromin and Ballinruddery, enters the Rive Feale at two locations.
WF9	Dromin Upper	• Lies to the north east of the study area in the townland of Ballygowloge where it enters the River Feale. However it is likely that this water course is culverted through Listowel as no evidence of this was seen on the surface but the entry point to the River Feale was observed.
WF10	Derra West stream	• Lies to the north east of the study area in the townland of Derra West; it enters the Galey River to the west in the townland of Dromloughra.

Further detailed descriptions of the watercourses crossed by the proposed development are provided in Section 8.3 Geomorphology and Hydromorphology.

There are also a number of unnamed drainage ditches within the study area.

(d) Overview of Surface Water Quality

(i) Water Quality and the Water Framework Directive Classification

The study area lies within the Shannon RBD and the Feale Water Management Unit (WMU). The River Waterbody WFD Status is shown in Table 8-2.

Table 8-2 WFD Waterbodies and Current Status in or adjacent to the Study ***Area***

Water Body	HMWB	Waterbody Code	Type	Status[28]	Element causing less than good	Achieve Good Status by
River Feale	No	IE_SH_23_2941	River	Good	N/A	N/A
Upper Feale Estuary	No	IE_SH_060_0200	Estuarine	Good	N/A	N/A
Galey River[29]	No	IE_SH_23_2931	River	Not monitored	N/A	N/A

[28] River Waterbody WFD Status for the period 2007-2009 taken from EPA Envision Mapper
[29] Also referred to as the Derra West River.

(ii) Water Quality and EPA Classification

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. There are two monitoring stations in the study area and Table 8-3 provides details of the current Q water quality status of this river.

Table 8-3 EPA Monitoring Station Locations and Current Status

EPA Station No	Location	Q Value	Status
23009	Listowel Weir	Q3-4	Moderate
23002	Listowel	Q3-4	Moderate

(e) Baseline Water Quality monitoring results

Baseline water quality monitoring was undertaken in March and June 2013 at various locations along the River Feale and surrounding watercourses see Figure 8.1.1 to 8.1.6, in line with the *NRA 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 8.1. 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 were all under the 25 mg/l annual average [30]for salmonid waters.

(f) Flow Measurements

Flow measurements are taken throughout the Republic of Ireland by the OPW and the EPA. Within the study area the OPW measure water level and flow on the River Feale at station no. 23002. The EPA measure water level and flow on the River Smearlagh at station no. 23017 and on the River Feale outside the study area at station no. 23006 and station no. 23007, in proximity to Abbeyfeale.

(g) Low Flow Estimates

Low flow (Q95) was estimated for the River Feale and the watercourses that are proposed to receive road runoff from the proposed development; these are presented in Table 8-4.

Table 8-4 Low Flow Estimates in the River Feale and other water feature receiving discharge

Water course	Derived Catchment Area (km^2)	Q95 (m^3/s)
River Feale	646	1.41
Mill Steam Lower (WF1)	3.465	0.002665
Mill Steam Upper (WF0)	2.223	0.00171
Unnamed Drainage Ditch (drain to WF10)	0.012	0.000009
Garryantanvally (WF5)	0.350	0.000364
Ballygrenane (WF4)	0.766	0.000795

[30] S.I. No. 293/1988:European Communities (Quality of Salmonid Waters) Regulations, 1988.

Low Flow (Q95) was estimated to be below 0.001 m^3/s in a number of the smaller watercourses and was especially low for the above unnamed drainage ditch.

(h) Public Water Supply Sources

The study area is served by the Dromin Water Works north of the existing N69 which is connected to the main Kerry County Council water supply. The plant serves approximately 5,000 – 6,000 people therefore the supply is considered a regional water supply. Water is abstracted from the River Feale at Scartleigh to serve the Dromin Water Works. This abstraction point is located over 600 m west downstream of the proposed development.

(i) Discharges and IPPC Licences

There are two licenced discharge points on the Feale in the vicinity of the study area. Kerry County Council operates a Waste Water Treatment Plant (WWTP Licence no. D0179-01) west of the study area in the townland of Gortnaminsha. Kerry Ingredients (Ireland) Limited operating under IPPC licence (P0393-02) discharges to the River Feale east of the study area within the town of Listowel.

(j) Ecological Designations

There are three european and one nationally designated site within 5 km of the proposed development. Full details of all the designated areas are included in Chapter 6: Flora and Fauna.

- *Lower River Shannon Special Area of Conservation (SAC, site code: 2165);*
- *Moanveanlagh Bog Special Area of Conservation (SAC, site code: 2351);*
- *Stacks to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle Special Protection Area (SPA, site code: 4161); and*
- *Moanveanlagh Bog proposed Natural Heritage Area (pNHA site code: 0374).*

The River Feale (which runs through the study area) forms part of the Lower River Shannon SAC (002165)[31] and is an important site for fish such as salmon, trout, and pearl mussel. The Stacks to Mullaghareirk Mountains SPA is located 2 km south of the proposed development. The Moanveanlagh Bog SAC and pNHA is located approximately 2 km east of the proposed development with Listowel Town lying between the location of the proposed development and this site.

(k) Fisheries

The River Feale is designated a Salmonid water under the European Communities (Quality of Salmonid Waters) Regulations, 1988, and it is considered to be a Nationally important river system for Atlantic salmon and Brown trout. Previous studies undertaken in relation to the proposed development noted the presence of holding pools for Atlantic salmon in the vicinity of the proposed crossing point, and spawning and nursery areas were present throughout the lower River Feale in the locality (Mott MacDonald, 2009 and Ryan Hanley, 2012).

All three species of lamprey are found in the River Feale with juvenile lamprey previously recorded at sampling stations at the Listowel Racecourse footbridge and upstream of the weir at Scartleigh (O'Connor, 2006). The larvae (or ammocoetes) of these species burrow into fine silts in areas of slack flow along the river bank, a habitat that is not present at the proposed crossing point.

[31] http://www.npws.ie/protectedsites/specialareasofconservationsac/lowerrivershannonsac/

- The fishing rights of the lower River Feale are controlled by both the North Kerry Anglers' Association and a private owner. The main angling pools on the lower river are located in the urban area of Listowel, downstream of Scartleigh Weir, in Joy's fishery which is located in Ballinruddery and the North Kerry Anglers' Association's waters upstream from here.

- The River Feale is one of the most important sea trout fisheries in Ireland and is also known as a salmon fishery. O'Reilly (2004) estimates as many as 2,000 sea trout and 1,500 salmon are caught on the river each year. A large weir is present in the lower reaches of the river at Scartleigh and this may have caused fish passage problems in the past. A new fish pass and fish counter was installed at this site in 2001. The upstream net counts of salmon and sea trout at this weir were 9,581 sea trout and salmon during 2004 and 9,693 sea trout and salmon during 2005 (Source: Marine Institute).

Previous studies undertaken in relation to the proposed development and consultation with the IFI noted the presence of holding pools for Atlantic salmon in the vicinity of the proposed crossing point, and spawning and nursery areas were present throughout the lower River Feale in the locality (Mott MacDonald, 2009 and Ryan Hanley, 2012).

(l) Amenity Areas

Kerry is well known as an international and domestic tourism centre with a varied tourism profile. The physical characteristics of the county, including its waterways, are a key attribute in its tourism offering.

Listowel Town is located on the River Feale, which is an important natural amenity for the town and the county. The River Feale and its immediate vicinity are widely used for recreational activities such as cycling, walking and high quality fishing for salmon and trout.

There are three fishing locations in the vicinity of the proposed development. There are no accessible angling sites in the area[32].

(m) History of Flooding and Flood Risk Assessment

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

The OPW have recorded flood events at Greenville, in the immediate vicinity of the study area; north of the existing N69 at Curraghatoosane, circa 3 km north-west of the study area at Shrone West; and 4 km north-east of the study area at Coilbee.

A Flood Risk Assessment (FRA), in line with Guidelines for Planning Authorities (GPA) 20: The Planning System and Flood Risk Management (OPW, 2009), has been conducted for the proposed development and is contained in Appendix 8.2. A summary of the outputs of this FRA are contained in Section 8.2.9 of this chapter.

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.*

A flood risk (Stage 1) and an Initial Flood Risk Assessment (Stage 2) were carried out as part 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. The Initial Flood Risk Assessment indicated that the site is potentially at high risk from river flooding. There is a lower risk of flooding from overland flow, artificial drainage systems and groundwater. Stage 2 recommended that a Detailed Flood Risk Assessment (Stage 3) was completed for the proposed development.

The Detailed Flood Risk Assessment was carried out to determine:

- *The level of flood risk to the proposed development; and*
- *The impact from the development on the proposed site and elsewhere.*

In addition, the Detailed Flood Risk Assessment has identified and assessed specific mitigation measures to reduce the flood risks to acceptable levels. The Stage 3 Assessment also identified and assessed any remaining residual risks. This assessment has been undertaken using hydraulic modelling. The construction of a hydraulic model also allowed the detailed testing and design of potential mitigation measures; see Appendix 8.2 for full details of the hydraulic model.

8.2.4 Description of the Proposed Development

Full details of the proposed development are provided in Chapter 2: Description of the proposed development. Aspects of relevance to the hydrology impact assessment, particularly water quality, are provided below.

(a) Overview of the Proposed River Feale Bridge Crossing

The proposed structure is a two span arrangement with an intermediate support located within the Lower Shannon SAC, but outside of the high water channel. The south abutment is set-back, with the intermediate pier set-back from the northern edge of the high water channel. The pier set-back allows for a natural bank path to be maintained for future access for maintenance and fishing and includes an allowance for the curvature of the river. The northern back span has been sized to minimise the overall length of the structure while preventing uplift at the abutment bearings. The length of the main span is approximately 69 m with a back span of 45 m, see Figure 2.1.28.

(b) Culverts and Watercourse Realignments

There are four culverts and two watercourse realignments required as part of the proposed development as listed in Table 8-5.

Table 8-5 Culvert and Realignment Locations

Watercourse	Details incl approx. lengths
Upper Mill Stream (WF0)	1 (35 m) on-stream culvert (ST39) and realignment of 200 m
Mill Stream (WF1)	1(25 m) on-stream culvert (ST27)
Ballygrenanae (WF4)	1 (20 m) on-stream culvert (ST13) and realignment of 45 m
Garryantanvally (WF5)	1 (50 m) on-stream culvert (ST15)
Unnamed drainage ditch	1 (25 m) culvert (ST15)

[32] The Inland Fisheries Ireland website http://www.ifigis.ie/AccessibleAnglingMap/ was checked in May 2013.

(c) Drainage

The drainage design for the proposed development is carried out in accordance with the principles set out in the relevant TII guidance and TII Standards. The principal objectives of the road drainage system are as follows:

- *To facilitate the prompt removal of surface water from the carriageway to provide for the safety of road users.*
- *To provide for effective sub-surface drainage to maximise the longevity of the road pavement and embankments by the adequate removal of groundwater.*
- *To minimise the impact of the runoff from the roadways on the surrounding environment via the provision of oil/petrol interceptors, silt traps and attenuation features as necessary.*
- *To facilitate the passage of existing watercourses through the development by the installation of bridge and culvert crossings.*

(i) Overview of the Existing Road Drainage System on the N69 and John B. Keane Road

There was limited information on the existing drainage system for the online section (i.e. the existing N69 and the John B. Keane Road). The carriageway runoff from the existing N69 and the John B. Keane Road is believed to discharge through a series of kerbs, gullies and pipes via three main drainage lines until it reaches the River Feale discharging via three outfalls within Listowel Town north of the River Feale. It is not believed that this discharge is attenuated or treated prior to discharge to the River Feale.

(ii) Overview of Proposed Drainage - Online Section

As part of the upgrade works on the online section of the scheme the width of the existing carriageway will be reduced to comply with TII Standards and to accommodate the shared cycle pedestrian facility. However the impermeable area will remain largely the same and the existing drainage layout will remain in place. Currently the drainage outfalls into the Listowel Town system and it is not therefore possible to segregate it, however there will be minimal change in the volume of runoff to this system as a result of the upgrade works.

(iii) Overview of the Proposed Drainage - Offline Section

Figure 2.1.1 to 2.1.5 depicts the drainage outfall locations for the proposed development. The drainage has been divided into six networks as detailed in Table 8-6.

Table 8-6 Detail of the Drainage Networks and Discharge Rates

Att No.	Contributing Impervious Area (ha)	Limiting Green Field Flow Rates (l/s)	Flow Rates to be attenuated (l/s)	Attenuation Volumes (m3)
A1	1.658	34	106	985
A2	0.936	19	60	565
A3	1.272	26	81	765
A4	2.232	46	143	1340
A5	0.847	17	55	510
A6	1.414	28	91	840

The entire impermeable area being drained by the offline section of the proposed development is approximately 8.5 hectares. The flow rates to be attenuated and the limiting greenfield flow rate are provided in Table 8-6.

Carriageway stormwater runoff can impact on receiving watercourses in two ways:

- *Rate of discharge – if the rate of discharge from the proposed road exceeds that of the existing "greenfield" catchment area then it is possible that overloading of the existing watercourse could occur, causing localised flooding and erosion of watercourse banks within the catchment.*
- *Quality – carriageway runoff can contain pollutants from the carriageway because of the traffic loading on the carriageway.*

In order to minimise the risk of overloading the existing receiver to which the carriageway runoff is being discharged to, it is important to design the outfall so that the rate of discharge does not exceed that of the existing "greenfield" catchment area, i.e. return the runoff rate to the flows that were present in the existing scenario without the proposed development. This has been achieved through the use of attenuation ponds at the proposed outfall locations.

The proposed road drainage system will incorporate for conveyance purposes:

- *Sealed drainage;*
- *Grassed surface water channels; and*
- *Over the edge drainage.*

The proposed road drainage system will incorporate for attenuation/treatment purposes:

- *Oil interceptors; and*
- *Attention and wetland system to include a forebay area.*

Table 2-6 and Chapter 2 provides a summary of the drainage methods proposed along the proposed development.

A sealed drainage system collects, conveys and discharges carriageway runoff via sealed (impervious) conduits.

Grassed surface water channels for use as road edge channels collect and convey rainwater runoff from the road surface similar to swales. These channels can provide mitigation against the impact of carriageway runoffas they have been shown to remove high percentages of suspended solids and metals. The treatment associated with the grassed surface water channels is typically:

- *80% for total suspended solids (TSS);and*
- *50% for dissolved copper and zinc (metals).*

Over the edge drainage is applicable to embankment conditions where the carriageway runoff is conveyed over the edge to open channels/carrier drains/swales at the toe of the embankments.

An oil interceptor will be provided between the carriageway drainage outfall and the attenuation pond 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 put remedial measures in place.

The proposed drainage network has been designed so that water runoff will be conveyed to the nearest attenuation area. Surface water attenuation is designed for a 1 in 100 year plus climate change storm event of critical duration with an allowance for an outflow sized to cater for the existing level of runoff, including that runoff from the existing road (greenfield runoff rate). The attenuation storage requirements will be primarily catered for

at each of the outfall locations by means of attenuation ponds which will incorporate a forebay in conjunction with a wetland area.

Attenuation ponds are considered an appropriate method for providing suitable stormwater storage and controlled means of discharge. The proposed attenuation ponds will store the runoff, allow a degree of settlement to occur and control the discharge into the receiving environment to that of the greenfield run-off rate. An additional benefit of attenuation ponds is that they can also provide a degree of protection against accidental spillage on the road from entering a receiving watercourse, giving the relevant authority time to organise appropriate remedial measures.

Carriageway runoff may contain pollutants that can have an adverse effect on the quality of the water within the receiving watercourse or waterbody and therefore it is important that the drainage system proposed would provide a form of treatment to ensure that any negative impact is reduced. It is therefore proposed to provide constructed wetland systems in tandem with the attenuation ponds to ensure the quality of the discharge at the outfall locations.

The constructed wetland systems would provide mitigation against the impact of carriageway runoff. Constructed wetland systems have been shown to remove high percentages of suspended solids, phosphorous and metals. They can also reduce the Biological Oxygen Demand of stormwater runoff. Pollutant removal is achieved through actions of both filtration and biological activity; they achieve this by adhesion to aquatic vegetation and aerobic decomposition. The wetlands shall each have a permanent pool of water at varying depths, and shall 'drain down' additional runoff water in no less than 24 hours for treatment while discharging into the receiving watercourse.

Typical expected treatment values are as follows for the attenuation pond/wetland system[33]:

- *70% to 95% for total suspended solids (TSS);*
- *50% to 85% for hydrocarbons;*
- *40% to 75% for various metals; and*
- *up to 40% for the dissolved metal fraction.*

8.2.5 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)*. Impact quality, type, magnitude/significance and duration are considered relative to the importance of the hydrological attributes; see Table 8-7 to Table 8-9. Reference has also been made to the TII standard, HD 45/15.

[33] EPA (2000) Impact Assessment of Highway Drainage on Surface Water Quality 2000-MS-13-M2 Main Report. The following report is also cited, Mudge, G. and Ellis, J. (2001). Guidelines for the Environmental Management of Highways. Technical report, Chapter 4, 67-102, The Institution of Highways and Transportation, London, UK.

Table 8-7 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 scale	Salmon fishery Locally important potable water source supplying >1000 homes 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 8-8 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

Magnitude of Impact	Criteria	Examples
		Reduction in predicted peak flood level >10 mm1 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
Major Beneficial	Results in major improvement of attribute quality	Reduction in predicted peak flood level >100 mm

Table 8-9 Rating of Significant Environmental Impacts

		Magnitude of impact			
		Negligible	Small	Moderate	Large
Importance of Attribute	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

(a) Highways Agency Water Risk Assessment Tool (HAWRAT)

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. This method centres on the HA Water Risk Assessment Tool (HAWRAT) and is used in the following assessment. The HAWRAT has subsequently been implemented trough TII standard 45/15.

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 8-10.

Table 8-10 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 the receiving watercourse;	• 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 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

8.2.6 Attribute Importance

Table 8-11 summarises the importance of the attributes within the study area based on the NRA *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*.

Table 8-11 Attribute Importance within the Study Area

Attribute	Attribute Importance	Rationale
River Feale	Extremely High	Part of the Lower Shannon SAC. Also has importance from an amenity and fishery perspective.
Listowel Water Supply	Very High	Regionally important potable water source supplying >2500
Mill stream (WF0 & WF1)	Medium	Value on a local scale due to connectivity with the wider River Feale and Lower Shannon SAC.
Other Watercourse and Channels (WF 2 - WF10)	Medium	Value on a local scale due to connectivity with the wider River Feale and Lower Shannon SAC.
Other unnamed drainage ditches	Low	Value on a local scale due to connectivity with the wider River Feale / Galey River and Lower Shannon SAC.

8.2.7 Predicted Impacts of the Proposed Development

This section considers and assesses the impact of the proposed development with regards to water quality. Impacts on the geomorphological and hydromorphological aspects are considered in Section 8.3. Flooding Impacts are addressed in the FRA specialist report contained in Appendix 8.2 and are summarised in Section 8.2.9.

(a) Construction Impacts

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:

- *Installation of the bridge structure with a clear span over the River Feale;*
- *Construction works within and adjacent to watercourses including provision of culverts and watercourse realignments;*
- *Excavations including those associated with the provision of drainage works;*
- *Site clearance works;*
- *Reconstructive and resurfacing works on the online section;*
- *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 114 m bridge structure over the River Feale. The construction of this structure will likely require the following elements however it is noted that the construction sequencing (see Appendix 8.5) will be up to the appointed construction contractor but will be in accordance with this EIS,:

- *The installation of temporary sheet piles on the northern bank to allow for the installation of the northern pier wall to enable the pier construction;*
- *Piling to bedrock for the installation of the north and south abutment and the northern pier;*
- *Casting of the north and south abutment and the northern pier;*
- *Ground profiling on the northern bank of the river to allow for crane access;*
- *Placement of bridge beams;*
- *Casting of the bridge deck and diaphragm; and*
- *Backfilling and finishes for the bridge.*

Culverts will be provided on WF0, WF1, WF4 and WF5. A 200 m section of WF0 will require realignment; see Figure 2.1.2 - 2.1.5 for details of the location of the proposed new culverts and watercourse realignments for the proposed development.

Chapter 2 of this EIS details the proposed drainage design for the proposed development and Figure 2.1.1 - 2.1.5 shows the locations of the six new attenuation pond/wetland systems. Attenuation/treatment ponds will be required adjacent to WF0, WF1, WF3, WF4 and the Rive Feale.

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.

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 have the potential to 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.

The construction period for the proposed development will be approximately 24 months.

Potential impacts from the construction works in the absence of construction phase mitigation measures on the various sensitive receptors (watercourses) are described below.

The River Feale forms part of the Lower Shannon SAC, which is considered to be an attribute of extremely high importance using the NRA guidelines classification. Any impact associated with increased sediment release or anthropogenic polluting substances during construction including installation of the bridge as described above could have an impact on this SAC. Ecological Impacts on the Lower Shannon SAC are considered in full in Chapter 6: Flora & Fauna. Impacts on water quality of the River Feale from the construction of the proposed development are considered to be direct (construction of the bridge) and indirect (runoff, spills), temporary, negative, and profound.

In addition the River Feale is a source of drinking water for Listowel Town with the abstraction point located approximately 600 m downstream of the proposed crossing point. Any increased sediment release or anthropogenic polluting substances during construction could have an impact on this public water supply. In addition, there is a potential for anthropogenic substances to enter the watercourse therefore impacts on water supply from the construction of the proposed development are considered to be indirect, temporary, negative, and significant.

In addition to general construction works in the vicinity of Mill Stream Upper (WF0) the Mill Stream Lower (WF1), Ballygrenanae (WF4) and Garryantanvally (WF5) there will also be a requirement for in-stream works in these watercourses. WF0 and WF4 will require a realignment of 200 m and 45 m respectively and the provision of a culvert (ST39 and ST13,), WF1, and WF5 will also require the provision of a culvert (ST27, ST15 respectively). Any impacts associated with increased sediment release during construction could have an impact on these watercourses. This may result in direct, temporary, negative and moderate impacts on these watercourses. Any impacts on the water quality of these attributes associated with the release or anthropogenic polluting substances (particularly a large or hazardous spillage) during construction is considered to be indirect, temporary, negative and significant due to the close proximity of the construction work to these watercourses.

Other watercourses in the study area Finuge (WF2), Coolnaleen Lower (WF3), Islandganniv North (WF6) and Kilcreen (WF7) will not be directly impacted by the construction of the proposed development however, there is a potential for indirect impacts associated with proximity/connectivity to other watercourses and the potential for sediment laden runoff from site clearance works. Impacts on the water quality of these watercourses from the construction of the proposed development are considered to be indirect, temporary, negative and slight.

There are no anticipated construction impacts associated with Dromin Lower (WF8) and Dromin Upper (WF9) due to the distance from the proposed development, see Figure 8.1.1.

There are a number of unnamed drainage ditches in the study area that could be impacted directly and indirectly by the construction of the proposed development. Impacts on the water quality of these watercourses from the construction of the proposed development are considered to be temporary, negative and slight to imperceptible.

The construction phase impacts are summarised in Table 8-17.

(i) Other Potential Impacts during Construction

The River Feale 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 agricultural land. There are a number of residential properties along the Greenville Road and the Forge Road that may utilise the River Feale for amenity purposed 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.

Chapter 6: Flora and Fauna details the impact on key ecological receptors including fish during the construction of the proposed development. The River Feale is also used for recreational fishing and there are known fishing spots in the vicinity of the proposed crossing. Access to these areas may be restricted during the construction phase of the proposed bridge. Therefore, impacts on recreational fishing during construction will be indirect, short term, negative and slight.

(b) Operation Impacts

(i) 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 using the proposed development are as follows:

- *In 2013 (current situation existing N69) the AADT is in the region of 8,000;*
- *By 2032 (future situation existing N69 – Do-Minimum), the AADT would be greater than 10,000 with increased queuing traffic; and*
- *By 2032, (future situation, proposed development in place), AADT for the proposed development will be greater than 9,500 with reduced queuing traffic.*

The HAWRAT was used to assess the carriageway runoff from the proposed development on the receiving watercourses. Two assessments were undertaken: a non-cumulative assessment for outfalls A1 to A6 for soluble acute impact and sediment chronic impact and a cumulative assessment for the outfalls as outlined in Table 8-12.

Table 8-12 Cumulative Assessment Type

Outfalls	Distance between Outfalls	Attribute	Cumulative Assessment Type
A1 & A2	<1 km but >100 m	WF4	Soluble acute impact
A4 & A3	<1 km but >100 m	River Feale	Soluble acute impact

Table 8-13 and Table 8-15 detail the HAWRAT Assessment Results for the Non-cumulative and Cumulative Assessments. These tables show the % removal of pollutants required to achieve required water quality objectives and whether the proposed drainage designs achieve these removals. In each case it can be seen that the proposed measures are adequate and that no additional mitigation measures are required. Full details of the assessment are provided in Appendix 8.3.

Based on the HAWRAT results, the potential impacts to water quality from the operational phase specifically to those waterbodies receiving road runoff (River Feale, WF0, WF1, WF4 and WF5) are assessed as described below.

The results of the non-cumulative (outfall A3) and cumulative assessments (outfalls A4 & A3) indicate that the impacts to the water quality of the River Feale 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.

The results of the non-cumulative (outfall A4) indicate that the impacts to the water quality of the Mill Stream Lower (WF1) 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.

The results of the non-cumulative assessment (outfall A6) indicates that impacts to the water quality of the Mill Stream Upper (WF0) 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.

The results of the non-cumulative (outfall A1) and cumulative assessments (outfalls A1 & A2) indicate that the impacts to the water quality of Ballygrenane (WF4) from the operational phase of the proposed development would be considered to be direct, long term, neutral to negligible due to pollutant removal in the proposed development drainage system.

The results of the non-cumulative assessment (outfall A2) indicates that impacts to the water quality of Garryantanvally (WF5) from the operational phase of the proposed development would be considered to be direct, long term, neutral to negligible due to pollutant removal in the proposed development drainage system.

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.

(ii) Accidental Spillage Risk Assessment

There remains 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 Highways Agency (HA) considers that in:

Circumstances where an outfall discharges within close proximity to (i.e. within 1 km) a protected area for conservation, or 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%.

Table 8-13 Accidental Spillage Risk Assessment Results

Outfall	Attribute	Probability	Acceptable risk
A1	WF4	0.023%	Yes
A2	WF5	0.001%	Yes
A3	River Feale	0.001%	Yes
A4	WF1	0.031%	Yes
A5	Drainage Ditch (WF10 Derra West)	0.001%	Yes
A6	WF1	0.002%	Yes

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 8.4. Table 8.13 shows the probability of an accidental spillage occurring. This is less than 0.5% in all cases therefore, the likelihood of a serous pollution incident is low.

(iii) Other Potential Impacts

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

Chapter 6: Flora and Fauna details the impacts on key ecological receptors with regards to fish during the operation of the proposed development. The River Feale is also used for recreational fishing and there are known fishing spot in the vicinity of the proposed crossing. The design of the bridge is such that the pier of the bridge will be set-back to allow for a natural bank path to be maintained for future access for maintenance and fishing. Impacts on amenity in the areas during operation will be indirect, long term, neutral, imperceptible.

The River Feale is a source of drinking water for Listowel Town with the abstraction point located approximately 600 m downstream of the proposed development. 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 and measures are not required to further reduce the risk of a serious pollution incident. The impacts on water supply from the operation of the proposed development are considered to be direct, temporary, negative, and imperceptible.

Table 8-16 summarises the impacts on water quality for each attribute during the construction and operational phases prior to mitigation (based on NRA, 2009).

8.2.8 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 River Feale could potentially decrease with increased traffic levels, increased incidence of queuing, and subsequent increased pollutant load entering the River Feale via an unattenuated/treated drainage system on the existing N69. In the absence of the proposed development it is anticipated that the baseline water quality of all other watercourses (WF0-WF7) would remain in their current condition.

8.2.9 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 undertaken. The full report is contained in Appendix 8.2. 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 apart from fluvial and overland flow sources. Similarly risk from the proposed development from all potential sources, apart from fluvial sources, was found to be low see Table 8-14.

Table 8-14 Summary of flood risk from the proposed development

Flood Risk	Summary of Risk from the Development Site	Notes	Mitigation Required
Coastal	Low	*The site is situated approximately 10km from the coast*	*X*
Fluvial	Medium	*Floodplain storage has been lost and a barrier to the flow of flood waters has been created. There is also potential increase in flood depth and extent to flooded properties*	√
Estuarial	Low	*The proposed development is situated approximately 10km from the Shannon Estuary and is therefore not considered*	*X*
Overland Flow	Low	*Highway drainage systems will be designed to be adequate to manage flooding from overland flow*	√
Land Drainage Infrastructure	Low	*Highway drainage systems are managed by TII and Kerry County Council and the risk of blockage is considered to be low*	*X*
Groundwater	Low	*New sections of carriageway are situated above the extent of groundwater flooding and the highway is assumed to have adequate drainage systems*	*X*

Detailed hydraulic modelling was undertaken to assess the risk from fluvial sources. The existing flood risk has been assessed and compared to the effect of the construction of the proposed development. The proposed development built without mitigation has a significant effect on flooding in the area. The raised carriageway of the proposed development blocks floodwater flow across the existing floodplain and the construction of the proposed development will also lead to the loss of floodplain storage.

Table 8-15 HD 45/09 HAWRAT Assessment Results Summary Non -Cumulative Assessment

Assessment Type	Outfall	Attribute	Percentage 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	A1	WF4 (Ballygrenane)	31	0	• Oil/petrol Interceptor; and • Initial Attenuation Pond including Forebay and Constructed Wetland.	No	Copper 5 or 30[34] Zinc 8 or 50 or 100[35]	Below Copper = 0.7 Zinc = 2.52
	A2	WF5 (Garryantanvally)	20	56	• Oil/petrol Interceptor; and • Initial Attenuation Pond including Forebay and Constructed Wetland.	No		Below Copper = 0.61 Zinc = 2.21
	A3	River Feale	0	0	• Oil/petrol Interceptor; and • Initial Attenuation Pond including Forebay and Constructed Wetland.	No		Below Copper = 0.0011 Zinc = 0.0047
	A4	WF1 (Mill Stream Lower)	8	59	• Oil/petrol Interceptor; and • Initial Attenuation Pond including Forebay and Constructed Wetland.	No		Below Copper = 0.6 Zinc = 2.19
	A5	Drainage Ditch (drains to WF10 Derra West Stream)	13	61	• Oil/petrol Interceptor; and • Initial Attenuation Pond including Forebay and Constructed Wetland.	No		Copper = 0.61 Zinc =2.23
	A6	WF0 (Mill Stream Upper)	17	62	• Oil/petrol Interceptor; and • Initial Attenuation Pond including Forebay and Constructed Wetland.	No		Below Copper = 0.61 Zinc = 2.21

Table 8-16 HD 45/09 HAWRAT Assessment Results Summary Cumulative Assessment

Assessment Type	Outfalls	Attribute	Assessment type (Sediment /Soluble)	% of mitigation required for dissolved pollutants	Additional measures required?	AAEQS (ug/l) in line with SI 792 of 2009	Comparison with AAEQS
Cumulative Assessment	A1 & A2	WF4 (Ballygrenane)	Soluble	49	No	Copper 5 or 30 Zinc 8 or 50 or 100	Below Copper = 0.73 Zinc = 2.62
	A4 & A3	River Feale	Soluble	0	No		Below Copper = 0.0028 Zinc = 0.01

[34] 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.

[35] 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 8-17 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 Effect Unmitigated		
				Magnitude	Significance	Impact Type
River Feale	Extremely High	Direct impact on watercourse from construction of the Bridge and indirect impacts associated with the transport of sediment or accidental release during construction entering the River System.	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
		Carriageway run-off and accidental spillage during operation.	Operation Potential for pollutants to be transported in surface run-off and enter the water environment via the road drainage system.	Negligible	Imperceptible	Direct negative long term
Water Supply (River Feale)	Very High	Direct impact on watercourse from construction of the Bridge and indirect impacts associated with the transport of sediment or accidental release during construction entering the River System.	Construction Potential increased siltation, release of suspended solids, and spillage of contaminants in general area during construction works which could impact on the water supply	Moderate	Significant	Indirect negative temporary
		Carriageway run-off and accidental spillage during operation.	Operation Potential for pollutants to be transported in surface run-off and enter the water environment via the road drainage system.	Negligible	Imperceptible	Direct negative long term
Mill Stream Upper WF0) Mill Stream Lower (WF1) Ballygrenane (WF 4) Garryantanvally (WF5)	Medium	Direct impact on watercourse from construction work in and within closed proximity and indirect impacts associated with the transport of sediment or accidental release during construction entering the watercourse.	Construction Potential increased siltation, release of suspended solids, and spillage of contaminants in general area during construction works.	Moderate	Moderate	Direct negative temporary
			Large Spill or hazardous spillage of contaminants during construction works.	Large	Significant	Indirect negative temporary
		Carriageway run-off and accidental spillage during operation.	Operation Potential for pollutants to be transported in surface run-off and enter the water environment via the road drainage system.	Negligible	Imperceptible	Direct negative long term
Other Watercourse (WF2, WF3, WF6 and WF7)	Medium	No direct impact on watercourse, indirect impacts associated with the transport of sediment or accidental release during construction	Construction Potential increased siltation, release of suspended solids, and spillage of contaminants in general area during construction works.	Small	Slight	Indirect negative temporary
		No predicted impacts associated with Operation	Operation No anticipated impact associated with Operation	Negligible	Imperceptible	No predicted impacts
Other Watercourse (WF8 and WF9)	Medium	No predicted impacts associated with Construction	No predicted impacts associated with Construction	No predicted impacts		
		No predicted impacts associated with Operation	Operation No anticipated impact associated with Operation	No predicted impacts		
Unnamed Drainage Ditches & WF10 Derra West	Low	Both direct and indirect impact on watercourse from construction work in and within closed proximity and indirect impacts associated with the transport of sediment or accidental release during construction entering the watercourse.	Construction Potential increased siltation, release of suspended solids, and spillage of contaminants in general area during construction works.	Moderate	Slight - Imperceptible	Direct and indirect negative temporary
		Carriageway run-off and accidental spillage during operation on 1 no Drainage Ditches. No anticipated impact associated with Operation on other Drainage Ditches	Operation Potential for pollutants to be transported in surface run-off and enter the water environment via the road drainage system.	Negligible	Imperceptible	Direct negative long term

8.2.10 Proposed Mitigation and Avoidance Measures

(a) 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); and*
- *'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";*
- *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.*

The Local Authority shall employ an Environmental Assurance Officer (EAO) who will be based on-site for the duration of the construction works and will form part of the Employer's Site Representative Team. The EAO shall have suitable environmental qualifications. The Local Authority will ensure that the EAO is delegated sufficient powers under the construction contract so that he/ she will be able to instruct the contractor to stop works and to direct the carrying out of emergency mitigation/ clean-up operations. The EAO will also be responsible for consultation with environmental bodies including the NPWS and IFI. The EAO shall be responsible for carrying out regular Audits of the Contractor's EOP on behalf of the Local Authority.

To avoid the pollution of watercourses during the construction phase a preliminary Erosion and Sediment Control Plan (pESCP) has been developed and 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 and this will be subject to approval by the Local Authority. 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:

- *Provision of measures to prevent the release of sediment concentrations over baseline conditions to the River Feale 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 WF0, WF1, WF4 and WF5. These measures will include but not be limited to silt curtains, settlement lagoons, filter materials and stockpile seeding; and*
- *Provision of exclusion zones and barriers (sediment fences) between earthworks, stockpiles and temporary surfaces and watercourses to prevent sediment washing into the watercourses.*
- *A temporary impervious barrier will be installed to ensure that all works associated with the bridge pier construction at the River Feale are protected against the 1:100 year return period flood event to ensure that there is no hydraulic connectivity between the temporary works and the River Feale during construction, see Appendix 8.5.*
- *No waste material will be discharge into any watercourse during the works.*
- *Temporary construction surface drainage and sediment control measures will be in place before earthworks commence.*
- *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.*
- *No storage of hydrocarbons or any toxic chemicals will occur within 50 m of a 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.*
- *Works within and adjacent to watercourses will only be conducted during forecast low flow periods.*

The contractor shall consult with the NPWS and IFI in relation to the dESCP and shall include their requirements in this regard.

To avoid potential impacts on the water abstraction point the contractor will liaise with Kerry County Council Water Services Division and/or Irish Water on a weekly basis 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 River Feale Bridge; and*
- *Construction works within and adjacent to watercourses including provision of culverts and watercourse realignments.*

Contact will be made by the contractor with permission of the Local Authority with the Kerry County Council Water Services Division, Environment Division and Irish Water immediately in the event of a spillage or other pollution risk to the River Feale. This shall be detailed in the contractor's emergency plan and will include contact names and telephone numbers. The emergency plan will form part of the overall contractor's EOP.

As requested by the IFI during consultation, the following measures will apply during the construction stage:

- *The contractor shall ensure that the construction methodologies used will ensure no wastes will be discharged to the Feale; and*
- *Consultation will be undertaking with the IFI prior to any advanced works including archaeological.*

(i) Pre- construction

Pre-construction water quality monitoring will be undertaken once a week for a six 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 proposed crossing points (River Feale, Mill Stream Upper, Mill Stream Lower, Ballygrenane and Garryantanvally) to build upon the baseline monitoring carried out at the EIA stage and in order to further establish the baseline water quality conditions prior to construction. 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.

(ii) Monitoring During Construction

Weekly during construction the contractor will monitor the levels of TSS, turbidity, pH, temperature, DO and hydrocarbons at locations to be agreed with Kerry County Council upstream and downstream 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 River Feale Bridge; and*
- *Construction works within and adjacent to watercourses including provision of culverts and watercourse realignments.*

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 addition, real-time telemetric monitoring will be used by the contractor to measure turbidity upstream and downstream of the River Feale Bridge. The turbidity level recorded downstream shall not exceed the upstream level by 10%. In the event of an exceedance, an investigation will be carried out to determine the cause and contact will be made with the Kerry Water Services and the Irish Water Environment Division immediately. These results will be compared by the contractor to the weekly turbidity results and reported to KCC.

In addition, daily visual inspections of the surface drainage and sediment control measures and the watercourses will be undertaken by the contractor and these inspections shall be recorded and reported to the EAO. 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.*

In the event that such indicators are observed in the River Feale and if the EAO directs 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.

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

- *Contact will be made with the Kerry Water Services and/ or Irish Water, the NPWS and IFI.*
- *Works capable of generating sediment into the waterecoure shall be stopped immediately.*
- *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 be having on water quality so 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 values established. Further requirements in relation to monitoring are outlined in the pESCP contained in Appendix 8.5.

(b) Operation Phase Mitigation – Water Quality

Measures to attenuate and treat the carriageway runoff have been incorporated into the drainage design of the proposed development.

The likelihood of a serous pollution incident is low This is less than 0.5% in all cases therefore, however 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. If lowered in time prior to discharge of significant quantities, penstocks can potentially retain 100% of spilled material.

In addition, in line with IFI requirements the drainage system used shall ensure a standard of 10-15 mg/l for suspended solids to inform retention time needed within the system. All other requirements of the IFI, as set out in their response in Appendix 6.1, will be implemented in the final drainage design.

In order to ensure the drainage system is working to the required standard, Kerry County Council will monitor on a twice yearly basis the water quality at the inlet and outlet to the attenuation/treatment ponds as undertaken for the EIS and compare these to the standards in the European Communities Environmental Objective (Surface Water) Regulations, S.I. 272 of 2009. If exceedance are found remediation measures will be undertaken by Kerry County Council as appropriate.

In order to avoid adverse impacts to watercourse due to a spill a contaminant spill emergency plan will be put in place by the local Authority 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 by the local Authority in secured locations within the area.

In order to avoid adverse impacts to the drinking water abstraction source (the River Feale) due to a potential spill on the proposed development, and following on from consultation with Irish Water, an automated abstraction control system linked to the SCADA (supervisory control and data acquisition) system that continuously monitors for hydrocarbon, turbidity and ammonia will be installed by the contractor at the Scartleigh abstraction point. This system will automatically shut the abstraction in the event of pollution incidences, including any incidences arising from the proposed development.

(c) Operation Phase Mitigation – Flood Risk

To mitigate again flood risk measures have been included the design and are described in full in Appendix 8.2. In summary these include:

- *A series of culverts to maintain the existing flow paths of flood waters;*
- *A land drain has been introduced along with localised re-profiling of the Mill Stream; and*
- *Road drainage has been provided along the proposed development to mitigate the potential flood risk from overland sources to and from the proposed development.*

As the mitigation provided reduces the flood risk to acceptable levels the development meets the requirement of the justification test for GPA20. It was found that a number of mitigation measures are successful in reducing the overall risk to low.

8.2.11 Difficulties Encountered in Compiling Information

A complete set of as built drawings were not available to confirm the complete drainage design of the existing N69 and John B. Keane Road.

The low flow estimates undertaken for use in the HAWRAT were low and therefore, in line with the guidance, the default of 0.001 was used.

8.2.12 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 8-18.

Table 8-18 Residual Impact after mitigation measures for construction

Attribute	Importance	Significance pre mitigation	Significance post mitigation
River Feale	Extremely High	Profound	Imperceptible
Listowel Water Supply	Very High	Significant	Imperceptible
Mill Stream Upper and Lower (WF0, WF1) Other Watercourse and Channels (WF 4 - WF5)	Medium	Significant	Imperceptible
Other Watercourse and Channels (WF2. WF3, WF6 and WF7)	Medium	Slight	Imperceptible
Unnamed Drainage Ditches	Low	Slight	Imperceptible

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 water quality by the proposed development will be negative, long term, imperceptible

The proposed development is at low risk of flooding and will not significantly increase the risk of flooding elsewhere.

8.2.13 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.

Other projects within the vicinity of the proposed development could result in cumulative impacts during the construction phase if these projects were to run concurrently. However, any new project will be subject to planning requirements and where required, EIA and Appropriate Assessment to address the impacts.

8.2.14 Water Framework Directive Compliance

The EU Water Framework Directive has introduced environmental targets with specific objectives including:

- *Prevention of deterioration in the status of surface water bodies; and*
- *Protection, enhancement and restoration of all surface water bodies with the aim of achieving good ecological and chemical status by 2015.*

As described above, the proposed development will not cause the 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. Section 8.3 below illustrates that the proposed development will not result in any significant hydromorphological impacts, while the flora and fauna assessment presented in Chapter 6: Flora and Fauna concluded that there would be no significant residual impacts to aquatic ecology and fish following implementation of mitigation measures. Therefore it can be concluded that the proposed development will not compromise the ability of the River Feale WFD designated waterbody from maintaining good status, and the development is therefore in compliance with the provisions of the WFD.

8.3 Geomorphological and Hydromorphological Environment

8.3.1 Introduction

This section describes the existing geomorphological and hydromorphological environment and the likely significant potential impacts associated with the construction and operation of the proposed development.

(a) Geomorphology and Environmental Impact Assessment

The *National Roads Authority Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2009)* recommends that geomorphological impacts are considered within the Hydrology section of an EIS. This should include reference to the EU Water Framework Directive (2000/60/EC) hydromorphology elements.

Geomorphology is considered as a mechanism (pathway) by which receptors such as water quality and aquatic ecology could potentially be affected by the proposed development. A measure of the potential impact on geomorphological forms and processes associated with the freshwater riverine environments is their potential 'vulnerability to change' as a result of the proposed development. The vulnerability of each riverine environment to change (low, moderate, high) has been assessed as part of the baseline (Section 8.3.2), and a magnitude classification of the potential impacts on each area 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.

(b) Hydromorphology and Water Framework Directive

Hydromorphology is a key aspect of the EU Water Framework Directive (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 may be a number of potential sources of impact at a more local level arising from the proposed development. It is important to understand these potential local level impacts before assessing impact at the scale of an entire water body.

To arrive at a conclusion as to whether or not the proposed development is likely to affect compliance of a particular water body with the WFD, an assessment of potential hydromorphological impacts of the proposed development has been made and the results are covered in this section.

In detail, hydromorphology as defined by the WFD for 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.*

(c) Desk Study

The desk study element of the geomorphological assessment was based on the following sources:

- *Ordnance Survey Ireland – exploring contemporary and historic maps;*
- *Water Framework Directive Ireland – exploring the hydromorphological pressures on the water body;*
- *Shannon River Basin Management Plan – for the ecological status and hydromorphological designation of the Feale water body;*
- *GSI – to establish the geology component of the fluvial audits; and*
- *NPWS – to understand the SAC designation to ascertain whether there were any contributing geomorphological factors.*

(d) Field Surveys

The geomorphological and hydromorphological assessments comprised walkover surveys of the watercourses potentially affected by the proposed development. The surveys were undertaken in June 2013. The walkover surveys provided a snapshot view of the watercourses at the time of survey. Surveying allows a greater understanding of the form of the streams and rivers and the processes that shape them. During the survey the following information was collected:

- *Bed and bank material;*
- *Cross sectional form;*
- *Riparian vegetation;*
- *Connectivity to the floodplain;*
- *Planform; and*
- *Land use, including sources of sediment.*

8.3.2 Description of the Existing Environment

(a) Geomorphology

The surface water features that have been assessed for geomorphology are:

- *River Feale;*
- *Upper Mill Stream (WF0);*
- *Mill Stream (WF1);*
- *Finuge (WF2);*
- *Coolnaleen - Lower (WF3);*
- *Ballygrenanae (WF4);*
- *Garryantanvally (WF5);*
- *Islandganniv - North (WF6);*
- *Kilcreen (WF7);*
- *Dromin Lower (WF8); and*
- *Dromin Upper (WF9).*

These are shown on Figure 8.1.1.

(i) River Feale

The River Feale is a large, irregularly meandering river. In the study area the river is underlain by Visean Limestone (undifferentiated), but the catchment is reported to be dominated by Namurian sandstones and shales (NPWS, 2012). It is an active river with erosion and depositional features upstream and downstream of the location of the proposed bridge crossing. Historically the course of the river at the location of the proposed bridge was significantly different to the contemporary planform (Image 8-1). Prior to the current course of the river there was an additional meander bend, totalling three relatively tortuous meander bends. At some point, following what was likely to have been a high, channel altering flow, the river shifted its course, cutting a new channel through the three meander bends. At this location, the old meander (which channelled flow in a north-westerly direction) became redundant and instead a new meander bend formed, directing flow in the opposite direction to the south east. The proposed road traverses the floodplain and crosses the River Feale at this contemporary meander. This is a natural evolutionary process of an active river. Through this alteration, the contemporary meander is shorter than the historic meander, thus flow is now conveyed along the increased gradient of the channel.

There were cobble point bars recorded on the meander bends upstream and downstream of the proposed bridge (Image 8-2 A and B). 50% to 90% of the point bars were vegetated and considered relatively stable. The river banks were also densely vegetated with tall grasses, shrubs and trees. Opposite the upstream point bar there was a concrete wall on the outside bend, where erosion would be expected. At the location of the proposed River Feale Bridge, large boulders line the toe of the left bank to protect the bank from erosion. Where visible, principally along the channel margins, and in the downstream riffle, the bed was composed of cobbles and gravel, overlain with a thin silt layer (Image 8-2 C). A variety of flow types were observed, namely riffles, runs and glides (Image 8-2 D).

The River Feale catchment was the subject of a comprehensive arterial drainage scheme carried out by the Commissioners of Public Works between 1951 and 1959. As part of these works the river channel was deepened and embankments constructed at various sections along the River Feale, including in the location of the proposed works. These increased the capacity of the channel whilst disconnecting the river from its floodplain. Thus during times of high flow, fine sediment remains contained with the system rather than being deposited on the floodplain (as a flood event recedes), contributing to the silt layer found on the bed of the river.

The River Feale is a morphologically diverse river which historically has displayed the ability to significantly modify its course. At present it appears to be relatively stable due to the bank protection on the outside of the meander bends, preventing the lateral movement of the channel. The embankments also confine the channel. As a result of the depositional features, the river is currently considered to function as a sink of sediment.

The River Feale is included within the Lower River Shannon SAC (site code 002165). The site is selected for 14 habitats listed in Annex I of the Habitats Directive and seven species in Annex II. One of the Annex I habitats is watercourses of plain to montane levels with *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation.

Due to the SAC designation, size of the river, evidence of fluvial processes and good morphological diversity, the River Feale is considered to have a high vulnerability to change.

Image 8-2 Photographs of the River Feale

A – upstream view of gravel/cobble bar and concrete bank protection. Site upstream of proposed crossing point

B – downstream view of vegetated point bar. Boulder revetment along base of left bank. View of proposed crossing point

C – view of bed. Fine and coarse gravel covered with a layer of fine sediment

D – downstream view of vegetated side bar and riffle

(ii) Upper Mill Stream (WF0)

Upper Mill Stream is typically an overdeep, overgrown watercourse. The average channel depth is approximately 1.5 m. The stream has a low sinuosity and low gradient, flowing through pasture fields and meadows (Image 8-3A). It has been culverted in a few locations to allow access to fields, and beneath an old grass track. The banks are vegetated with a variety of plants, including shrubs and trees (Image 8-3B). These provide cover for the channel and stability to the river banks. However they can prevent the longitudinal movement of sediment downstream. At the time of survey there was little flow and in places pools of stagnant, cloudy water were present.

The bed of the river, where visible, was observed to consist primarily of fine sediment (earthy and silt) and some gravel (fine to coarse). The stream appeared to have a trapezoidal cross section with steep, and in places, vertical banks.

Upper Mill Stream appeared stable at the time of survey with no signs of erosion and dense vegetation cover. The primary function of the stream appears to be a sink of sediment as a result of the low gradient and dense vegetation. During winter months when the vegetation dies back and there are higher levels of water the channel may act as a transfer of sediment. Overall Upper Mill Stream is considered to have low vulnerability to change.

Image 8-3 Photographs of Upper Mill Stream

A – downstream view of straightened, overdeep, overgrown channel

B – downstream view of vegetated bank and silty bed

(iii) Mill Stream Lower (WF1)

Mill Stream Lower is a moderate size stream with a low sinuosity. The bed of the stream is predominantly fine sediment, comprising a mixture of earth and silt. The banks are steep-sided and typically vegetated by shrubs and tall grasses (Image 8-4 A), with occasional trees growing on either side of the channel, both deciduous and coniferous. Land use is a mixture of residential development and pasture land for a variety of livestock (Image 8-4 B). Upstream of the proposed carriageway the stream exhibits signs of over deepening. Through the fields immediately before its confluence with the River Feale (downstream of the proposed development), Lower Mill Stream is embanked (Image 8-4 C). The embankments and overdeepening have the effect of disconnecting the channel from its floodplain.

Mill Stream was initially a mill leat with its inlet cut into the banks of the River Feale upstream at the location of the old St Mary's Chapel and Union Workhouse, now one of the schools and hospital in Listowel. The water once fed the corn mill a few hundred metres downstream of the inlet. The inlet to the mill is now stopped up, and water from surface runoff and groundwater primarily feed the downstream extent of the Mill Stream. Downstream of the proposed carriageway, to the confluence with the Feale, Mill Stream flows within the old planform of the River Feale. Therefore, through this location, the banks and bed are likely to be cut within alluvium.

The low flow and artificial origin of the stream, accompanied by the historical flow regulation, has limited the development of morphological features and as a consequence the stream is considered to have a low vulnerability to change.

Image 8-4 Photographs of Mill Stream

A – view of channel from above – fine sediment bed and vegetated banks

B – upstream view of deepened watercourse, rough pasture land grazed by cattle, vegetated bank face/channel margins

C – downstream view of straightened and embanked channel, vegetated by grass and scattered/isolated trees

(iv) Finuge (WF2)

Finuge is a straightened and overdeepened stream (Image 8-5 A). The average depth of the channel is 1.25 m. The stream has a trapezoidal cross section with steep bank faces. The bankfull width is approximately 2.25 m. The stream flows through fields of pasture grazed by cattle before discharging into the River Feale. Fencing along both sides of the channel prevent the cattle from trampling the river banks and introducing fine sediment into the system. There is an indefinite buffer strip, comprised primarily of tall grasses with occasional trees. The bed is composed of silt and other fine sediment (Image 8-5 B).

Finuge appears to be relatively stable with limited signs of erosion and deposition. There was little flow at the time of the survey, with limited capacity to transport sediment. Since the channel is considered to be overdeep, there is limited floodplain connectivity. Therefore, during high flows the channel is anticipated to act as a transfer of sediment. Finuge is considered to have a low vulnerability to change.

Image 8-5 Photographs of Finuge

A – downstream view of straightened, overdeep, trapezoidal channel

B – view of the watercourse bed, composed of silt and other fine sediment

(v) Coolnaleen – Lower (WF3)

Coolnaleen Stream has a straight artificial planform with few morphological features (Image 8-6). It has been overdeepened and consequently is disconnected from its floodplain. Dense vegetation grows along the stream banks, suggesting stability and a sink of sediment during the summer. As vegetation dies back the stream may become a transfer of sediment during high flows. Adjacent to the channel is pasture land, however there were limited signs of poaching by animals. Overall Coolnaleen Stream is considered to be stable and have a low vulnerability to change.

Image 8-6 Upstream photograph of Ballygrenanae with Coolnaleen Stream in the distance (indicated by red dashed line and arrow)

(vi) Ballygrenanae (WF4)

Ballygrenanae is a straightened, overgrown watercourse (Image 8-7 A). At the time of the survey the bed and banks of the stream were barely visible due to the dense shrub and tree growth. The stream flows through meadow and pasture land, typically grazed by cattle. Where visible the bed was a mixture of fine sediment (silt and sand), some gravels and cobbles (Image 8-7 B).

The stream has been overdeepened and is approximately 1.5 m deep. Consequently, it has limited floodplain connectivity. The stream appeared to have a trapezoidal cross section, with a bankfull width of approximately 1.5 m. Where visible the banks were composed of earth with a moderate level of cohesion, strengthened by vegetation.

The stream is stable, with limited signs of erosion. It predominantly acts as a transfer of sediment. Ballygrenanae is considered to have a low vulnerability to change.

Image 8-7 Photographs of Ballygrenanae

A – upstream view of overdeepened and densely vegetated channel

B – downstream view of fine gravel, sandy, silty bed

(vii) Garryantanvally (WF5)

Garryantanvally is a straightened and overdeep channel forming the edge of field boundaries (see image 8-8A). The depth of the stream was up to 2.25 m, and consequently there is limited floodplain connectivity. The watercourse has a trapezoidal channel with steep bank profiles. Bankfull width was approximately 3 m. The banks were composed of clayey earth with moderate cohesion. Land use along the right hand side of the channel was arable and along the left hand side was pasture land for cattle grazing. Livestock access to the channel was restricted by fencing and tall vegetation and there were no signs of fine sediment supply from poaching within the surveyed area. Trees and shrubs lined the left bank and providing and cover to the channel. The tree roots provide stability to the river bank. There was no buffer strip between the arable field and the river. Vegetation was sparse along the right bank face and bank top. Therefore during periods of heavy or prolonged rainfall fine sediment is likely to be washed into the channel.

At the time of survey there was little flow in the channel. The bed was composed of earth and silt. At the confluence with the River Feale there is a concrete pipe culvert with a flap valve to reduce flooding of this stream (Image 8-8B). A tree branch was observed during the survey to be trapped in the valve preventing it from closing.

Garryantanvally appeared to be relatively stable, with no signs of erosion and deposition. It is likely to act as a transfer of sediment, unless water backs-up in the channel as a result of the head of water in the River Feale. In this situation the channel is likely to temporarily act as a sink of sediment. Garryantanvally is considered to have a low vulnerability to change.

Image 8-8 Photographs of Garryantanvally

A – upstream view of overdeepened, trapezoidal channel and no buffer strip between cultivated land

B – downstream view of channel at inlet of culvert before outfall into the River Feale

(viii) Islandganniv – North (WF6)

Islandganniv – North is an overdeepened and resectioned watercourse, with a low sinuosity. The average depth of the channel was 2 m. The channel typically has a trapezoidal cross-section with steep sided banks (

Image 8-9 B). The width of the stream was between 2 m and 4 m at bankfull level. At the time of survey the channel was largely overgrown with vegetation, including trees and shrubs. Where the banks were visible they were composed of predominantly of fine material. The banks appeared to have a moderate level of cohesion. The bed was composed of fine sediment, similar to the banks, and some coarse cobbles.

In the study area, the tributary demarks the edge of two field boundaries. Use of these fields at the time of survey was predominantly pasture for cattle grazing. Almost continuous fencing lined the channel, apart from two locations to allow field access for the cattle. Therefore the extent of poaching by animals was limited to these locations. A thin buffer strip of trees and shrubs has established between the fencing and the bank top edge.

Islandganniv – North appears to be stable and during times of high flow is likely to act primarily as a transfer of sediment. During summer months, when vegetation growth is dense and flow levels are low, the stream is likely to act as a sink for fine sediment. Islandganniv – North is considered to have a low vulnerability to change.

Image 8-9 Photographs of Islandganniv - North

A – downstream view of straightened channel

B – upstream view of bare slopes indicating recent dredging and fine sediment bed with some coarse gravel-cobbles

(ix) Kilcreen (WF7)

Kilcreen is a small watercourse which has a straightened planform and borders arable and pasture fields and Listowel racecourse. This watercourse has been straightened and deepened to improve drainage of the surrounding fields. Such modification has created a trapezoidal channel, with relatively steep banks and an absence of morphological diversity. Aerial photography on Ordnance Survey Ireland and the Bing website reveal a simple riparian corridor, with few trees and a predominantly grass-lined bank top. It also appears to be locally culverted for access. The watercourse appears to be stable with little change in planform from historic maps. Kilcreen is considered to have a low vulnerability to change.

(x) Dromin Lower (WF8)

Dromin Lower appears to be a small watercourse. The source of the watercourse is unclear. Downstream of the dismantled railway the watercourse is tree lined and likely to be stable as a consequence. Upstream of the dismantled railway is a new housing development, under which the watercourse appears to have been culverted. Consequently Dromin Lower is considered to have a low vulnerability to change.

(xi) Dromin Upper (WF9)

Dromin Upper appears to be extensively culverted underneath the town of Listowel. The stream discharges into the River Feale from a concrete box culvert with a high gradient and a two stage channel (Image 8-10 A). At the time of survey the flow was contained within the low flow channel, which is approximately 30 cm wide (Image 8-10 B). The stream has been stabilised artificially and acts as a transfer of sediment. As a consequence of the artificial nature of Dromin Upper, it is considered to have a low vulnerability to change.

Image 8-10 Photographs of Dromin Upper of the River Feale

A –view of the culverted watercourse outlet into the Feale. Outlet into the Feale is just off the left hand side of the photograph

B – view of concrete 2 stage culvert channel (yellow dashed lines mark the edge of the low flow channel)

(b) Summary of Geomorphology Baseline

Table 8-19 presents a summary of the geomorphological vulnerability of the eleven watercourses identified within the study area.

Table 8-19 Geomorphology vulnerability rating for each watercourse

Watercourse	Watercourse vulnerability
River Feale	High
Upper Mill Stream (WF0)	Low
Mill Stream (WF1)	Low
Finuge (WF2)	Low
Coolnaleen – Lower (WF3)	Low
Ballygrenanae (WF4)	Low
Garryantanvally (WF5)	Low
Islandganniv – North (WF6)	Low
Kilcreen (WF7)	Low
Dromin Lower (WF8)	Low
Dromin Upper (WF9)	Low

(c) WFD Hydromorphological Status

The surface water feature that has been assessed for hydromorphology is:

- *Water body Feale, (IE_SH_23_2941)*

The Feale is the largest water body in the study area and is the only watercourse assessed that forms part of the Shannon River Basin Management Plan. The ten other watercourses are tributaries of this water body. The impacts on these tributaries are considered as part of the impacts to the Feale water body.

The overall status of the water body is “good” with the objective to protect. The water body is not designated as heavily modified. Overall ecological status is good and overall chemical status is ‘pass’. There is no data on hydromorphology status of the Feale water body within the Shannon River Basin Management Plan (July 2010). There are 27 measures which apply to this water body, including controls on physical modifications to surface waters and controls on other activities impacting on water status. The baseline observations, made from the desk study and walkover surveys, for the hydromorphological elements, are presented in Table 8-20.

Table 8-20 Baseline status of hydromorphology quality elements in the area of the proposed road crossing

WFD Hydromorphology Quality Elements	Baseline Observations
River depth and width variation	Large, irregularly meandering river with depositional features creating varied width and depth of channel. Over geological timescales it is an actively meandering channel indicated by historical change of planform (over the last two centuries). Channel is confined by bank protection, focused on the outside of meander bends. Historically deepened and embanked, the depth and capacity of channel has been increased and the river disconnected from its floodplain.
Structure and substrate of the river bed	Cobbles and gravels, exposed cobble point bars and riffles. Siltation over coarse sediment on channel margins.
Structure of the riparian zone	Tall grasses, shrubs and trees line the banks of the river for several hundred metres upstream and downstream of the proposed road crossing. Concrete bank and revetment replaces natural bank material in localised areas.
River continuity	Limited disruption to the transfer of water and sediment downstream. Slight step change in gradient of bed at minor weir below footbridge leading from The Square car park to the grounds of Listowel Racecourse.
Quantity and dynamics of flow	Varied flow with a mixture of riffles, runs and glides. Existing bridge piers deflect flow and alter the natural bed formations.
Connection to groundwater bodies	Overlays Ballybunion_1 (IE_SH_G_025) groundwater body which has an overall status of good. The chemical status is 'probably at risk' from general groundwater quality risk and risk due to landfill sites/old closed dump sites. The upstream groundwater body is Abbeyfeale (IE_SH_G_001) and downstream one is Ballybunnion (IE_SH_G_027) groundwater body.

Image 8-11 Upstream view of the River Feale, Listowel Racecourse is on the right hand side of photograph

8.3.3 Appraisal Method used for Assessment of Impacts

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 (refer to Section 8 for the full impact assessment methodology).

There is no currently prescribed or standard method for assessing the hydromorphological impacts of road schemes, therefore the geomorphological principles in the NRA 2009 Guidelines have been followed where applicable. The geomorphological impacts are considered at reach scale, whereas the hydromorphological impacts are captured at the water body scale.

The assessment method used takes each of the baseline geomorphology and hydromorphology elements documented in Section 8.3.2 above, 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 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 processes. This affects any one or a combination of the hydromorphological elements described in Section 8.3.2(c). Interrelations between the different hydromorphological elements have also been considered. The potential impact magnitude has been considered in conjunction with the receptor vulnerability to indicate significance.

The assessment is primarily qualitative and based on a site walkover of the watercourses in the proposed vicinity of the road, supplemented by a baseline desk study as described in Section 8.3.1(c) and 8.3.1(d).

Impact type, magnitude, significance and duration are considered relative to the geomorphological vulnerability to change identified for each of the watercourses (Section 8.3.2(a)). Although there are no published guidelines for the assessment of geomorphology and hydrology the NRA (2009) Guidelines and significance matrix (Table 8-20) are used. Table 8-22 provides a description of the significance of impacts.

Table 8-21 Impact significance matrix

	Magnitude of impact			
Geomorphological vulnerability of Attribute	**Negligible**	**Small**	**Moderate**	**Large**
High	Imperceptible	Moderate/ Slight	Significant/ Moderate	Profound/ Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/ Moderate

Table 8-22 Description of the significance of impact

Significance of Impact	Description
Imperceptible	An impact capable of measurement but without noticeable consequences
Slight	An impact that alters 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 or 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 all previous sensitive characteristics

8.3.4 Predicted Impacts of the Proposed Development

(a) Construction Works that have a Potential Impact on the Geomorphological and Hydromorphological Receptors

The construction works that would potentially have an impact on the geomorphological and hydromorphological receptors are listed in Table 8-23. Four of the watercourses

within the study area are not considered to be impacted by the proposed development, these are:

- *Finuge (WF2);*
- *Coolnaleen (WF3);*
- *Islandganniv - North (WF6); and*
- *Kilcreen (WF7).*

Consequently these are screened out of the impact assessment for the construction phase and do not appear in the Table 8-23.

Table 8-23 Construction works that have a potential impact on the surface water features in the study area

Watercourse	Construction of carriageway	Construction of embankments	Culverts	Bridge	Outfall from SUD pond	Road surfacing/ upgrade
River Feale	✓	✓		✓	✓	
Upper Mill Stream (WF0)	✓		✓ (1 on WF0, 6 flood culverts and 4 on field drains)		✓ (2, one into a tributary)	
Mill Stream Lower (WF1)	✓	✓	✓ (plus 6 flood culverts)			
Ballygrenanae (WF4)	✓	✓	✓		✓	✓
Garryantanvally (WF5)	✓	✓	✓ (plus 13 flood culverts)		✓	
Dromin Lower (WF8)						✓
Dromin Upper (WF9)						✓

(b) Construction Impacts on Geomorphological Receptors

During the construction phase there is the potential for release of sediment into the watercourses from earthworks including topsoil strip and placement of structures within the watercourse. Sediment release can result in increased rates of deposition, including the siltation of a gravel/cobble bed, affecting the morphology of the channel and dynamics of flow. Potential sources during the construction phase include:

- *Construction within and adjacent to watercourses including outfalls, culverts, a bridge, watercourse realignment (e.g. realignment on Upper Mill Stream is related to increased carriageway width and culvert placement) and embankments;*
- *Stockpiling of materials;*
- *Run-off from exposed bare soil surfaces;*
- *Accidental spillage of anthropogenic polluting substances in or adjacent to watercourses; and*
- *Construction plant and vehicle washing.*

Exposed soil surfaces along the river bank can also result in increased rates of erosion, altering the morphology of the channel and dynamics of flow.

(c) Construction Impacts on Hydromorphological Receptors

The construction activities listed in Section 8.3.4(a) would have potential temporary impacts on the Feale water body. The impacts on each of the hydromorphological aspects of the water body are presented in Table 8-6.

Table 8-24 Impact of construction on the Feale water body

WFD Hydromorphology Quality Elements	Construction impacts on the Feale's hydromorphology
River depth and width variation	Small change to water body anticipated. Construction of steel sheet pile around bridge pier would locally affect width of channel. Localised changes to tributaries from installation of culverts, however this would not affect the Feale water body.
Structure and substrate of the river bed	Temporary release of sediment potentially deposited on bed of water body and those tributaries prone to deposition. Natural bed replaced by artificial material as a result of culverts on WF0, WF1, WF4 and WF5. Overall small impact on water body.
Structure of the riparian zone	Along the road corridor and the construction compounds the vegetation would be cleared, resulting from the construction of the carriageway, bridge, culverts, SUDs and outfalls. This would reduce the stability of the watercourse banks and alter the fluvial processes. This is considered to have moderate impact.
River continuity	There would be negligible impact on the continuity of the flow and sediment movement downstream with the construction of the bridge on the Feale. At high flows there would be a slight diversion around the abutment. On watercourses WF0, WF1,WF 4 and WF5 the flow and sediment regime would be temporarily disrupted by the installation of culverts, but this is considered to have a negligible impact on the Feale water body.
Quantity and dynamics of flow	If a high flow event occurred during the construction of the bridge the flow would be diverted around the bridge abutment, potentially causing scour of the point bar. During normal flows there would be no disruption to the quantity and dynamics of flow along the Feale. During the construction of the culverts on WF0, WF1,WF 4 and WF5 there would be a temporary disruption to the dynamics of flow, but this is considered to have a negligible impact on the Feale water body.
Connection to groundwater bodies	The bridge would have a negligible impact on connection to groundwater bodies, due to the size of the water body and the size of the bridge abutments in relation to the water body. During the construction of the culverts on WF0, WF1, WF4 and WF5 there would be a temporary disruption to the connection to groundwater bodies, but this is considered to have a negligible impact on the Feale water body.

(d) Aspects of the Proposed Development during Operation that have a Potential Impact on the Geomorphological and Hydromorphological Receptors

The aspects of the proposed development that would have an impact on the geomorphological and hydromorphological receptors during the operational phase are

listed in Table 8-25 As with the construction impacts, four of the watercourses within the study area are not considered to be impacted by the proposed development, these are:

- *Finuge (WF2);*
- *Coolnaleen (WF3);*
- *Islandganniv - North (WF6); and*
- *Kilcreen (WF7).*

Consequently these are screened out of the impact assessment for the operational phase and do not appear in the Table 8-25.

Table 8-25 Operational aspects of the proposed development that have a potential impact on the surface water features in the study area

Watercourse	Change to drainage system	Outfall from SUD pond	Embankments	Culverts	Bridge
River Feale	✓	✓	✓		✓
Upper Mill Stream (WF0)	✓	✓ (2, one into a tributary)		✓ (1 on stream, 6 flood culverts and 4 on field drains)	
Mill Stream (WF1)	✓		✓	✓ (plus 6 flood culverts)	
Ballygrenanae (WF4)	✓	✓	✓	✓	
Garryantanvally (WF5)	✓	✓	✓	✓ (plus 13 flood culverts)	
Dromin Lower (WF8)	✓				
Dromin Upper (WF9)	✓				

(e) Operational Impacts on Geomorphology

The following operational impacts could potentially occur on any one of the seven watercourses as a result of the installation of drainage outfalls, watercourse realignment and culverts:

- *Increase in surface runoff from increased hard standing areas and embankments – causing a change to flow dynamics, potentially resulting in scour and change in morphology of the river bed or banks;*
- *Incorrect placement of structure – alteration of flow dynamics resulting in scour around the structure, increasing in sediment release and potential siltation of gravel/cobble bed, locally changing the watercourse morphology;*
- *Increased capacity of channel as a result of culverting – potentially cause deposition within structure;*
- *Change in length or gradient of the watercourse as a result of a crossing – change to flow dynamics, creating erosion or deposition, locally altering the morphology of the bed/banks; and*
- *Realignment of the watercourse to redirect flow through a culvert - a significant increase or decrease of channel length would result in a decrease or increase in channel gradient respectively. A decrease in channel gradient could lead to deposition along the channel bed and an increase could lead to erosion of the bed or banks upstream or downstream.*

The construction of a bridge over the River Feale would lead to a slight alteration of depositional features (point bar), primarily through the excavation of material. Potentially some deflection of flow at high flows would occur around bridge abutment works, but the surrounding ground would be stabilised by vegetation. Overall the bridge is considered to have a small impact on the River Feale. 'Natural' channel adjustment could continue on the left bank (i.e. the outside of the meander) with potential for erosion towards the southern abutment. The existing bank would not be altered as part of the proposed development. Some toe erosion was noted as part of the baseline, but the left bank was otherwise considered stable. It is likely that the bank was re-graded historically when the channel was realigned creating a uniform bank gradient; and, the bank already has a lining of toe protection in the form of large boulders. Therefore, it is not anticipated that there would be any significant change in the processes occurring against the left bank or excessive erosion towards the southern abutment. Overall the bridge is considered to have a small impact on the River Feale.

(f) Operational Impacts on Hydromorphology at the Water Body Scale

The hydromorphological impacts on the Feale water body from operation of the proposed development (Table 8-25) is presented in Table 8-26.

Table 8-26 Permanent operational impacts of the proposed development on the Feale water body's hydromorphological elements

WFD Hydromorphology Quality Elements	Operational impacts on the Feale's hydromorphology
River depth and width variation	Bridge causes slight confinement on the bankfull width of the channel, only applicable at very high flood flows. Negligible impact on the water body. Culverts on WF0, WF1, WF4 and WF5 will locally affect the watercourses' depth and width, fixing them with artificial material. However these will have a negligible impact on Feale water body.
Structure and substrate of the river bed	No impact of the bridge on the river bed. Culverts on WF0, WF1, WF4 and WF5 will locally affect the bed of the tributaries of the River Feale but overall there will a negligible impact on the Feale water body.
Structure of the riparian zone	In the long term, vegetation would re-establish along the river banks, except at the location of the culverts. Overall negligible impact on the Feale water body.
River continuity	Slight deflection around bridge abutment during high flows, but overall negligible impact on the Feale river continuity (downstream movement of water and sediment). Culverts on WF0, WF1, WF4 and WF5 have the potential to disrupt river continuity, through a change in bed gradient.
Quantity and dynamics of flow	Slight deflection of flow at very high flood flows. Slight increase in discharge from the drainage network (through SUDS pond A3). Negligible impact on the water body. Road drainage would increase discharge to WF0, WF4 and WF5. This would have and a negligible impact on the Feale water body. The flood culverts on WF0, WF1 and WF5 would maintain reasonable floodplain connectivity, and drainage of land following heavy or prolonged rainfall.
Connection to groundwater bodies	Negligible impact on the groundwater flows as a result of the bridge and embankment. Culverts on WF0, WF1, WF4 and WF5 have the potential to disrupt groundwater flows through the introduction of hard artificial bed and banks. The culverts affect a relatively small area of the watercourses and overall have a negligible impact on the Feale water body.

In summary, the magnitude of impact from the proposed development on the water body is considered to be negligible. This is primarily as a result of the open span design of the road bridge. The culverts on the River Feale would have a localised adverse impact on the watercourse, but overall have a negligible impact to the Feale water body.

(g) Do-Minimum Scenario Impacts

If the proposed development is not constructed, the watercourses would not experience any change to geomorphological forms or processes at the local or water body scale from anthropogenic activities.

8.3.5 Proposed Mitigation and Avoidance Measures

(a) Construction Phase Mitigation

Construction phase mitigation for geomorphology and hydromorphology is detailed in Section 8.2.10(a) under the hydrology assessment.

Further specific mitigation to avoid impact the for geomorphology and hydromorphology of the watercourses in the study area include:

- *In-channel working and channel realignments will be minimised as far as possible to reduce the exposure of bare ground, reducing the amount of fine sediment released into the channel. Channel realignment greater than 5 m in length will be constructed one growing season (growing season is March to April) before the flow is diverted into the new channel to allow vegetation to colonise the bank face; and*
- *The extent of channel/bank disturbance shall be limited.*

(b) Operation Phase Mitigation

To avoid the alteration of watercourses by structure the position of structures such as headwalls and wingwalls will be designed to limit the potential for scour. Outfall placement will be such that no significant alteration to flow patterns, leading to turbulence and/or excessive deflection of flow towards the bed or banks, would occur. The structures will not encroach into the channel and will not be located where flow converges (i.e. where the river has higher shear stresses).

Culvert design will create or maintain a natural bed where possible. The width of the culverts, particularly the low flow (Q95) channel width, and the gradient will be maintained to prevent or minimise a change to the sediment regime.

Channel realignments will be minimised to reduce or remove the impact on gradient and the resultant flow dynamics and sediment regime. Opportunities to improve the morphology of the channel will be taken, such as an increase of the sinuosity of the channel, creation of low flow channel to reduce siltation potential, and cut back of vegetation where overgrown, where feasible within the landtake.

For the bridge crossing of the River Feale, the design of the southern bridge abutment would incorporate a line of erosion protection around the toe of the structure. This would be set back from the channel edge as close to the new structure as practicable. Although it is not anticipated that excessive erosion would occur of the left bank, based on baseline conditions, the additional measure would provide some protection if the channel does begin to adjust. If the river channel erodes back to the protection, it is not anticipated that this would lead to any significant changes to the downstream processes, with flows already deflecting from the left bank downstream.

8.3.6 Difficulties Encountered in Compiling Information

No difficulties were encountered during the assessment.

8.3.7 Cumulative Impacts and Impact Interrelations

Four of the watercourses within the study area will not be impacted by the proposed development; Finuge (WF2), Coolnaleen (WF3), Islandganniv - North (WF6) and Kilcreen (WF7). The magnitude of impacts on the geomorphology of the remaining seven watercourses (River Feale, Upper Mill Stream, Mill Stream, Ballygrenanae, Garryantanvally, Dromin Lower and Dromin Upper) is considered to be small to negligible. The impact on the hydromorphology of the Feale water body is also considered to be negligible.

8.3.8 Assessment Conclusions

(a) Vulnerability of Existing Environment

The existing hydromorphology of the River Feale (Feale water body) has a high vulnerability to change, due to its existing morphological diversity. Historical channel analysis reveals a significant change in channel planform which is understood to have occurred naturally. The placement of bank protection on the outside of meander bends and gravel bars reveals a natural tendency for the river to laterally migrate and confinement by channel engineering. In contrast the surrounding tributaries have a low vulnerability to change due to their small size, artificial natural and current low morphological diversity.

(b) Residual Impacts and Significance

The predicted residual long term impact of the proposed development on geomorphology is negligible to small for all watercourses within the study area. This results in an imperceptible significance for the geology of the eleven watercourses within the study area. The predicted residual long term impact on the hydromorphology of the Feale water body is considered to be negligible resulting in an imperceptible significance.

With sediment release and disturbance to flow reduced through mitigation measures, there would be a slight temporary impact at a local level to the watercourses that are crossed by the proposed carriageway. Post construction vegetation would re-establish and reduce the long term impact on the tributaries of the River Feale. The installation of new culverts would represent a permanent adverse change to the watercourses, however these would be localised. With appropriate environmentally friendly culvert design (as described in Section 8.3.5 b) these will have a residual imperceptible impact (due to the low vulnerability of the watercourses to change).

The level of residual impact is based on an assumption that in-channel working, watercourse realignments and installation of hard bed and bank material would be minimised and as far as possible watercourse crossing designs would be environmentally sensitive. A change to the flow or sediment regime would worsen the impact on the watercourse, as would a large release of sediment during construction.

(c) Potential Enhancements

The aspects of the proposed development that impact the watercourses' geomorphology, such as drainage outfalls, culverts and the River Feale road bridge, have been designed to mitigate the adverse impacts. However, no watercourse enhancements have been included within the design of the proposed development. Therefore no improvement in geomorphology or hydromorphology is anticipated.

(d) Effect on WFD Hydromorphology Status

The proposed development is not considered to cause deterioration to the Feale water body and therefore there is not a risk to compliance with WFD from a hydromorphological perspective. No improvement in hydromorphology is anticipated.

8.4 References

CIRIA C649 Control of Water Pollution from Linear Construction Projects: Site Guide (Murnane et al. 2006); and

Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors' (CIRIA, 2001).

Department of Communications, Marine and Natural Resources: GSI Datasets Public Viewer. Available at: http://spatial.dcenr.gov.ie/imf/imf.jsp?site=GSI_Simple

Environmental Protection Agency: Water Quality Monitoring Database and Reports; and

EPA flow and water level measurements (EPA Hydronet System).

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);

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

Kerry County Council Development Plan 2009 - 2015;

Listowel Town Development Plan 2009-2015;

National Parks and Wildlife Service (designated sites);

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 Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes' (NRA, 2005);

National Parks and Wildlife Service (designated sites);

NPWS,2012. Lower River Shannon SAC (site code 2165). Available at: http://www.npws.ie/protectedsites/specialareasofconservationsac/lowerrivershannonsac/

Office of Public Works (OPW) Guidelines for Planning Authorities (GPA) 20: The Planning System and Flood Risk Management (OPW, 2009).

Ordinance Survey of Ireland (current and historic mapping);

Water Framework Directive Ireland Database (http://www.wfdireland.ie/);

The Shannon River Basin District Management Plan (SWRBDMP) and the Feale Water Management Unit (WMU) Action Plan;

9 Air Quality and Climate

9.1 Introduction

This chapter of the EIS 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 pollutant concentrations.

9.1.1 Ambient Air Quality Standards

In order to reduce the risk to health and the risk to the environment 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 9-1 and Appendix 9.1)

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 have set limit values for the pollutants SO_2, NO_2, PM_{10}, $PM_{2.5}$, benzene and CO (see Table 9-1). Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by the EU Directives are used which are triggers for particular actions (see Appendix 9.1).

Table 9-1 EU Air Quality Standards (based on European Commission Directive 2008/50/EC transposed as S.I. 180 of 2011)

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 limit for protection of vegetation	None	30 µg/m^3 NO + NO_2
Lead	2008/50/EC	Annual limit for protection of human health	100%	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 limit for the protection of ecosystems	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}
		Annual limit for protection of human health	20%	40 µg/m^3 PM_{10}
$PM_{2.5}$ (Stage 1)	2008/50/EC	Annual limit for protection of human health	20% from June 2008. Decreasing linearly to 0% by 2015	25 µg/m^3 $PM_{2.5}$
$PM_{2.5}$ (Stage 2) Note 2	-	Annual limit for protection of human health	None	20 µg/m^3 $PM_{2.5}$
Benzene	2008/50/EC	Annual limit for protection of human health	None	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 was 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'.

9.1.2 Climate Agreements

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the *Kyoto Protocol* in principle in 1997 and formally in May 2002 (Framework Convention on Climate Change, 1999 and Framework Convention on Climate Change, 1997). For the purposes of the European Union burden sharing agreement under Article 4 of the *Kyoto Protocol*, in June 1998, Ireland agreed to limit the net growth of the six Greenhouse Gases (GHGs) under the *Kyoto Protocol* to 13% above the 1990 level over the period 2008 to 2012 (ERM, 1998). The UNFCCC is continuing detailed negotiations in relation to GHGs reductions and in relation to technical issues such as emissions trading and burden sharing.

The EU has published the "20-20-20 Climate and Energy Package" which calls for a 20% reduction in greenhouse gas emissions, a 20% share of renewable energy and 20% energy efficiency improvements by 2020.

9.1.3 Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. COM (2013) 917 Final is the *"Proposal for a Council Decision for the acceptance of the Amendment to the 1999 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-level Ozone*" which sets out the initial objectives of the Protocol to control and reduce emissions of Sulphur Dioxide (SO_2), Nitrogen Oxides (NOX), 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% below 2005 levels), 65 kt for NO_X (49% reduction), 43 kt for VOCs (25% reduction), 108 kt for NH_3 (1% reduction) and 10 kt for $PM_{2.5}$ (18% reduction).

European Commission Directive 2001/81/EC and 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 (Department of the Environment, Community and Local Government, 2004). The 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 (European Economic Area, 2011). 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", which 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 PM2.5 (35% reduction) and for CH_4 (7% reduction).

9.1.4 Local Air Quality Assessment

The air quality assessment has been carried out following procedures described in the publications by the EPA (EPA, 2002; EEA, 2013 and using the methodology outlined in the following guidance documents published by the UK DEFRA (UK DEFRA, 2001; UK DEFRA, 2007; UK DEFRA, 2016a; UK DEFRA, 2016b; UK DETR, 1998.). The assessment of air quality was carried out using a phased approach as recommended by the UK DEFRA (2016a). 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 possible key pollutants was carried out and the likely location of air pollution "hot-spots" identified. An examination of recent EPA and local authority data in Ireland (EPA, 2013; EPA, 2017), has indicated that SO_2, smoke and CO are unlikely to be exceeded at locations such as in the region 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, 2013; EPA, 2017). Benzene, although previously reported at quite high levels in urban centres (EPA, 2013), has recently been measured at several city centre locations to be well below the EU limit value (EPA, 2013; EPA, 2017). 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, 2013; EPA, 2017).

The current assessment thus focused firstly on identifying the existing baseline levels of NO_2, PM_{10}, $PM_{2.5}$, benzene and CO in the region of the proposed development, both currently (by an analysis of suitable EPA and local monitoring data), and when the proposed development is opened (through modelling). Thereafter, the impact of the proposed development on air quality at the neighbouring sensitive receptors was determined relative to "Do Minimum" levels for the opening and design years (2017 and 2032). The assessment methodology involved air dispersion modelling using the UK DMRB Screening Model (UK DEFRA, 2007), the NO_x to NO_2 Conversion Spreadsheet (UK DEFRA, 2012) and following guidance issued by TII (2011), UK DEFRA (UK DEFRA, 2007; UKDEFRA, 20016a) and the EPA (2002; 2003). The inputs to the air dispersion model consist of information on road layouts, receptor locations, annual average daily traffic movements (AADT), annual average traffic speeds and background concentrations. Using this input data the model predicts ambient ground level concentrations at the worst-case sensitive receptors using generic meteorological data. This worst-case concentration is then added to the existing background concentration to give the worst-case predicted ambient concentration. The worst-case predicted ambient concentration is then compared with the relevant ambient air quality standard to assess the compliance of the proposed development with the ambient air quality standards.

9.1.5 Regional Impact Assessment Including Climate

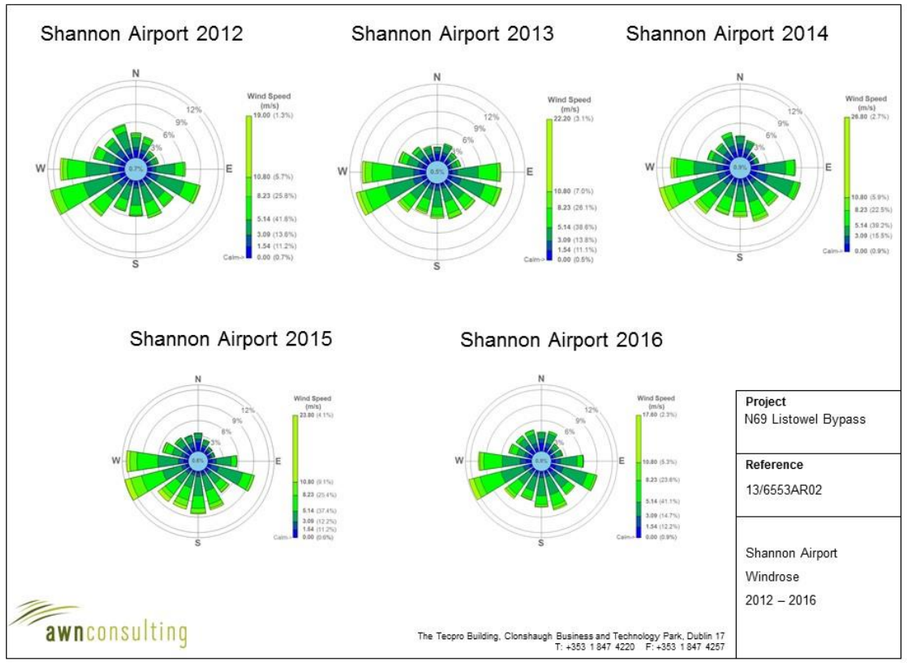
The impact of the proposed development at a national / international level has been determined using the procedures given by TII(2011) and the methodology provided in Annex 2 in the UK DMRB (2007). The assessment focused on determining the resulting change in emissions of VOCs, NO_x and CO_2. The Annex provides a method for the prediction of the regional impact of emissions of these pollutants from road schemes. The inputs to the air dispersion model consist of information on road link lengths, AADT movements and annual average traffic speeds.

9.2 Description of the Existing Environment

9.2.1 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 ($PM_{2.5}$ - PM_{10}) will actually increase at higher wind speeds. Thus, measured levels of PM_{10} will be a non-linear function of wind speed.

The nearest representative weather station collating detailed weather records is Shannon Airport meteorological station, which is located approximately 47 km northeast of the proposed development. For data collated during five representative years (2012 - 2016), the predominant wind ranges from south-easterly to westerly in direction with an average wind speed of approximately 4.7 m/s over the period 1981-2010 (see Appendix 9.2).



9.2.2 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 DEFRA, 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.

9.2.3 Baseline Air Quality

A baseline air quality survey was carried out as part of the air quality impact assessment of the proposed development. The pollutants measured were nitrogen dioxide (NO_2), PM_{10} and $PM_{2.5}$.

(a) NO_2

The passive diffusion tube survey was designed to assess background levels and roadside levels in the region of the proposed development (see Table 9-2 and Figure 9.1.1). NO_2 concentrations, using diffusion tubes, indicated current baseline concentrations in the region of the proposed development of the order of 31% of the EU Annual limit value for worst-case rural background and roadside levels.

Table 9-2 Results of NO_2 Diffusion Tube Monitoring Carried Out Near the proposed development (May 2013 – July 2013)

Location Type	Location	NO_2 ($\mu g/m^3$)[Note 1]		
		14/05/13 -14/06/13	14/06/13 -14/07/13	Average
Roadside	1	5.9	-	5.9
Roadside	2	8.1	8.6	8.4
Roadside	3	11.2	13.2	12.2
Roadside	4	8.5	7.6	8.1
Background	5	3.6	3.2	3.4
Background	6	5	4.7	4.9
Background	7	10	11.4	10.7
Background	8	7	7.9	7.5
Limit Value				40[Note 2]

Note 1 Diffusion tube bias factor of 0.79 applied to laboratory results.
Note 2 EU Council Directive 2008/50/EC (S.I. 180 of 2011) as an annual average.

(b) PM_{10}

PM_{10} concentrations throughout the two-month period were subject to some local interference during the survey period leading to the data being rejected. Consequently, the PM_{10} results are not reported here as they are not an accurate reflection of the air quality in the area. As a result, air quality data provided by the EPA was used to determine the background PM_{10} levels which are representative of the region.

(c) $PM_{2.5}$

The $PM_{2.5}$ monitoring program was carried out by means of a Turnkey Instruments® Osiris Environmental Dust Monitor at one location (see Location 9 in Figure 9.1.1). The location was positioned to allow an assessment of background levels in the region of the proposed development. The average $PM_{2.5}$ concentration measured over the two month period was 52% of the annual limit value. Summary results of $PM_{2.5}$ monitoring carried out at this location can be seen in Table 9-3.

Table 9-3 Summary of $PM_{2.5}$ Monitoring Results at a Background Location West of Listowel (May 2013 – July 2013)

$PM_{2.5}$ Monitoring Results Summary		
$PM_{2.5}$ Results	Total No. Days Sampling	64
	$PM_{2.5}$ Average	13.3 $\mu g/m^3$
	Limit Value	*25 $\mu g/m^3$* [Note 1]

Note 1 EU Council Directive 2008/50/EC - a*nnual limit value*.

9.2.4 Background Data

Air quality monitoring programs have been undertaken in recent years by the EPA and local authorities. The annual report on air quality “Air Quality Monitoring Annual Report 2012” (EPA, 2013), details the range and scope of monitoring undertaken throughout Ireland and was used to assess background levels of pollutants in the region of the proposed development.

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, 2013). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 21 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 D (EPA, 2013).

Long-term NO_2 monitoring was carried out at the two rural Zone D locations, Glashaboy and Kilkitt (EPA, 2013). The NO_2 annual average in 2012 for both sites was 9 and 4µg/m^3 respectively. Hence long-term average concentrations measured at these locations were significantly lower than the annual average limit value of 40 µg/m^3. Based on the above information and the baseline survey which was carried out in 2013, a conservative estimate of the 2014 background NO_2 concentration, for the region of the proposed development is 12 µg/m^3.

The results of CO monitoring carried out in Shannon Town in 2012 showed no exceedences of the 8-hour limit value (EPA, 2013), with average levels of 0.2 mg/m^3. In addition, data for the Zone C stations of Balbriggan and Mullingar in 2012 and Zone B station of Old Station Road, Cork in 2012 indicated long-term average of 0.6, 0.3 and 0.2 mg/m^3 respectively (EPA, 2013). Based on the above information, a conservative estimate of the background CO concentration for the region of the proposed development in 2014 is 0.4 mg/m^3.

With regard to benzene, continuous monitoring was carried out at Shannon Town, Co. Clare in 2012 and Emo Court, Co. Laois in 2010 with a long-term average of 0.4 µg/m^3 at both locations (EPA, 2013). The results of monitoring carried out in the Zone C locations in Balbriggan and Mullingar in 2012 indicated long-term averages 0.4 µg/m^3 respectively (EPA, 2013). Based on the above information, a conservative estimate of the background benzene concentration for the region of the proposed development in 2014 is 0.4 µg/m^3.

Long-term PM_{10} monitoring was carried out at the rural Zone D locations of Kilkitt and Claremorris in 2012 (EPA, 2013). The average concentration measured at Kilkitt and Claremorris in 2012 was 9 and 10 µg/m^3 respectively. Long-term PM_{10} measurements carried out at urban Zone D locations of Castlebar and Shannon Town in 2012 gave average levels of 12 and 11 µg/m^3 respectively (EPA, 2013). Data from the Phoenix Park in Dublin also provides a good indication of urban background levels, with an annual average in 2012 of 11 µg/m^3 (EPA, 2013). Data from the Zone C locations of Ennis and Bray give average concentrations of 19 and 17 µg/m^3, respectively. Based on the above information, a conservative estimate of the 2014 background PM_{10} concentration for the region of the proposed development which is defined as Zone D is 20 µg/m^3.

The results of $PM_{2.5}$ monitoring at Claremorris in 2012 (EPA, 2013) indicated an average $PM_{2.5}/PM_{10}$ ratio of 0.6. Based on this information, a conservative ratio of 0.6 was used to generate a rural background $PM_{2.5}$ concentration in 2014 of 12 µg/m^3. This is a similar background concentration measured by the OSIRIS monitor during baseline monitoring, where an average concentration of 13.3 µg/m^3 was recorded.

Background concentrations for 2017 and 2032 were calculated from the 2014 background concentrations using the Netcen background calculator, which uses year on year reduction factors provided by UK DEFRA (2016a).

In summary, existing baseline levels of NO_2, PM_{10}, $PM_{2.5}$, CO and benzene based on extensive long-term data from the EPA are expected to be below ambient air quality limit values in the vicinity of the proposed development. A summary of the background concentrations is detailed in Table 9-4.

Table 9-4 Summary of Background Concentrations Used in the Air Dispersion Model

Background Values	Nitrogen Oxides (µg/m^3)	Nitrogen Dioxide (µg/m^3)	Benzene (µg/m^3)	Particulates (PM_{10}) (µg/m^3)	Particulates ($PM_{2.5}$) (µg/m^3) Note 1	Carbon Monoxide (mg/m^3)
2014	15.3	12.0	0.40	20.0	12.0	0.40
2017	12.8	10.1	0.41	19.7	11.8	0.40
2032	7.6	6.0	0.42	19.5	11.7	0.42

9.3 Appraisal Method used for Assessment of Impacts

9.3.1 Air Quality Impact Significance Criteria

Although no relative impact, as a percentage of the limit value, is enshrined in EU or Irish legislation, TII guidance (TII, 2011) details 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. These significance criteria have been adopted for the proposed development and are detailed in Table 9-5 to Table 9-6. 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 9-5 Definition of Impact Magnitude for Changes in Ambient Pollutant Concentrations

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* - Transport Infrastructure Ireland (2011)

Table 9-6 Air Quality Impact Significance Criteria for Annual Mean Nitrogen Dioxide, PM_{10} and $PM_{2.5}$

Absolute Concentration in Relation to Objective/Limit Value	Change in Concentration Note 1		
	Small	Medium	Larger
Increase with the proposed development			
Above Objective/Limit Value with the proposed 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 the proposed 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 the proposed 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 the proposed 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 the proposed development			

Absolute Concentration in Relation to Objective/Limit Value	Change in Concentration [Note 1]		
	Small	Medium	Larger
Increase with the proposed development			
Above Objective/Limit Value with the proposed 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 the proposed 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 the proposed 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 the proposed development (<30 µg/m^3 of NO_2 or PM_{10}) (<18.75 µg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Beneficial
Decrease with the proposed development			
Above Objective/Limit Value with the proposed development (≥35 days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value with the proposed development (32 - <35 days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value with the proposed development (26 - <32 days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value v (<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 Schemes* - Transport Infrastructure Ireland (2011)

Table 9-7 Air Quality Impact Significance Criteria for Changes to Number of Days with PM_{10} Concentration > 50µg/m^3 at a Receptor

Absolute Concentration in Relation to Objective/Limit Value	Change in Concentration [Note 1]		
	Small	Medium	Larger
Increase with the proposed development			
Above Objective/Limit Value with the proposed development (≥35 days)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value with the proposed development (32 - <35 days)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value with the proposed development (26 - <32 days)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value with the proposed development (<26 days)	Negligible	Negligible	Slight Adverse
Decrease with the proposed development			
Above Objective/Limit Value with the proposed development (≥35 days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value with the proposed development (32 - <35 days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value with the proposed development (26 - <32 days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value v (<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 Schemes* - Transport Infrastructure Ireland (2011)

9.4 Predicted Impacts of the Proposed Development

9.4.1 Construction Phase – Air Quality & Climate

The greatest potential impact on air quality during the construction phase of the proposed development is from construction dust emissions and the potential for nuisance dust. While construction dust tends to be deposited within 200 m of a construction site, the majority of the deposition occurs within the first 50 m. Most importantly, when the dust minimisation measures detailed in Section 9.5.1 and Appendix 9.3 of this EIS are implemented, fugitive emissions of dust from the site will be insignificant and pose no nuisance at nearby receptors.

Due to the size and nature of the construction activities, CO_2 and N_2O emissions during construction will have a negligible impact on climate.

9.4.2 Operational Phase – Local Air Quality

Detailed traffic flow information developed as part of this EIS was used to model pollutant levels under various traffic scenarios and under sufficient spatial resolution to assess whether any significant air quality impact on sensitive receptors may occur. The traffic data corresponded to the opening year of 2017 and the design year of 2032. The traffic data used represented figures for the “Do Minimum” and “Do Something” scenarios.

Cumulative effects have been assessed, as recommended in the EU Directive on EIA (Council Directive 97/11/EC) and using the methodology of the UK DEFRA (UK DEFRA, 2009; UK DETR, 1998). Firstly, background concentrations (UK DEFRA, 2009) have been included in the modelling study, for both “Do Minimum” and “Do Something” scenarios. These background concentrations are year-specific and account for non-localised sources of the pollutants of concern (UK DEFRA, 2016a). Appropriate background levels were selected based on the available monitoring data provided by the EPA and local authorities (EPA, 2013; EPA, 2017) (see Section 9.2.4).

Once appropriate background concentrations were established, the existing situation, including background levels, was assessed in the absence of the proposed development

for the opening year. The assessment methodology involved air dispersion modelling using the UK DMRB Screening Model (Version 1.03c) (UK DEFRA, 2007), the NO_x to NO_2 Conversion Spreadsheet (UK DEFRA, 2012) (Version 3.2 (Released September 2012)) and the following guidance issued by the UK DEFRA (UK DEFRA, 2007; UK DEFRA; 2016a; UK DEFRA, 2016b; UK DETR, 1998). Ambient concentrations of CO, benzene, NO_2, PM_{10} and $PM_{2.5}$ were predicted at the nearest sensitive receptors to the proposed development. "Do Minimum" and "Do Something" modelling was carried out at the building façade of the worst-case receptors for 2017 and 2032. This assessment allows the significance of the proposed development, with respect to both relative and absolute impact, to be determined both temporally and spatially.

(a) Receptor Locations

Fifteen locations were modelled close to the proposed development. The receptors modelled represent the worst-case locations in the vicinity of the proposed development and were chosen due to their close proximity to the proposed development as well as existing local roads. Details of the assessment locations are provided in Table 9-8 and Figure 9.1.1.

Table 9-8 DMRB Screening Air Quality Assessment. Details of Assessment Locations

Receptor	Location / Townland	Chainage	Co-ordinates ITM
1	Clieveragh Road	N/A	498943 634223
2	John B. Keane Road	N/A	498893 634177
3	John B. Keane Road	N/A	498478 634151
4	Market Street	N/A	498279 634155
5	Ballybunion Road	N/A	498018 634314
6	Convent View	4480	498084 634210
7	Ashfield	4300	497924 634151
8	Islandganniv Place	3700	497348 633900
9	Forge Road	3300	496981 633820
10	Forge Road	3300	497069 633750
11	Gortcurreen	2700	496995 633473
12	Gortcurreen	2500	496804 633273
13	Coolnaleen Lower	1100	497479 632065
14	Coolnaleen Lower	540	497538 631928
15	Coolnaleen Upper	565	497795 631991

(b) Modelling Results and Impact Assessment

(i) 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 9-9 and Table 9-10. Predicted pollutant concentrations in the region of the proposed development are below the ambient standards at all locations. Levels of both pollutants range from 8 - 22% of the respective limit values in 2017.

Future trends indicate similarly low levels of CO and benzene. Levels of both pollutants are below the relevant limit values, ranging from 8 - 24% of their respective limits in 2032.

The impact of the proposed development can be assessed relative to "Do Minimum" levels in 2017 and 2032 (see in Table 9-9 and Table 9-10). Relative to baseline levels, some small increases and decreases 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 15 receptors assessed will experience an increase or decrease in concentrations of greater than 5% of the limit value in either 2017 or 2032 and thus the magnitude of the changes in air quality is either small or imperceptible at all receptors based on the criteria outlined in Table 9-5.

The greatest impact on CO and benzene concentrations in either 2017 or 2032 will be an increase of 0.9% of their respective limit values at Receptor 4. Furthermore, the greatest improvement in CO and benzene concentrations will be a decrease of 1% of their respective limit values at Receptor 15.

Thus, using the assessment criteria for NO_2 and PM_{10} outlined in Table 9-5 and Table 9-6, and applying these criteria to CO and benzene, the impact of the proposed development in terms of CO and benzene is negligible.

Table 9-9 DMRB Screening Air Quality Assessment. Predicted Maximum 8-Hour CO Concentrations

		Maximum 8-Hr CO Concentration (mg/m^3)			
		Do Minimum		Do Something	
Receptor	Location / Townland	2017	2032	2017	2032
1	Clieveragh Road	2.2	2.4	2.2	2.4
2	John B. Keane Road	2.2	2.4	2.3	2.4
3	John B. Keane Road	2.1	2.2	2.2	2.3
4	Market Street	2.2	2.3	2.3	2.4
5	Ballybunion Road	2.1	2.2	2.1	2.2
6	Convent View	2.0	2.1	2.0	2.2
7	Ashfield	2.0	2.1	2.1	2.2
8	Islandganniv Place	2.0	2.1	2.0	2.1
9	Forge Road	2.0	2.1	2.0	2.2
10	Forge Road	2.0	2.1	2.0	2.2
11	Gortcurreen	2.0	2.1	2.0	2.1
12	Gortcurreen	2.0	2.1	2.0	2.1
13	Coolnaleen Lower	2.0	2.1	2.0	2.1
14	Coolnaleen Lower	2.0	2.1	2.0	2.1
15	Coolnaleen Upper	2.1	2.2	2.0	2.1
Ambient Limit Value[Note 1]		10 mg/m^3	10 mg/m^3	10 mg/m^3	10 mg/m^3

[Note 1] Maximum 8-hour CO Limit Value: S.I. No. 180 of 2011 & EU Directive 2008/50/EC

Table 9-10 DMRB Screening Air Quality Assessment. Predicted Annual Mean Benzene Concentrations

Receptor	Location / Townland	Annual Mean Benzene Concentrations (mg/m^3)			
		Do Minimum		Do Something	
		2017	2032	2017	2032
1	Clieveragh Road	0.46	0.49	0.46	0.48
2	John B. Keane Road	0.47	0.50	0.47	0.50
3	John B. Keane Road	0.43	0.45	0.45	0.47
4	Market Street	0.45	0.48	0.47	0.50
5	Ballybunion Road	0.42	0.44	0.43	0.45
6	Convent View	0.41	0.43	0.42	0.44
7	Ashfield	0.41	0.42	0.42	0.44
8	Islandganniv Place	0.41	0.42	0.41	0.42
9	Forge Road	0.41	0.42	0.42	0.43
10	Forge Road	0.41	0.42	0.42	0.43
11	Gortcurreen	0.42	0.43	0.41	0.43
12	Gortcurreen	0.41	0.42	0.42	0.43
13	Coolnaleen Lower	0.41	0.42	0.41	0.43
14	Coolnaleen Lower	0.41	0.43	0.42	0.43
15	Coolnaleen Upper	0.43	0.44	0.41	0.42
Ambient Limit Value[Note 1]		5 µg/m^3	5 µg/m^3	5 µg/m^3	5 µg/m^3

Note 1 Annual Average Benzene Limit Value: S.I. No. 180 of 2011 & EU Directive 2008/50/EC

(ii) 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 9-11. Predicted annual average concentrations in the region of the proposed development are below the ambient standards at all worst-case receptors, ranging from 49 - 51% of the limit value in 2017. In addition, the 24-hour limit value will be exceeded four times in 2017.

Future trends with the proposed development in place indicate similarly low levels of PM_{10}. Annual average PM_{10} concentrations range from 49-51% of the limit in 2032. Furthermore, the results show that the 24-hour limit value will be exceeded four times in 2032.

The impact of the proposed development can be assessed relative to “Do Minimum” levels in 2017 and 2032 (see Table 9-11.). Relative to baseline levels, some small increases and decreases 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 15 receptors assessed will experience an increase or decrease in concentrations of over 5% of the limit value in 2017 and 2032. Thus the magnitude of the changes in air quality is small or imperceptible at all receptors based on the criteria outlined in Table 9-5.

The greatest impact on PM_{10} concentrations in the region of the proposed development in either 2017 or 2032 will be an increase of 1.4% of the annual limit value at Receptor 7. Furthermore, the greatest improvement in PM_{10} concentrations will be a decrease of 1.8% of the annual limit value at Receptor 15.

Thus, using the assessment criteria outlined in in Table 9-5 and Table 9-6 the impact of the proposed development with regard to PM_{10} is negligible at all 15 of the receptors assessed.

Table 9-11 DMRB Screening Air Quality Assessment. Predicted Annual Mean PM_{10} Concentrations

Receptor	Location / Townland	Annual Mean PM_{10} Concentrations (µg/m^3)			
		Do Minimum		Do Something	
		2017	2032	2017	2032
1	Clieveragh Road	20.3	20.3	20.3	20.3
2	John B. Keane Road	20.4	20.5	20.5	20.5
3	John B. Keane Road	20.1	20.0	20.3	20.2
4	Market Street	20.2	20.2	20.5	20.5
5	Ballybunion Road	19.9	19.7	20.2	20.2
6	Convent View	19.8	19.6	20.0	20.0
7	Ashfield	19.7	19.5	20.1	20.1
8	Islandganniv Place	19.7	19.5	19.8	19.6
9	Forge Road	19.7	19.5	20.0	19.9
10	Forge Road	19.7	19.5	20.0	19.9
11	Gortcurreen	19.8	19.6	19.8	19.6
12	Gortcurreen	19.7	19.5	19.9	19.8
13	Coolnaleen Lower	19.7	19.5	19.9	19.7
14	Coolnaleen Lower	19.8	19.6	19.9	19.7
15	Coolnaleen Upper	20.4	20.3	19.8	19.6
Ambient Limit Value[Note 1]		40 µg/m^3	40 µg/m^3	40 µg/m^3	40 µg/m^3

Note 1 Annual Average PM_{10} Limit Value: S.I. No. 180 of 2011 & EU Directive 2008/50/EC

(iii) $PM_{2.5}$

The results of the modelled impact of the proposed development for $PM_{2.5}$ in the opening and design years are shown in Table 9-12. Predicted annual average concentrations in the region of the proposed development are below the ambient standard at all worst-case receptors, ranging from 47 - 50% 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 range from 47 - 51% of the limit in 2032.

The impact of the proposed development can be assessed relative to “Do Minimum” levels in 2017 and 2032 (see Table 9-12). Relative to baseline levels, some small increases and decreases 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 15 receptors assessed will experience an increase or decrease in concentrations of over 5% of the limit value in 2017 and 2032. Thus the magnitude of the changes in air quality is small or imperceptible at all receptors based on the criteria outlined in Table 9-5.

The greatest impact on $PM_{2.5}$ concentrations in the region of the proposed development in either 2017 or 2032 will be an increase of 2.3% of the annual limit value at Receptor 7. Furthermore, the greatest improvement in $PM_{2.5}$ concentrations will be a decrease of 2.9% of the annual limit value at Receptor 15.

Thus, using the assessment criteria outlined in Table 9-5 and Table 9-6, the impact of the proposed development with regard to $PM_{2.5}$ is negligible at all receptors assessed.

Table 9-12 DMRB Screening Air Quality Assessment. Predicted Annual Mean $PM_{2.5}$ Concentrations

Receptor	Location / Townland	Annual Mean $PM_{2.5}$ Concentrations (µg/m^3)			
		Do Minimum		Do Something	
		2017	2032	2017	2032
1	Clieveragh Road	12.4	12.6	12.4	12.5
2	John B. Keane Road	12.6	12.7	12.6	12.7
3	John B. Keane Road	12.2	12.2	12.4	12.4
4	Market Street	12.3	12.4	12.6	12.7
5	Ballybunion Road	12.0	11.9	12.3	12.4
6	Convent View	11.9	11.8	12.1	12.2
7	Ashfield	11.8	11.7	12.2	12.3
8	Islandganniv Place	11.8	11.7	11.9	11.8
9	Forge Road	11.8	11.7	12.1	12.1
10	Forge Road	11.8	11.7	12.1	12.1
11	Gortcurreen	11.9	11.8	11.9	11.8
12	Gortcurreen	11.8	11.7	12.0	12.0
13	Coolnaleen Lower	11.8	11.7	12.0	11.9
14	Coolnaleen Lower	11.9	11.8	12.0	11.9
15	Coolnaleen Upper	12.5	12.5	12.0	11.8
Ambient Limit Value[Note 1]		25 µg/m^3	25 µg/m^3	25 µg/m^3	25 µg/m^3

Note 1 Annual Average $PM_{2.5}$ Limit Value: S.I. No. 180 of 2011 & EU Directive 2008/50/EC

(iv) NO_2

The results of the assessment of the impact of the proposed development for NO2 in the opening and design years are shown in Table 9-13 and Table 9-14. The annual average concentration is within the limit value at all worst-case receptors. Future trends, with the proposed development in place, indicate similarly low levels of NO2. Levels of NO2 range from 16 - 34% of the annual limit value in 2017 and 2032.

Maximum one-hour NO2 levels with the proposed development in place will be significantly below the limit value, with levels at the worst-case receptor reaching 34% of the limit value in 2017 and 26% of the limit value in 2032.

The impact of the proposed development on maximum one-hour NO2 levels can be assessed relative to “Do Minimum” levels in 2017 and 2032 (see Table 9-13 and Table 9-14). Relative to baseline levels, some small increases and decreases in NO2 levels at the worst-case receptors are predicted as a result of the proposed road. With regard to impacts at individual receptors, none of the 15 receptors assessed will experience an increase in concentrations of over 5% of the limit value in 2017 and 2032. One receptor will experience a decrease in concentrations of over 5% of the limit value in 2017 and 2032. Thus the magnitude of the changes in air quality is medium and positive at one receptor and small or imperceptible at all remaining receptors based on the criteria outlined in in Table 9-5.

The greatest impact on NO_2 concentrations in the region of the proposed development in either 2017 or 2032 will be an increase of 4.7% of the annual or maximum 1-hour limit value at Receptor 7. Furthermore, the greatest improvement in NO_2 concentrations will be a decrease of 6.4% of the annual or maximum 1-hour limit value at Receptor 15.

Thus, using the assessment criteria outlined in Table 9-5 and Table 9-6 the impact of the proposed development in terms of NO_2 is negligible at all 15 of the receptors assessed.

Table 9-13 DMRB Screening Air Quality Assessment. Predicted Annual Mean NO_2 Concentrations

Receptor	Location / Townland	Annual Mean NO_2 Concentrations (µg/m^3)			
		Do Minimum		Do Something	
		2017	2032	2017	2032
1	Clieveragh Road	12.7	9.5	12.6	9.4
2	John B. Keane Road	13.2	10.1	13.4	10.1
3	John B. Keane Road	12.2	8.7	13.6	10.1
4	Market Street	12.4	9.2	13.6	10.3
5	Ballybunion Road	11.0	7.1	12.0	8.6
6	Convent View	10.5	6.5	11.2	8.0
7	Ashfield	10.1	6.0	11.5	7.9
8	Islandganniv Place	10.1	6.0	10.3	6.3
9	Forge Road	10.1	6.0	11.0	7.3
10	Forge Road	10.1	6.0	11.1	7.4
11	Gortcurreen	10.5	6.4	10.4	6.5
12	Gortcurreen	10.1	6.1	10.7	6.9
13	Coolnaleen Lower	10.2	6.1	10.6	6.7
14	Coolnaleen Lower	10.6	6.7	10.9	6.9
15	Coolnaleen Upper	12.8	9.0	10.7	6.4
Ambient Limit Value[Note 1]		40 µg/m^3	40 µg/m^3	40 µg/m^3	40 µg/m^3

Note 1 Annual Average NO_2 Limit Value: S.I. No. 180 of 2011 & EU Directive 2008/50/EC

Table 9-14 DMRB Screening Air Quality Assessment. Predicted Maximum 1-Hour NO_2 Concentrations

Receptor	Location / Townland	Maximum 1-Hour NO_2 Concentrations (µg/m^3)			
		Do Minimum		Do Something	
		2017	2032	2017	2032
1	Clieveragh Road	63.4	47.6	63.2	46.9
2	John B. Keane Road	66.0	50.7	67.0	50.6
3	John B. Keane Road	61.0	43.5	67.8	50.6
4	Market Street	61.9	45.9	68.1	51.7
5	Ballybunion Road	54.8	35.7	60.1	43.2
6	Convent View	52.3	32.5	55.8	39.8
7	Ashfield	50.5	30.2	57.4	39.6
8	Islandganniv Place	50.5	30.2	51.4	31.4
9	Forge Road	50.5	30.2	55.2	36.6
10	Forge Road	50.5	30.2	55.5	37.1
11	Gortcurreen	52.3	32.2	52.0	32.4
12	Gortcurreen	50.6	30.3	53.7	34.6
13	Coolnaleen Lower	50.8	30.6	52.9	33.5
14	Coolnaleen Lower	53.0	33.4	54.3	34.7
15	Coolnaleen Upper	63.9	44.8	53.3	32.0
Ambient Limit Value[Note 1]		200 µg/m^3	200 µg/m^3	200 µg/m^3	200 µg/m^3

Note 1 Maximum 1-Hour NO_2 Limit Value: S.I. No. 180 of 2011 & EU Directive 2008/50/EC

9.4.3 Air Quality Impacts on Sensitive Ecosystems

The TII guidance (TII, 2011) state that as the potential impact of a scheme 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 NO_x (i.e. NO and NO_2) emissions resulting from the proposed development at the Lower River Shannon SAC was assessed. This section of the proposed development encroaches on the River Feale which is a part of the Lower River Shannon SAC at Islandganniv South (approximate chainage 1,700). Dispersion modelling and

prediction was carried out at typical traffic speeds at this location. Ambient NO_x concentrations predicted for the opening and design years along a transect of up to 200 m within the Lower River Shannon SAC are given in Table 9.15. The road contribution to dry deposition along the transect is also given and was calculated using the methodology of TII 2011.

The predicted annual average NO_x level in the Lower River Shannon SAC near Islandganniv South is below the limit value of 30 µg/m^3 for the "Do Minimum" scenario in 2017 and 2032, with NO_x concentrations reaching 43% of this limit in 2017 and 25% in 2032. Levels increase with the proposed development in place with levels reaching 58% of the limit value for the "Do Something" scenario in 2017 and 48% of the limit value in 2032.

The predicted annual average NO_x levels at the Lower River Shannon SAC near Islandganniv South are below the limit value of 30 µg/m^3 for the "Do Something" scenario in both the opening and design years. The impact of the proposed development leads to an increase in NO_x concentrations of at most 6.8 µg/m^3 within the Lower River Shannon SAC. TII guidance states that where a proposed scheme 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 will be assessed by the project ecologist.

The road contribution to the NO_2 dry deposition rate along the 200 m transect within the SAC at Islandganniv South is also detailed in Table 9-15. The maximum increase in the NO_2 dry deposition rate is 0.25 Kg(N)/ha/yr in 2017 and 0.35 Kg(N)/ha/yr in 2032. This reaches only 7% of the critical load for inland and surface water habitats of 5-10 Kg(N)/ha/yr (TII, 2011).

Table 9-15 Air Quality Assessment of Ecosystems. Assessment of Impact Along Transect from Proposed Development Through the Lower River Shannon SAC at Islandganniv South (Chainage 600)

Dist. To Road (m)	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
10	12.8	17.49	4.7	7.6	14.4	6.8	0.25	0.35
20	12.8	16.35	3.6	7.6	12.7	5.1	0.19	0.27
30	12.8	15.53	2.7	7.6	11.5	3.9	0.15	0.21
40	12.8	14.92	2.1	7.6	10.7	3.1	0.12	0.16
50	12.8	14.47	1.7	7.6	10.0	2.4	0.09	0.13
60	12.8	14.11	1.3	7.6	9.5	1.9	0.07	0.10
70	12.8	13.84	1.0	7.6	9.1	1.5	0.06	0.08
80	12.8	13.61	0.8	7.6	8.8	1.2	0.04	0.06
90	12.8	13.44	0.6	7.6	8.5	0.9	0.04	0.05
100	12.8	13.30	0.5	7.6	8.3	0.7	0.03	0.04
110	12.8	13.19	0.4	7.6	8.2	0.6	0.02	0.03
120	12.8	13.10	0.3	7.6	8.0	0.4	0.02	0.02
130	12.8	13.04	0.2	7.6	7.9	0.3	0.01	0.02
140	12.8	12.99	0.2	7.6	7.9	0.3	0.01	0.01
150	12.8	12.96	0.2	7.6	7.8	0.2	0.01	0.01
160	12.8	12.95	0.1	7.6	7.8	0.2	0.01	0.01
170	12.8	12.94	0.1	7.6	7.8	0.2	0.01	0.01
180	12.8	12.92	0.1	7.6	7.8	0.2	0.01	0.01
190	12.8	12.89	0.1	7.6	7.7	0.1	0.01	0.01
200	12.8	12.9	0.1	7.6	7.7	0.1	0.00	0.01
Standards	30 µg/m^3	30 µg/m^3	-	30 µg/m^3	30 µg/m^3	-	5 – 10 (KG(N)/ha/yr)	

9.4.4 Operational Phase – Regional Air Quality

The regional impact of the proposed development on emissions of NO_x and VOCs has been assessed using the procedures of TII 2011 and the UK DEFRA (2007). The results (see Table 9-16) indicate that the impact of the proposed development on Ireland's obligations under the Gothenburg Protocol is negligible. For the assessment year of 2017, the predicted impact of the proposed development is to increase NO_x levels by 0.00004% of the NO_x emissions ceiling and decrease VOC levels by 0.000001% of the VOC emissions ceiling to be complied with in 2010. For the assessment year of 2032, the predicted impact of the proposed development is to increase NO_x levels by 0.0003% of the NO_x emissions ceiling and increase VOC levels by 0.00007% of the VOC emissions ceiling to be complied with in 2010.

9.4.5 Operational Phase – Climate

The impact of the proposed development on emissions of CO_2 was also assessed (see see Table 9-16). The results show that the impact of the proposed development will be to increase CO_2 emissions by 0.00001% and 0.003% of Ireland's Kyoto target in 2017 and 2032, respectively. The impact of the proposed development on emissions of CO_2 was also assessed against Ireland's 2020 target for Non-ETS sectors which is to reduce CO_2 levels by 20% of 2005 levels by 2020, this equates to 37.5 Mtonnes of CO_2eq. The results show that the impact of the proposed development will be to increase CO_2 emissions by 0.00002% and 0.0005% of Ireland's reduction target for 2020. Thus, the impact of the proposed development on national greenhouse gas emissions will be insignificant in terms of Ireland's obligations under the Kyoto Protocol and the EU Commission's Climate and Energy Package (DEHLG, 2006; FCCC,1999).

Table 9-16 Regional Air Quality Assessment.

Year	Scenario	VOC (KG/annum)	NO_x (KG/annum)	CO_2 (tonnes/annum)
2017	Do Minimum	1283	8753	8605
	Do Something	1282	8782	8612
2032	Do Minimum	1828	7515	9150
	Do Something	1864	7678	9351
Increment in 2017		-1 kg	29 kg	7 tonnes
Increment in 2032		36 kg	163 kg	201 tonnes
Emissions Ceiling		55 kt[Note 1]	65 kt[Note 1]	62800 kt[Note 2]
Impact in 2017		-0.000001 %	0.00004 %	0.00001 %
Impact in 2032		0.00007 %	0.0003 %	0.0003 %

Note 1 kt = kilo tonnes. National Emission Ceiling (EU Directive 2001/81/EC)

Note 2 kt = kilo tonnes. Ireland's Target Under The Kyoto Protocol

9.5 Proposed Mitigation and Avoidance Measures

In order to sufficiently ameliorate any potential negative impacts on the air environment, a schedule of measures has been formulated for the construction phase associated with the proposed development.

9.5.1 Construction Phase

(a) Air Quality

The potential for dust to be emitted depends on the type of construction activity being carried out in conjunction with environmental factors including levels of rainfall, wind speeds and wind direction. The potential for impact from dust depends on the distance to potentially sensitive locations and whether the wind can carry the dust to these locations. The majority of dust produced will be deposited close to the generated source. A dust minimisation plan will be formulated for the construction phase of the project, as construction activities are likely to generate some dust emissions.

In order to ensure that no dust nuisance occurs, a series of measures will be implemented. Full details of the recommendation for the dust minimisation plan are included in Appendix 9.2; in summary, the measures which will be implemented will include:

- *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;*
- *Public roads outside the site will be regularly inspected for cleanliness, and cleaned;*
- *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; and*
- *Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions.*

The dust minimisation procedures put in place will be monitored and assessed by the contractor. These measures will be included in the EOP. In the event of dust nuisance occurring outside the site boundary, the effectiveness of existing measures will be reviewed and the above mitigation regime intensified in terms of frequency of cleaning, misting and sweeping etc to rectify the problem.

When the dust minimisation measures outlined above and included in Appendix 9.2 are adhered to, the air quality impacts during the construction phase will not be significant.

(b) Climate

Emissions of carbon dioxide will be mitigated by the appropriate scheduling of construction activities to minimise duration, and the shutting off of equipment during periods of inactivity. No additional mitigation measures are considered necessary.

9.5.2 Operational Phase – Air Quality

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 has entered into force since 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, 2009).

9.5.3 Operational Phase – Climate

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.

The EPA publication "*Ireland's Greenhouse Gas Emissions Projections 2013 – 2020*", outlines the measures which will be taken to mitigate greenhouse gas emissions from the transport sector. These measures include:

- *The improvement to the fuel economy of private cars supported by EU Regulation which will mandates that maximum levels of CO2 for new cars will be 120 g/km in 2015 and 95 g/km in 2020;*
- *More efficient road traffic movements and public transport efficiencies will deliver savings; and*
- *Renewable energy penetration of 10% by 2020 under the RES-T target which is binding under the Renewable Energy Directive (28/EC/2009).*

9.6 Difficulties Encountered in Compiling Information

The only difficulties encountered throughout this assessment was the baseline monitoring of PM_{10}. The monitor was subject to local interference which led to elevated results which were not representative of the baseline condition in the area. However, EPA monitoring data was used to determine the baseline conditions in the area for PM_{10}.

9.7 Cumulative Impact and Impact Interrelations

There are no cumulative impacts with regards to this assessment.

9.8 References

Department of the Environment, Heritage and Local Government (DEHLG) (2003) Strategy to Reduce Emissions of Trans-boundary Pollution by 2010 to Comply with National Emission Ceilings - Discussion Document

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DEHLG (2007a) Update and Revision of the National Programme for Ireland under Article 6 of Directive 2001/81/EC for the Progressive Reduction of National Emissions of Transboundary Pollutants by 2010

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UK DEFRA (2001) DMRB Model Validation for the Purposes of Review and Assessment

UK DEFRA (2007) Design Manual for Roads and Bridges, Volume 11, Section 3, Part 1 - HA207/07 (Document & Calculation Spreadsheet)

UK DEFRA (2012) NOx to NO2 Conversion Spreadsheet (Version 3.2)

UK DEFRA (2016a) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM.TG(16)

UK DEFRA (2016b) Part IV of the Environment Act 1995: Local Air Quality Management, LAQM. PG(16)

UK Department of the Environment, Transport and Roads (UK DETR) (1998) Preparation of Environmental Statements for Planning Projects That Require Environmental Assessment - A Good Practice Guide, Appendix 8 - Air & Climate

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10 Noise and Vibration

10.1 Introduction

This chapter outlines the assessment of the potential noise impacts associated with the proposed development.

10.2 Assessment Criteria & Methodology

For new national roads in Ireland, it is standard practice to adopt the traffic noise design goal contained within the TII document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (NRA, 2004). In the case of the proposed scheme, due to the large offline element, these guidelines are highly relevant. Supplementary guidance on the application of these Guidelines has also been published in the form of the *Good Practice Guidance (GPG) for the Treatment of Noise during the Planning of National Road Schemes* (NRA, 2014). Where relevant and applicable, the content of this best practice guidance has been incorporated[36].

In order to assess the noise impact of any proposed road scheme, the following methodology is normally adopted:

- *The first stage is to assess and quantify the noise environment in the vicinity of sensitive receptors that may be affected by the proposed development.*
- *The noise levels resulting from the operational phase are then calculated using established prediction techniques. The noise levels associated with the operational phase of the proposed development are predicted in accordance with guidance set out in calculation of road traffic noise (CRTN), giving results in the form of $L_{A10(18hour)}$ values. These are then converted to Lden values in accordance with the Method A procedure as detailed in the TII guidance. The derived values for Lden should be rounded to the nearest whole number, with 0.5 being rounded up.*
- *The predicted values are then assessed against the three conditions set out in the TII guidance in order to assess the need for mitigation measures.*

10.3 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 project.

10.3.1 Survey Locations

The location reference and a description of each survey position are given in Table 10-1.

Table 10-1 Details of Survey Locations

Location	Description of Survey Location	ITM Grid Reference	
		E	N
S01	In the vicinity of a Coolnaleen Cottage located along a small road near the southern extent of the proposed development.	497,832	631,379
S02	In the vicinity of a residence located along the N69 at the southern extent of the proposed development.	497,573	631,465
S03	In the vicinity of the residential property and farm to the east of the proposed development near the southern tie in with the N69.	497,492	632,066
S04	In the vicinity of the residential property along the N69 near the proposed southern tie in with the N69.	497,739	631,995
S05	In the vicinity of the residential dwellings along the small road to the west of the proposed alignment.	497,827	632,332
S06	In the vicinity of the residential dwellings along the small road to the west of the proposed alignment.	497,578	632,649
S07	In the vicinity of the residential properties along the Greenville Road (L-1011).	496,697	633,349
S08	In the vicinity of the residential property to the south of the proposed development near the crossing point with the L-10112	497,062	633,758
S09	In the vicinity of the residential properties along the Greenville Road (L-1011).	496,984	633,483
S10	In the vicinity of the residential properties within Islandganniv Place to the south of the proposed alignment.	497,361	633,913
S11	In the vicinity of the residential properties the Ashfield housing estate to the south of the proposed alignment.	497,974	634,166
S12	At the residential property along the R553 near the tie in with the proposed alignment.	498,018	634,329
S13	Within the Feale Drive estate	498,496	634,154
S14	In the vicinity of the residential dwellings along the John B. Keane Road	498,797	634,176
S15	In the vicinity of the residential properties next to Listowel Fire Station	499,150	634,164
S16	In the vicinity of the residential properties within Meelish Close	499,558	634,196
S17	In the vicinity of the residential properties within College Lawn	499,706	634,135
S18	In the vicinity of the residential properties within Stockers Lawn	500,010	634,062

[36] Although the survey work undertaken as part of this assessment was completed in advance of the publication of this document, the survey work is generally analogous to that outlined in the GPG

10.3.2 Survey Periods

Attended measurement survey periods were as follows:

- *S01 to S12 on 5 June 2013, 10:00hrs to 17:00hrs; and*
- *S13 to S18 on 26 June 2013, 10:00hrs to 17:00hrs.*

Unattended 24-hour monitoring was conducted at the following locations:

- *S03 between 17:00hrs on 4 June to 17:00hrs on 5 June 2013;*
- *S08 between 16:30hrs on 4 June to 16:30hrs on 5 June 2013, and;*
- *S15 between 17:00hrs on 25 June to 17:00hrs on 26 June 2013.*

10.3.3 Measurement Procedure

10.3.4 Unattended Measurement Procedure

Unmanned continuous measurements were conducted over a 24-hour period at three locations. L_{den} values are derived directly from the measured data.

10.3.5 Attended Measurement Procedure

Short-term measurements were conducted at survey locations on a cyclical basis. Sample periods were 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.

Fifteen locations were identified for attended measurements. The survey work was conducted in accordance with the shortened measurement procedure as laid down in TII guidance.

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 and 24:00hrs.

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 and 17:00hrs;*
- *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 Lden value is calculated from the $L_{A10\ (18hour)}$ value, i.e.*
  - *$L_{den} = 0.86 \times L_{A10(18hour)} + 9.86\ dB$*

10.3.6 Personnel & Equipment

Stephen Smyth and Louis Smith of AWN Consulting conducted the noise level measurements.

The continuous measurements were conducted using a Brüel & Kjær Type 2238 Sound Level Meter. The measurement apparatus were check 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.

The short-term measurements were conducted using a Brüel & Kjær Type 2260 sound level meter.

10.3.7 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 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; generally used to quantify background noise.

(a) Attended

The attended results for all eighteen locations, along with the derived L_{den} values, are presented in Table 10-2.

Table 10-2 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	10:21 – 10:36	49	47	35	48	• Distant traffic on N69 • Birdsong • Distant farm yard activity
	11:23 – 11:38	43	44	35		
	12:22 – 12:37	42	45	35		
S02	10:42 – 10:57	73	78	46	76	• Traffic on N69 • Birdsong
	11:43 – 11:58	72	77	36		
	12:40 – 12:55	73	78	40		
S03	10:00 – 10:15	54	53	45	55	• Road traffic on R557 • Birdsong • Dogs Barking
	11:02 – 11:17	68	54	46		
	12:02 – 12:17	55	55	46		
S04	13:00 – 13:15	67	71	45	71	• Traffic on N69 • Birdsong
	14:02 – 14:17	67	72	51		
	15:08 – 15:23	68	73	48		
S05	13:19 – 13:34	51	52	45	55	• Road traffic on N69 • Birdsong • Occasional Local Traffic • Agricultural Activity
	14:26 – 14:41	52	53	45		
	15:27 – 15:42	53	53	46		
S06	13:40 – 13:55	46	48	42	50	• Road traffic on N69 • Birdsong • Occasional Local Traffic • Agricultural Activity
	14:44 – 14:59	48	50	42		
	15:45 – 16:00	46	47	41		
S07	09:58 – 10:13	60	58	39	62	• Road traffic on Greenville Road • Birdsong
	11:27 – 11:42	65	64	37		
	11:42 – 11:57	65	64	37		
S08	10:16 – 10:31	44	46	36	49	• Distant traffic • Birdsong
	11:09 – 11:24	45	47	36		
	12:01 – 12:16	43	45	37		
S09	10:33 – 10:48	62	65	40	64	• Road traffic on Greenville Road • Birdsong
	10:48 – 11:03	59	63	37		
	12:19 – 12:34	62	64	38		
S10	12:47 – 13:02	43	45	39	49	• Distant traffic • Birdsong
	14:22 – 14:37	45	45	39		
	14:37 – 14:52	46	47	40		
S11	13:05 – 13:20	45	46	40	49	• Distant traffic • Birdsong
	14:04 – 14:19	44	46	40		
	14:54 – 15:09	46	48	41		
S12	13:27 – 13:42	58	63	45	63	• Road traffic on R553 • Birdsong
	13:42 – 13:57	59	64	46		
	15:13 – 15:28	59	63	43		
S13	10:10 – 10:25	61	64	44	59	• Road traffic on John B. Keane Road • Birdsong • Grass cutting • Children playing
	11:08 – 11:23	59	61	42		
	12:08 – 12:23	56	49	39		
S14	10:30 – 10:45	71	74	49	72	• Road traffic on John B. Keane Road
	11:28 – 11:43	70	72	46		
	12:26 – 12:41	67	72	44		
S15	10:48 – 11:03	59	62	47	62	• Road traffic on John B. Keane

Survey Location Reference	Survey Time	Measured Noise Levels (dB re.2x10^{-5}Pa)			Derived dB L_{den}	Notes
		L_{Aeq}	L_{A10}	L_{A90}		
	11:47 – 12:02	59	63	46		Road • Birdsong
	12:48 – 13:03	60	62	47		
S16	13:12 – 13:27	66	70	47	69	• Road traffic on John B. Keane Road • Birdsong • Some pedestrian activity
	14:08 – 14:23	66	70	49		
	15:04 – 15:19	66	70	50		
S17	13:30 – 13:45	49	53	42	55	• Road traffic on John B. Keane Road • Birdsong • Distant grass cutting
	14:25 – 14:40	50	53	42		
	15:49 – 16:04	51	54	40		
S18	13:49 – 14:04	59	62	46	63	• Road traffic on John B. Keane Road • Birdsong • Children playing
	14:46 – 15:01	60	64	44		
	15:27 – 15:42	60	64	47		

Full details of the noise environment at each monitoring location is provided in Appendix 10.5. In summary the existing noise levels are typical of the environment adjacent to busy national roads. Noise levels at those locations close to the existing N69 are dominated by traffic on this road. At other locations further away from the N69 the noise levels were dominated by distant road traffic but also had contributions from birdsong and occasional local vehicle movements.

(a) Unattended

The unattended results for S03, S08 and S015 are presented in Appendix 10.6.

10.4 Appraisal Method used for Assessment of Noise Impacts

For new roads, it is standard practice to adopt the traffic noise design goal contained within the Guidelines for the Treatment of Noise and Vibration in National Road Schemes. This document specifies that TII considers it appropriate to set the design goal as follows:

- *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}; and,*
    - *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 scheme under consideration.

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, 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.

Reference is also made to the Kerry Local Authorities *Noise Action Plan* (October 2013) which has adopted the following onset levels for the assessment of noise mitigation measures for noise due to road traffic:

- 70dB L_{den}, and;
- 57dB L_{night}.

It is important to note that whilst the onset levels are beneficial as a general indication of noise exposure, the TII assessment procedure for mitigation is deemed to represent a more robust approach to assessment of road traffic noise for a scheme such as that proposed. As such, the mitigation assessment procedure as proposed in the guidelines has therefore been adopted to assess the impact of the proposed scheme.

10.4.1 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.

(a) Brüel & Kjær Type 7810 Predictor

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 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, however, 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.*

(b) 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 TII 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 TII document.

(c) Model Inputs

The noise model was prepared using the following data:

- *Road alignments, topographical data and background ordnance survey mapping, and;*
- *High growth expanded Annual Average Daily Traffic (AADT) for the proposed development for the year 2017 and design year 2032, data was provided for the Do Nothing and Do Something scenarios.*

(d) 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}.

(e) Model Calibration and Validation

In order to ensure that accurate results are presented. The noise model was calibrated by running a validation model using baseline AADT road traffic data.

This baseline model showed acceptable correlation (<3dB variation) with the measured L_{day} at relevant survey locations.

It must be noted that a sample of receptors located within close proximity of modelled roads have been referenced. Correlation will normally fall off with distance to the increased dominance of background noise in the measured values.

Table 10-3 Model Calibration

Receptor	Measured L_{Day}	Model L_{Day}	Variation (dB)	Within 15 m of modelled road
S07	62	59	-3	Y
S12	63	62	-1	Y
S13	59	59	0	Y
S15	62	62	0	Y
S18	63	62	-2	Y

(f) Receiver Locations

Free-field traffic noise levels have been predicted at a number of properties in the vicinity of proposed and existing roads.

A total of one hundred and eighteen (118 No.) properties have been considered in the assessment. The properties were selected on the basis of proximity to the existing and proposed development. The guidance does not specify a set back or cut off point for assessment purposes at EIS stage. Therefore, in order to ensure that all relevant receptors were assessed, a preliminary noise contour map for the Do Something scenario was referenced at the outset. Any receptor experiencing road traffic noise exposure level greater than 60dB L_{den} was deemed to be eligible for assessment. As such, the group of receptors referenced in the assessment is deemed to be comprehensive and complete.

In all cases, where a group of properties is present, the closest receptor to the road has been selected to determine the worst case noise levels at that group of properties. All properties experiencing an increase in proximity to the realigned road have been considered as per best practice.

The coordinates of all receptor locations has been provided in Appendix 10.1.

All receptor properties were originally modelled at 1.5 m and 4 m to represent ground and first floor at one and two storey dwellings. The relevant predicted levels have been presented in Table 10-5. A full list of results has been presented in Appendix 10.2.

10.5 Predicted Noise Levels

Four scenarios have been considered as follows:

- *Year 2017 – Do Nothing (i.e. proposed development is not built);*
- *Year 2017 – Do Something (i.e. proposed development is not built);*
- *Year 2032 – Do Nothing; and*
- *Year 2032 – Do Something.*

The results of the traffic noise predictions are presented in Appendix 10.2. The receptors numbers have been given a suffix “A” or “B” to denote whether the predicted results is at single storey (A) or two storey (B) level. In all cases where the TII Mitigation criteria have been met, the actual height of the receptor in question has been verified as listed accordingly.

10.5.1 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 69 no. receptor positions along the proposed road development.

On review of the modelled results, predicted traffic noise levels at 60 no. of these locations will experience a neutral noise impact (i.e. noise levels will not increase by more than 1dB as a result of the proposed road development). In this instance, whilst traffic noise levels at these properties will remain above the 60dB L_{den} guidance level, the noise impact to these properties arising from the proposed road development will be neutral to positive.

As the “Do Something” noise level at the remaining 9 no. receptors is above 60dB L_{den} and is increased by 1dB or more as a direct result of the proposed road development, mitigation is deemed to be required at these locations based on the TII/NRA criteria for noise mitigation measures.

10.5.2 Design Year 2032

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 75 no. receptor positions along the proposed road development.

On review of the modelled results, predicted traffic noise levels at 64 no. of these locations will experience a neutral noise impact (i.e. noise levels will not increase by more

than 1dB as a result of the proposed road development). In this instance, whilst traffic noise levels at these properties will remain above the 60dB L_{den} guidance level, the noise impact to these properties arising from the proposed road development will be neutral to positive.

As the "Do Something" noise level at the remaining 11 no. receptors is above 60dB L_{den} and is increased by 1dB or more as a direct result of the proposed road development, mitigation is deemed to be required at these locations based on the TII/NRA criteria for noise mitigation measures.

Receptors which meet the TII criteria for requiring mitigation, have been extracted, and have been presented in Table 10-4 for reference.

Table 10-4 Receptors requiring mitigation

Receiver Location Reference[37]	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)	
R006_B	59	61	**Yes**	60	62	**Yes**
R025_A	44	59	No	45	61	**Yes**
R041_B	48	65	**Yes**	50	66	**Yes**
R042_B	48	62	**Yes**	49	63	**Yes**
R043_B	49	61	**Yes**	51	62	**Yes**
R044_B	54	60	No	55	62	**Yes**
R045_A	60	63	**Yes**	61	65	**Yes**
R047_A	60	62	**Yes**	61	63	**Yes**
R050_A	59	63	**Yes**	61	64	**Yes**
R051_B	62	65	**Yes**	64	67	**Yes**
R052_A	59	61	**Yes**	61	63	**Yes**

10.6 Mitigation Requirements

The results of the modelling exercise show that noise mitigation shall be required for 11 no. properties along the proposed development.

Mitigation measures required shall include a combination of acoustic barriers and low noise road surfacing.

Low noise road surfacing providing a maximum source reduction of 2.5dB will be provided between chainage 5,000 to 5,440. This corresponds to typical performance provided by a thin surface course paving system.

Details of the proposed mitigation measures are outlined in Table 10-5 and shown in Figure 10.1.3 to 10.1.6. The required acoustic barriers shall have a surface density of at least 10kg/m^2 and meet category A3 in terms of absorptive characteristics as tested in accordance with BS EN 1793-1:2012 *Road Traffic Noise Reducing Devices - Test Method for Determining the Acoustic Performance Intrinsic Characteristics of Sound Absorption*.

[37] A and B refer to the height of the dwelling. A signifies a single storey whilst B signifies a two storey building.

For barriers no. B09, B11 and B12, due to the absence of sufficient space to install new barriers, it will be necessary to increase the height of the existing boundary walls.

Table 10-5 Predicted Noise levels and Extent of Noise Mitigation Required During Operational Phase

No.	Incident Receptor	Ch Start (m)	Ch End (m)	Length (m)	Height (m)	Orientation
B01	R06	455	565	110	2.5	West/Northbound
B03	R25	3220	3380	160	2.5	West/Northbound
B04	R41, R42, R43	4180	4210	30	3	South/Southbound
B05	R41, R42, R43, R44	4210	4510	300	3.55	South/Southbound
B06	R47	4260	4480	220	2.5	North/Northbound
B07	R44, R45	5010	5080	70	2	West/Northbound
B08		5085	5095	10	2	West/Northbound
B09	R50	5090	5130	40	2.2	East/Southbound
B10	R51	5130	5180	50	1	West/Northbound
B11	R52	5200	5220	20	2	South/Westbound
B12		5220	5310	90	2.5	South/Westbound

It is also necessary to discuss the proportionality of the specified noise mitigation measures. The TII good practice guide recognises that "in some cases the attainment of the design goal may not be possible by sustainable means".

For instance, the benefits arising from barrier numbers B10 to 12 can be regarded as negligible as these barriers would provide an average screening loss of 1 to 2dB. Conversely, the benefits arising from barrier numbers B03 to B05 can be regarded as moderate to significant as these barriers would provide an average screening loss of between 3 and 6dB.

Table 10-6 details the predicted noise levels with the mitigation measures specified in Table 10-5 in place. With mitigation, the predicted noise levels are within the design goal at all of the locations assessed.

Table 10-6 Predicted Noise Levels (Post Mitigation)

Receiver Location Reference[38]	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)	
R006_B	59	60	No	60	61	No
R025_A	44	44	No	45	60	No
R041_B	48	48	No	50	60	No
R042_B	48	48	No	49	60	No
R043_B	49	49	No	51	60	No
R044_B	54	54	No	55	60	No
R045_A	60	60	No	61	61	No
R047_A	60	60	No	61	61	No
R050_A	59	59	No	61	62	No
R051_B	62	62	No	64	66	No
R052_A	59	59	No	61	62	No

[38] A and B refer to the height of the dwelling. A signifies a single storey whilst B signifies a two storey building.

10.6.1 Residual Impact - Operational Phase

During the course of the assessment, it was shown that the predicted noise levels at 14 no. properties exceeded the specified TII Noise Mitigation Criteria. In this instance, mitigation measures have been specified. Once such measures are implemented, it was shown that all locations comply with the adopted criterion.

It may be concluded that the proposed development complies with the appropriate guidance in relation to noise; hence the associated impact is considered acceptable.

10.7 Construction Impacts and Mitigation Measures

10.7.1 Standards and Guidelines

As per TII guidance noise levels associated with construction may be calculated in accordance with guidance 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 generally not possible to conduct detailed prediction calculations for the construction phase of a project pre-construction. This is due to the fact that the programme for construction works has not been established in detail. Under such circumstances, best practice involves the consideration of appropriate mitigation measures.

The TII guidance document specifies noise levels that it typically deems acceptable in terms of construction noise. These limits are set out in Table 10-7.

Table 10-7 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 to 19:00hrs	70	80
Monday to Friday 19:00 to 22:00hrs	60*	65*
Saturdays 08:00 to 16:30hrs	65	75
Sundays & Bank Holidays 08:00 to 16:30hrs	60*	65*

*Construction activity at these times, other than that required for emergency works, will normally require the explicit permission of the relevant local authority

Note that these limits are indicative only; it may be appropriate to apply more stringent limits in areas where pre-existing noise levels are low. Therefore the adopted construction noise criteria will be cross referenced against the "ABC" Method as outlined in Annex E3.2 of BS5228-1:2009+A1:2014. This method is outlined in Table 10-8.

Table 10-8 BS5228:2009+A1:2014 threshold of potential significant effect at dwellings

Assessment category and threshold value period (LAeq)	Threshold value, in decibels (dB)		
	Category A[39]	Category B[40]	Category C[41]
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends42	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75

In exception circumstances there may be a requirement that certain construction works are carried out during night time periods.

10.7.2 Assessment of Construction Noise

A variety of items of plant will be in use, such as excavators, lifting equipment, dumper trucks, compressors and generators. It is also possible that rock breaking may be required on occasions and there will be vehicular movements to and from the site that will make use of existing roads.

Due to the nature of the activities undertaken on a large construction site, there is potential for generation of significant levels of noise. The flow of vehicular traffic to and from a construction site is also a potential source of relatively high noise levels.

Due to the fact that the construction programme has been established in outline form only, it is not possible to calculate the actual magnitude of noise emissions to the local environment. However, the impact due to construction activities will be transient in nature.

10.7.3 Mitigation Measures

To avoid impacts from noise generated during the 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 BS 5228-1:2009+A1:2014 and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001. These measures will ensure that:

- *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 07:00hrs or after 19:00hrs will be surrounded by an acoustic enclosure or portable screen.*
- *During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Table 10-7 using methods*

[39] Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.
[40] Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.
[41] Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.
[42] 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

outlined in BS 5228 "Noise and Vibration Control on Construction and open sites", Annex E. It should be noted that BS 5228 does not detail any specific noise limits in relation to construction noise.

Normal working times will be 07:00 to 19:00hrs Monday to Friday and 08:00 to 16:30hrs 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 the Contracting Authority. This permission, if granted, 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 the Contracting Authority. Night is defined as 19:00 to 07:00hrs. Emergency work 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 with working on public roads.

When overtime and shift work is permitted, the hauling of spoil and delivery of materials outside normal working hours is prohibited and the noise limits outlined in Table 10-7 will apply.

10.7.4 Residual Impacts - Construction Phase

During the construction phase of the proposed development there will be some minor impact on nearby residential and business properties due to noise emissions from site traffic and other activities. The application of binding noise limits and hours of operation, along with implementation of appropriate noise control measures, will ensure that noise impact is kept to a minimum. The construction impacts will be of a relatively short duration given the short length of proposed development.

10.8 Vibration

This section deals with the potential for vibration during both construction and operational phases of the proposed development. The TII Guidelines provide guidance in relation to vibration from the construction and operational phases of road schemes and this is referenced in this section.

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. For example, rock breaking and piling, two of the primary sources of vibration during construction, are typically tolerated at vibration levels up to 12 mm/s and 5 mm/s respectively. This guidance is applicable to the daytime only; it is unreasonable to expect people to be tolerant of such activities during the night.

10.8.1 Description of Existing Environment

A survey of vibration along the proposed route 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.

10.8.2 Potential Impacts – Operational Phase

As a vehicle travels along a road, vibration can be generated in the road and subsequently propagate towards nearby buildings. Such vibration is generated by the interaction of a vehicle's wheels and the road surface and by direct transmission through the air of energy waves. Some of these waves arise as a function of the size, shape and speed of the vehicle, and others from pressure fluctuations due to engine, exhaust and other noises generated by the vehicle.

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.

10.8.3 Potential Impacts – Construction Phase

The potential for vibration at neighbouring sensitive locations during construction is typically limited to demolition, excavation works, rock-breaking operations and lorry movements on uneven road surfaces. The more significant of these is the vibration from excavation and rock-breaking 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.

10.8.4 Mitigation Measures and Residual Impacts

The TII 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 10-9.

Table 10-9 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

Measures shall be taken 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.

Ground vibration from the project would be expected to be orders of magnitude less than that required to cause cosmetic or structural damage to buildings or lead to disturbance of occupiers, hence mitigation measures are not required in respect of the operational phase.

It may be concluded that the project is not expected to give rise to vibration that is either significantly intrusive or capable of giving rise to structural or even cosmetic damage.

10.9 Difficulties Encountered in Compiling Information

No difficulties were encountered during the assessment.

10.10 Cumulative Impacts and Impact Interrelations

During the preparation of the noise and vibration impact assessment interaction and consultations have taken place with the several other disciplines in order to ensure that the cumulative impacts of the proposed development have been considered.

11 Landscape and Visual

11.1 Introduction

This chapter of the Environmental Impact Statement (EIS) outlines the assessment of the effects of the proposed N69 Listowel Bypass on the existing visual environment and landscape character of the surrounding area. Brady Shipman Martin was commissioned to carry out this assessment.

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. Measures to mitigate the likely significant impacts of the scheme are proposed, and residual impacts described.

This assessment comprised a detailed assessment of the proposed development and involved reviewing plans and sections of the proposed development, aerial photography and various publications, together with visits to the environs of the proposed scheme.

11.1.1 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 July 2013 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;
  - The character and quality of the surrounding landscape in relation to the position of the proposed development.

The assessment has been undertaken with regard to the relevant guidelines for landscape and visual assessment, including;

- *Guidelines for Landscape and Visual Impact Assessment (3rd Edition), The Landscape Institute/ Institute of Environmental Management and Assessment (2013);*
- *Guidelines on the information to be contained in Environmental Impact Statements, Environmental Protection Agency (2002); and*
- *NRA: Environmental Impact Assessment of National Road Schemes- A Practical Guide 2008.*

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.

11.2 Description of the Existing Environment

11.2.1 Landscape Context

The study area lies directly north, west and south of the town of Listowel in north County Kerry. The existing N69 (Limerick to Tralee) lies to the east, the R553 to Ballybunion lies to the north west and R557 to Finuge lies to the south west of the site. The River Feale runs east west of the site. The area is located within the boundary of Kerry County Council.

Listowel is located at the head of the north Kerry limestone plain. The landform of the area is consistent with north Kerry, see Figure 11.1.1: Landscape Features. Positioned in the very heart of north Kerry, on the River Feale, its hinterland is an area of mainly dairy agricultural use, which has been driven somewhat by Kerry Group food processing facility which is located to the south west of the town.

Apart from the prominent ridgelines to the south of the area and the distinguished hill of Knockanone Mountain which lies northwest of the area, the study area is predominantly flat, pasture land. Much of the hedgerows are removed due to the intensity of dairy production, however south of the river the definition of field boundaries are greater. There is a wind farm to the south west of the site which is visible at a distance from some parts of the study area. Within the pastural land of the study area, there is dispersed ribbon development of one-off housing and farmsteads. Dirrha Bog, which is a pocket of raised bog located to the north of the study area, is a locally important cultural and amenity site and was a literary inspiration to John B. Keane, where he spent much time walking.

Locally Listowel is an important urban town for north Kerry, with both the Clieveragh Industrial Estate and Kerry Group attracting business to the area. Traffic travels through the town centre to access both of these areas. The town developed around Listowel Castle which at the time was fortress to the Fitzmaurice family, and its magnificent Square.

Listowel is often described as ‘the Literary Capital of Ireland’ and is celebrated in the 'Writer's Week' festival every year. Writer's such as John B. Keane, Brendan Kennelly and Bryan MacMahon are among Listowel's most distinguished scribes. John B. Keane has wrote about the nearby Dirrha Bog, which holds a cultural significance to the landscape of Listowel.

Listowel Town itself has a population of almost 5000 according to the 2011 census and it is a market town, which has undertaken environmental and renewal works in recent years. It is also a town of both architectural and historical heritage was officially designated as one of Ireland's 26 "Heritage Towns" in July 2000.

The study area has a number of landscape components including:

- *Outside the town itself, much of the land is flat, with dispersed ribbon development. Dairy farmland dominates the area with large farm holdings where much of the hedgerows have been removed;*
- *John B. Keane Road, which is R553 and 1.8 km in length. It runs through the suburban area north of Listowel Town. Housing developments are located on the northern and southern boundaries of this road;*
- *To the north of the study area there is the old railway line, known locally as ‘Sive Walk’, people use it as an amenity footpath / cycleway;*
- *Further north west approximately 10 km from Listowel is Knockanore Mountain, at a height of 267 m;*

- *To the west of the study area, approximately 2 km from the town centre lies the Dirrha Bog, which is a blanket bog. This is a unique contrast to the agricultural land and was much written about by John B. Keane;*
- *To the south lies the River Feale, this meanders through the town of Listowel.*
- *The land beyond the River is also agricultural land but with a greater definition of field boundaries;*
- *Further south the prominent ridgelines within the elevated hills around Coolnaleen Upper and Ballyduhig with the Stack's Mountains beyond are important features in the landscape; and*
- *Views north, east and west of the study area are open, extending over the agricultural land. To the south the views are somewhat contained by the backdrop of Stack's Mountains.*

11.2.2 Landscape Character

The study area is located within the Listowel Plain character area in the Kerry County Council Draft Development Plan 2015-2021, the area is described as the following:

> *'Delineated to the north by raised topography running from Kerry Head to Triskmore Mountain and Maulin Mountain across to the village of Causeway. The eastern boundary corresponds with high topography to the east and south of Listowel including Slievecahill (99 m), Ballyduhig and the development clusters at Rathea and Banemore, before continuing south. The southern boundary follows the raised topography of the Stack's Mountains to the summit of Crusline (355 m) before continuing westwards to Barrow Harbour. A further visual delineation is also apparent extending from Ardfert which continues northwards corresponding to the development clusters of Ardconnell, Kilmoyly and Ballynorig West*[43]*.*

The landscape of the area is predominantly rural, with the landform relatively flat pasture and arable land, with an open landscape with limited trees. It is a managed landscape with a high density of roads in the area with settlements distributed evenly along the roads.

The final section of the proposed scheme runs through a suburban zone north of Listowel Town. The online section has residential and commercial developments located either side of the road.

11.2.3 Landscape Significance

The only National Assessment of landscape quality published for Ireland is the Inventory of Outstanding Landscapes in Ireland prepared by An Foras Forbartha in 1977. Many of the areas highlighted in the Inventory were subsequently given protection within the statutory County Development Plans and these plans in many instances designate additional areas. It is noted that the proposed development does not pass through or is not within close proximity to any such listed Outstanding Landscapes. The closest area of outstanding beauty is at Ballybunion, approximately 14 km west of the study area and at Glin coast road, north of the area, approximately 16 km from Listowel.

Listowel is an important heritage town and is seen as a valuable asset for the area. It has the potential to become vibrant, multi-functional place to live, work and visit. Kerry County Council aims to protect the heritage of Listowel in order to safeguard their distinctive character.

[43] Kerry County Council – *Landscape Character Assessment prepared for the Renewable Energy Strategy 2012*

At a county level the statutory Development Plans for Kerry are referenced with regard to landscape and visual aspects.

(a) Landscape Planning Context

The site falls within the Kerry County Development Plan (KCoDP), 2009-2015 and the Ballybunnion & Listowel Electoral Area Local Area Plan (BLEALAP) 2012.

Within the KcoDP, objective INF 8-15 states;

'Construct new National roads along the routes listed in table 8.5' (Note: N69 Listowel Bypass is listed in Table 8.5)

(i) Designated Scenic Landscape

There are no designated scenic landscapes within the study area.

(ii) Designated Scenic Routes

Kerry County Development Plan protects views and prospects in its Views and Prospects Policy 12.3.1. *Policy ZL 12-7 – Preserve the views and prospects as defined on Map No's 12.1c.*

Within the Kerry County Development Plan (KCDP) 20015-2021, there are no views and prospects in the study area.

(iii) Trees and woodland

There are no known tree preservation orders detailed on the Kerry County Development Plan or the Ballybunnion & Listowel Electoral Area Local Area Plan relevant to the area.

(iv) Visually prominent protected structures

Whilst the town of Listowel has numerous properties which are protected, there are also a number of protected, recorded and NIAH (National Inventory of Architectural Heritage) structures and monuments within the study area which are outlined in detail within the Chapter 12: Cultural Heritage. A number of these NIAH structures are visually prominent within the landscape and significantly contributes to the visual character of the study area, refer to Table 11-1 and Figure 11.1.1: Landscape Features.

Table 11-1 Visually Important NIAH Structure/Monuments

Title/Location	NIAH	Document	Location	Description
The Lartigue, Monorailway, John B. Keane Road (immediately south east of study area)	21400288	Listowel Town Council – Town Development Plan 2009 -2015	Adjoining east boundary of study area	The Lartigue monorailway, designed by Charles Lartigue (1834–1907), ran from Listowel to Ballybunion. It closed in 1924 after damage during the Irish Civil War. In 2003, a 1,000 metre section was recreated using replica steam locamotives.
Teampailín Bán, Curraghtoosane (immediately east of study area)	21400287	Listowel Town Council – Town Development Plan 2009 -2015	Immediate north of study area	A mass grave for victims of the famine 1845 -1847.

11.3 Appraisal Method used for Assessment of Impacts

11.3.1 Introduction

In order to assess the significance and magnitude of potential impacts it is important to fully understand the existing landscape context. Section 11.2.1 of this study provides an appraisal of the existing landscape condition.

Section 11.4 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 11.5 provides a description of the mitigation measures to avoid, reduce or remediate any potential negative impacts that have been identified.

(a) 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. responses that are felt towards the landscape, and draws on the appearance of the land, including shape, form and colour and their interaction to create specific patterns that are distinctive to particular localities.

Landscape character is derived from the appearance of the land, and takes account of natural and manmade features such as topography, landform, vegetation, land use and built environment and their interaction to create specific patterns that are distinctive to particular localities. The landscape impact assessment predicts impacts and describes the likely nature and scale of changes to individual landscape elements and characteristics, together with the significance of such affects.

Landscape planning designations, including National and County designations or listings are considered and assessed for impacts, where appropriate. In addition, potential impacts on designated sites of cultural heritage value and ecological value are also considered. For example, historic demesne landscapes as defined by the National Inventory of Architectural Heritage (NIAH) are considered as are other informal demesnes identified during site visits and in consultation with the Architectural Heritage consultant.
The impact on trees, hedgerows and woodlands is considered in Chapter 6 Flora and Fauna. Any impacts on these elements are set out within this chapter where they are considered to have particular landscape significance.

Areas of Outstanding Landscape, together with Landscape Planning Designations, including National and County designations or listings and historic estate or demesne landscapes as defined by the National Inventory of Architectural Heritage (NIAH) have also been evaluated and assessed for impacts where appropriate. It should be note that there is no landscape planning designations within the study area.

(b) 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 used:

- *Construction Stage: considers the period including the active construction of the road up to completion of the works and opening of the proposed development;*
- *Pre-establishment Stage: considers the period including the initial operation of the road where new landscaping is unlikely to provide effective mitigation. The impact is assessed in the year the road would open to traffic; and*
- *Post Establishment Stage: considers the impact as assessed in the fifteenth year after opening before which stage proposed landscaping will have developed as effective mitigation, as designed. The development of planting to effective visual screening usually requires a period of five to seven years after planting.*

Visual impact has been assessed for nearby properties impacted by the proposed development. The visual assessments are presented in the Visual Impact Schedule (VIS) and illustrated in Figures 11.1.2 – 11.1.5: Visual Impact. Some properties have been grouped into clusters where they experience a similar type and level of effect.

The extent to which significant additional illumination will be visible in the night landscape is also taken into account. The introduction of road lighting may affect individual views and also the character of the landscape.

11.3.2 Standards and Guidelines

The landscape and visual assessment has been undertaken with reference to the following main standards and guidelines:

- *EPA: Guidelines on the Information to be contained in Environmental Impact Statements, 2002;*
- *EPA: Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) 2003;*
- *NRA: Environmental Impact Assessment of National Road Schemes- A Practical Guide 2008;*
- *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;*
- *DOE (UK): Design Manual for Roads and Bridges; and*
- *Landscape Institute UK: Guidelines for Landscape and Visual Impact Assessment, 3rd Edition, 2013.*

11.3.3 Significance Assessment Criteria

The significance criteria as set out in the EPA guidelines have been used for the purpose of this assessment.

Table 11-2 Landscape and Visual Impact 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).

11.4 Predicted Impacts of the Scheme

11.4.1 Scope of the Impacts

The N69 Listowel Bypass will allow traffic to by-pass the town centre, alleviating traffic congestion within the town and improving access and circulation of pedestrian, cycle and vehicular traffic within the Heritage town. The project will provide a new road from the N69 (south of Listowel), crossing the R557 at Coolnaleen Lower and heading northwest over the River Feale with a new bridge constructed. It will continue to travel north east to meet Grenville Road, where it will arc and sweep east and meet the dismantled railway line and join the existing R553. The on-line section will have improved pedestrian and cycleway links. The overall approximate length of the proposed development is 7 km.

The following main elements have the potential for landscape and visual impact of the proposed development:

- *Removal of existing vegetation;*
- *General construction disturbance;*
- *Significant, elevated structures and bridge over the River Feale including earthen embankments and earth retaining / structural walls;*
- *Illumination at the proposed roundabout junctions, there will be 8-10 m high street lighting columns;*
- *Realignment of Boundaries on R553;*
- *Signage; Route Confirmatory type and active digital signage (ADS);and*
- *Moving traffic during operation.*

These elements will impact upon:

- *Adjoining residential properties and protected structures;*
- *Visitors to Listowel;*
- *River Feale;*
- *Adjoining areas of commercial and industrial development;*
- *Road users; and*
- *Amenity users of dismantled railway line.*

Other elements such as lower level signage, barriers, flood relief culverts, fencing etc. are an integral part of most roads and will have little or no landscape impact due to their low elevation and limited off-scheme visibility.

11.4.2 Visual Impact

The visual impact on properties is outlined in and illustrated on Figures 11.1.2 – 11.1.5: Visual Impact. Photomontages have also been produced at various locations along the proposed development and are contained in Appendix 11.1. These show the existing view and the view pre and post-establishment[44].

[44] *Pre-establishment Stage: the year the road would be open to traffic.*
Post Establishment Stage:the development of planting to effective visual screening usually requires a period of five to seven years after planting.

Landscape and visual impact will be most pronounced during the construction stage and in the short term thereafter, when disturbance at close proximity to properties is at its greatest and mitigation not yet in place or least effective. In general, adverse visual impact will arise upon residential and from other properties close to or adjoining the construction boundary. Visual impact will primarily arise through visual disturbance, visual intrusions from the loss of the existing screen vegetation, alteration to ground levels and construction traffic.

The crossing of the River Feale will require a new bridge structure with elevated embankments north and south of the structure. Due to the flat nature of the surrounding landscape with intervening hedgerows and riparian vegetation, the River Feale bridge structure will be substantially screened from Listowel Town and buildings and structures therein. Visual impacts arising from the bridge will be localised to the immediate surrounding agricultural areas and dwellings at Finuge, Garryvantally and the L-1011 (Greenville Road). There will be views of the proposed road and bridge from the elevated agricultural areas and dispersed dwellings on the hills 1-2 km to the south of the proposed development at Slievecahill and Ballyduhig.

The proposed lighting installation will have a moderate impact on the local environment at each of the road junctions. During the day the impact will not be significant due to the slenderness of the lighting columns. Night time lighting impacts will arise locally around the road junctions on the N69/R557 and Greenville Road. The Ballybunion/R553 road junction is already lit, so there will be no appreciable impact. These lanterns have a fully cut-off light output configuration which emits no light above the horizontal plane of the lantern.

Signage is proposed in a number of locations along the proposed development. They will be visible over adjoining areas particularly those sections adjacent to the route that are at or above existing grade. Screen planting will be provided behind signage where possible, avoiding road user sightlines, but minimising visual impact from surrounding visual receptors. Moving traffic and in particular high sided trucks and buses will lead to visual impact to surrounding residential properties and areas of open space.

Table 11-3 Visual Impact Schedule

Property Ref	Location	Approx. distance from road centre line (m)	Notes	Construction Impact	Pre-establishment Impact	Post-establishment Impact
PR-01	100 m chainage Billeragh Cottage	400 m West	Farmstead with avenue	Moderate	Slight	Slight
PR -02	100 m chainage	Adjacent to road on westside	2 properties next to existing road, currently the N69 has a significant impact on these properties.	Moderate	Moderate	Slight
PR -03	100 m chainage Coolnaleen Cottage & others	400 m East	Cluster of houses with a large farmstead	Moderate	Slight	Slight
PR-04	565 m chainage (South of Side Road 3)	150 m West	Farmstead with dwelling, next to Coolnaleen Lower Road.	Significant	Significant	Moderate
PR-05	565 – 1,000 m chainage (South of Side Road 2)	Beside junction – east	2 dwelling and farmstead with dwelling, next to Coolnaleen Lower Road.	Moderate	Moderate	Slight
PR-06	1,000 m chainage	400 m East	Cluster of properties that are well screened by existing vegetation at boundaries to properties.	Moderate	Slight	Slight
PR-07	500 – 1,200 m chainage Coolnaleen Lower	Adjacent to road on Eastside	Farmstead and dwelling, set back from road with avenue, limited intervening vegetation present.	Significant	Significant	Moderate
PR-08	1,200 m chainage Coolnaleen Lower	800 m West	Farmstead and dwelling, set back from road.	Moderate	Slight	Slight
PR-09	1,200 – 1,800 m chainage	400 m east	Cluster of one off houses at Garryantanvally.	Moderate	Moderate	Slight
PR-10	1,800 chainage Garryantanvally House	600 m east	Garryantanvally House, set back from road with avenue.	Moderate	Moderate	Slight
PR-11	2,500 m chainage	Adjacent to road on westside	Farmstead at Gortcurreen.	Significant	Significant	Moderate
PR-12	2,500-2,600 m chainage (South of Side Road 5)	Immediately south of Grenville Road	Cluster of one off house south of the existing road.	Significant	Slight	Slight
PR-13	2,500 m chainage Gortcureen (North west of Side Road 5)	350 m west	3 one off houses, ample vegetation to their boundaries.	Moderate	Slight	Slight
PR-14	2,300 – 3,000 m chainage Gortcureen	500 m west	Cluster of one off houses at Gortcurreen.	Slight	Moderate	Slight
PR-15	2,700 m chainage Greenville	400 m west	Large farmstead with dwelling set back form road with avenue.	Moderate	Significant	Moderate
PR-16	2,700 m chainage Kilcreen (South of Side Road 4)	Adjacent to road on eastside	Farmstead with dwelling at Kilcreen.	Significant	Moderate	Slight
PR-17	2,500-3,000 m chainage Properties south of Greenville Road (south of Side Road 4)	300 m east of road.	2 dwellings, including Kilcreen Cottage.	Moderate	Significant	Moderate
PR-18	3,000-3,300 chainage	North and south of the road, extending approximately to 200 m.	Cluster of dwellings, north of Grenville Road.	Significant	Moderate	Slight
PR-19	3,300 – 4,100 m chainage Properties from Markey's Bridge to Furze Island	350 m south of road	Cluster of properties with some intervening vegetation.	Moderate	Significant	Significant
PR-20	3,700 m chainage Properties at Islandganniv Place	100 m south of road	Cluster of one-off properties at Islandganniv Place.	Moderate	Moderate	Slight
PR-21	4,100 – 4,500 m chainage Properties at Ashfield, off Grenville Road	250 m south of road	Cluster of detached properties.	Slight	Moderate	Slight
PR-22	4,100 – 4,200 m chainage	100 m south of road	Cluster of detached properties.	Moderate	Slight	Slight
PR-23	4,300 – 4,400 m chainage	Adjacent south of road	Cluster of detached properties in Ashfield (north).	Moderate	Moderate	Slight
PR-24	4,400 – 5,000 m chainage. Properties at Convent View (South west of Side Road 9)	150 m south of road	Cluster of semi-detached properties.	Slight	Moderate	Slight
PR-25	Properties at the junction of John B. Keane Road and Ballybunion Raod (North east of Side Road 9)	Adjacent south of road	Cluster of detached houses.	Slight	Slight	Slight
PR-26	4,480m chainage	West of Roundabout 3.	2 detached properties, north and south of proposed road as it intersects Ballybunion Road.	Significant	Significant	Moderate

Property Ref	Location	Approx. distance from road centre line (m)	Notes	Construction Impact	Pre-establishment Impact	Post-establishment Impact
PR-27	4,480 m chainage Roundabout no. 3	North, east and south of proposed roundabout.	Cluster of properties where new road insects Ballybunion Raod, some vegetation at boundaries. Properties in closer proximity to proposed road will experience higher levels of impact than those located further from proposed road.	Moderate	Moderate	Slight
PR-28	North west of Side Road 7	490 m north west of road	Cluster of properties at Curragh Close	Slight	Slight	Slight
PR-29	North of proposed roundabout on R553	240m north of road	Cluster of residential properties located between Curraghatoosane, Coolnalaght and Derra East	Slight	Slight	Slight
PR-30	5,200 m chainage to 5,840 m Properties south side of John B. Keane Road.	Adjacent south of road	Group of property developments located south, adjacent to John B. Keane road	Slight	Slight	Slight
PR-31	5,680- 5,880 m chainage (North of John B. Keane Road	Adjacent north of road	Cluster of Cottage Development with shared surface road. Property frontage shall be moderately affected by new cycleway going through development.	Slight	Moderate	Moderate
PR32	5890 m chainage north of proposed scheme.	50m north of junction of proposed scheme	Established Housing Development	Slight	Slight	Slight
PR-33	5880-6390 m chainage	Adjacent south of road	Established Housing Development	Slight	Slight	Slight
PR-34	6300-7000 m chainage	Adjacent north of road	Established Housing Developments in Ballygologue	Slight	Slight	Slight
PR-35	6500 – 7050 m chainage	Adjacent south of road	Established Housing Developments in Ballygowloge	Slight	Slight	Slight

11.4.3 Impact on Existing Landscape Character

The proposed road will alter the landscape character of the immediate surroundings and for road users. The bridge crossing the River Feale will have a significant impact but as views to the river are localised, this will limit the visual impact in the greater landscape context. The road itself will alter the character of the agricultural land and will have impact on some properties locally.

During construction, the character of the area will be significantly and negatively impacted upon due to the removal of some of the existing roadside planting, earthworks and construction activities. However, post completion, this impact on the landscape character will recede and in time as the mitigation planting establishes and matures will be moderate and neutral in impact.

11.4.4 Impact on Designated Landscape

(i) Designated Scenic Landscape

There is no designated scenic landscape within the study area or surrounding area.

(ii) Designated Scenic Routes

There are no designated scenic routes within the study area or indirect impact on nearby designated scenic routes.

(iii) Designated Special Areas of Conservation (SAC)

The River Feale is designated a SAC by the National Parks and Wildlife Service. SACs are prime wildlife conservation areas in the country, considered to be important on a European as well as Irish level. The legal basis on which SACs are selected and designated is the EU Habitats Directive; Commission Note on the Designation of SACs May 2012. The Directive lists certain habitats and species that must be protected within SACs[45]. The construction of the proposed bridge over the river will involve bridge abutments which will have an impact of the existing vegetation during construction. Though, upon completion of the bridge and associated earthworks, planting of indigenous species will be carried out and an organic maintenance programme to ensure planting will establish shall be carried out.

11.4.5 Impact on Trees and Hedgerows

No protected trees or woodland will be impacted upon by the proposed development. The bridge crossing of the River Feale will require vegetation to be removed, the extent, description and impact is tabulated below in

Table 11-4 and illustrated on Figures 11.1.2 – 11.1.5: Visual Impact. Street tree planting along the northern edge of John B. Keane Road shall also impacted upon by the proposed development and will have to be removed. Please refer to below table 11.4 for detailed information on this. Planting a narrow hedgerow along this northern edge of the John B. Keane Road shall help negate any removals mentioned.

[45] www.npws.ie – National Parks and Wildlife Services

Table 11-4 Impact on trees and hedgerows

Ref	Location/Chainage	Description	Impact
T/01	000 – 400 m	Removal of existing road hedgerow, with dispersed trees within hedge on west side, removal of sod bank on east side.	Moderate
T/02	Upgrade of R557	Removal of hedgerow and dispersed trees within hedge to facilitate proposed roundabout.	Moderate
T/03	1,200 – 1,300 m	Removal of hedgerow and other vegetation along stream corridor as proposed road crosses over, stream will be culvert.	Moderate
T/04	1,400 m	Removal of hedgerow where proposed road crosses field.	Moderate
T/05	1,500 m	Removal of hedgerow and other vegetation along stream corridor as proposed road crosses over, stream will be culvert.	Moderate
T/06	1,600 – 1,700 m	Removal of existing vegetation at either side of River Feale to facilitate proposed bridge crossing.	Moderate
T/07	Upgrade of Greenvile Road (L-1011)	Removal of dispersed trees within sod bank / hedgerow at either side of the existing road to facilitate new road.	Moderate
T/08	2,800 m	Removal of existing hedgerow and dispersed trees within hedgerow to facilitate new roundabout.	Moderate
T/09	3,300 m	Removal of existing hedgerow to facilitate proposed road crossing over R553.	Moderate
T/10	3,400 m	Removal of existing hedgerow within field to facilitate new road.	Moderate
T/11	3,600 m	Removal of existing hedgerow within field to facilitate new road.	Moderate
T/12	3,600 – 4,400 m	Removal of hedgerow and dispersed trees within hedgerow on the dismantled railway line (now amenity footpath) to facilitate new road.	Significant
T/13	4,400 m	Removal of existing hedgerow within field to facilitate new road.	Moderate
T/14	5250 – 5450 m	Removal of semi mature street trees to facilitate new cycle scheme.	Moderate
T/15	5900 – 6170 m	Removal of young street trees to facilitate new scheme. Existing leylandii hedge shall remain.	Slight
T/16	5900 – 6170 m	Removal of 2 semi mature trees to facilitate new scheme.	Slight
T/17	6260 – 6300 m	Removal of standard street trees to facilitate scheme	Moderate
T/18	6320 – 6580 m	Removal of young Willow, Ash and Prunus to facilitate new scheme.	Slight

11.4.6 Impact on visually prominent protected structures

There are a number of NIAH structures/monuments surrounding the proposed development and which are outlined in detail within Chapter 12: Cultural Heritage. A number of these structures are visually prominent within the landscape and significantly

contribute to the visual character of the area. There will be some impact upon these structures arising from the proposed development as follows;

Table 11-5 Visual Impact on Important NIAH Monuments

Title/Location	NIAH Reference	Description	Impact – Pre-mitigation	Impact – Post mitigation
The Lartigue, Monorailway, John B. Keane Road. Adjoining east boundary of study area.	21400288	The Lartigue monorailway, designed by Charles Lartigue (1834–1907), ran from Listowel to Ballybunion. It closed in 1924 after damage during the Irish Civil War. In 2003, a 1,000 metre section was recreated using replica steam locomotives.	The proposed road will merge with the existing John B. Keane Road, traffic will be distrupted during construction period. The section of operating monorail will be unaffected by the proposal. The remnant elements of bridge structure close to the proposed roundabout on the Ballybunnion road will be unaffected by the scheme.	With the completion of the proposed development, the landscape development of the new road junction will improve the visual setting of the Lartigue monrailway.
Teampailín Bán, Curraghtoosan eImmediately north of study area	21400287	A mass grave for victims of the famine 1845 -1847.	The proposed development will intersect the existing R553 just north of the entrance to the Famine Graveyard of Teampailín Bán. Whilst the road will not directly impact upon the grave site, it will be important to sensitively to design the public realm and associated footpaths. Teampailín Bán forms part of the walking tour of Listowel, so adequate pedestrian facilities will need to be provided.	With the completion of the proposed development, the landscape development of the new road junction will improve the visual setting of Teampailin Ban, Curraghtoosane.

11.4.7 Impact on Amenities

The dismantled Great Southern railway line is an amenity footpath for the town and a 650 m long section of the proposed development is proposed along this old railway line. In addition, this walkway will also form part of the proposed Great Southern Trail (cycling and walking trial), linking Limerick to Tralee/Fenit railway line. The Great Southern Trail Ltd. is a voluntary group assisted by various Local and State agencies. The proposed road will require the realignment of the 4 m wide walkway between road chainage 3600 to 4480. The treatment of the boundary interface of the proposed carriageway is important, so that the amenity users are kept safe and feel comfortable in this section of the amenity footpath / cycleway. There will be slight negative impact upon views during construction, however upon completion, with the provision of a new amenity path and cycle way, the visual impact from this amenity will be neutral.

11.5 Proposed Mitigation and Avoidance Measures

Consideration was given to avoidance of impact wherever possible during the route selection and design process for the proposed road. This attempt at avoidance commenced at an early stage with the preparation of a landscape and visual constraints assessment of a wide study area as part of the overall constraints study for the project.

On assimilation of the various constraints studies, a number of potential options were developed in compliance with the scheme objectives. In developing the various route options the avoidance of identified constraints was a significant element of the consideration process. Subsequently all of the routes were assessed and compared in the course of the Route Selection report during which the likely impacts of all the route options were highlighted and a best option in landscape and visual terms identified. While all the options have potential for landscape and visual impact the recommended option was considered to have the least overall potential for significant adverse landscape and visual impact.

As such, in this respect the alignment has already been selected to minimise impact on residential property, topographical features, trees and hedgerows wherever possible. However, as with any development some degree of impact is inevitable and wherever possible measures have been proposed to mitigate the negative nature of these impacts and the various specific measures are listed in detail below.

11.5.1 General Landscape Mitigation Measures

(a) Landscape Strategy

The objectives for the landscape works to the proposed road are:

- *To develop a landscape, the character of which relates to the patterns, scale and diversity of the existing character of the study area, and one which defines the entrance / exit of Listowel Town;*
- *To develop a landscape structure this physically and visually integrates the proposed road, its embankments and associated features into the local surroundings;*
- *To minimise visual intrusion and reduce the adverse nature of any visual obstruction;*
- *To protect, reinstate or enhance elements of the existing landscape, directly or indirectly affected by the proposed scheme;*
- *To assist in the creation of pleasant safe driving conditions;*
- *Where possible, existing planting adjacent to the proposed road should be retained to minimise impact upon adjoining residential and amenity areas; and*
- *To minimise the visual intrusion of the bridge crossing over the river.*

(b) General Mitigation Measures

The proposed development will be a scheme that includes a bridge, roundabout junctions, signage, lighting, earthworks and planting. An integrated and cohesive design strategy for all of these elements is essential in creating a unified visual design that will help to mitigate visual impact. The detailed design of the road aims to create a strong sense of place, defining an entrance / exit to the heritage town of Listowel.

The design of the horizontal and vertical alignments have taken due cognisance of the existing dwellings, habitats, contours, field boundaries and vegetation in order to minimise the impact on the landscape.

The bridge crossing over the River will be designed to integrate with the landscape. Appropriate riparian planting shall be planted at the abutments to the bridge, which will anchor the bridge and hedgerows will be planting to allow bridge environment eventually merge with the existing field pattern.

(c) Specific Landscape Measures

A number of specific landscape mitigation measures will be implemented as follows, refer to Figures 11.1.6 – 11.1.9: Landscape Mitigation.

Table 11-6 Specific landscape measures

Reference	Location/Reference	Description
SLM01	Proposed Roundabout 1 (Coolnaleen Lower)	Upon completion of road alignment and associated earthworks, low canopy screen woodland planting of native species such as hawthorn, holly, blackthorn, Oak, Pine and Alder will be planted. All planting material shall be indigenous and certified Irish providence as per NRA guidelines. This planting will help to assist in screening the road from nearby properties.
SLM02	Banks of River Feale	Upon completion of the bridge crossing and associated earthworks, low scrub river corridor planting (i.e. Willow, Alder, Hazel, Holly, Hawthorn), this planting stock should be indigenous and certified Irish providence as per NRA guidelines. Organic method of weed control to be carried out in the vicinity (10 m offset from the SAC boundary) of this protected SAC, e.g. Mulch mats.
SLM03	Proposed Roundabout 2 (Kilcreen)	Upon completion of road alignment and associated earthworks, low canopy screen woodland planting of native species such as hawthorn, holly, blackthorn, Oak, Pine and Alder will be planted. All planting material shall be indigenous and certified Irish providence as per NRA guidelines. This planting will help to assist in screening the road from nearby properties.
SLM04	Proposed Roundabout 3 (At R553)	Upon completion of road alignment and associated earthworks, low canopy screen woodland planting of native species such as hawthorn, holly, blackthorn, Oak, Pine and Alder will be planted. All planting material shall be indigenous and certified Irish providence as per NRA guidelines. This planting will help to assist in screening the road from nearby properties.
SLM05	Proposed Sive Walk (Accommodate the amenity and cycle route (GST))	Plant stretches of native hedgerows with trees, such as holly or hawthorn and tree species such as Oak. All planting material shall be indigenous and certified Irish providence as per NRA guidelines. This planting will help to assist in screening the proposed Sive Walk from the proposed development.
SLM06.1	Proposed 'Hop over' points for Barn Owls. Located approximately 270m north of Proposed Roundabout 1 (Coolnaleen Lower)	Plant double staggered row of Alder/*Alnus glutinosa* (Multistem, 4x, 5-6m high, RB) at 3m centres to provide immediate hop over points for Barn owls, as recommended in Ecology report. Plant 2.5m setback from grass verge.
SLM06.2	Proposed 'Hop over' points for Barn Owls. Located at the banks of the River Feale.	Plant double staggered row of Alder/*Alnus glutinosa* (Multistem, 4x, 5-6m high, RB) at 3m centres to provide immediate hop over points for Barn owls, as recommended in Ecology report. Plant 2.5m setback from grass verge.
SLM06.3	Proposed 'Hop over' points for Barn Owls. Located approximately 30m south of Proposed Roundabout 2 (Kilcreen)	Plant double staggered row of Alder/Alnus glutinosa (Multistem, 4x, 5-6m high, RB) at 3m centres to provide immediate hop over points for Barn owls, as recommended in Ecology report. Plant 2.5m setback from grass verge.
SLM06.4	Proposed 'Hop over' points for Barn Owls. Located approximately 105m south west of Proposed Roundabout 3 (At R553)	Plant double staggered row of Alder/Alnus glutinosa (Multistem, 4x, 5-6m high, RB) at 3m centres to provide immediate hop over points for Barn owls, as recommended in Ecology report. Plant 2.5m setback from grass verge.

(d) Construction Aspects

Contracts will be framed to ensure good working practices that will reduce any adverse impacts arising from construction to the lowest possible level. The NRAs '*Guidelines on the Implementation of Landscape Treatments on National Road Schemes'* is used as a reference for implementing the works. Storage areas will be so located to avoid impacting on existing residential properties, trees, hedgerows, drainage patterns etc. and such areas will be fully re-instated prior to or at the end of the construction contract.

(e) Landscape Mitigation

Landscape mitigation measures are illustrated on Figures 11.1.6 – 11.1.9: Landscape Mitigation.

To give a logical and coherent approach to landscaping of the proposed development objectives for such works were considered as follows:

- *Maximise screening to minimise impact upon adjoining properties and amenities;*
- *Where feasible the existing vegetation along the route will remain unaffected by the scheme. The working area will be defined at the construction stage by the erection of protective fencing which will be set outside the canopy lines of trees and vegetation to be retained;*
- *Planting will be used to soften the complex retaining structures, embankments and bridge;*
- *Planting will be avoided where it would interfere with sight-lines or road safety.*
- *Planting design will enable the physical and visual integration of the road and its associated features into the local surrounds;*
- *Maintenance to be minimal by selection of progressive naturalistic systems where possible;*
- *A high standard of landscaping which reflect their status as gateways to Listowel Heritage Town will be provided;*
- *To select species that will achieve this integration in the shortest possible time.*
- *The selection of predominantly indigenous tree and shrub species that will successfully establish in such a setting and which will provide habitats and visual enclosure in keeping with and similar to those of the surrounds; and*
- *Lighting and signage requirements for the proposed road shall be sited required locations with planting mitigation measures carried out where applicable to assist in reducing the impact of lighting and signage to the wider environment.*

Higher percentages of evergreen trees will be planted at sensitive locations to reduce visual impact. In particular, this will be provided at the Bridge abutments at the River and the three roundabout junctions. Standard woodland planting mixtures will be used elsewhere with semi-mature specimen trees used at road junctions, avoiding road sightlines, to give immediate impact.

The proposed planting will generally be established with forestry planting techniques, i.e. bare root transplants, whips and feathered trees which adapt readily to disturbed ground

conditions. A proportion of 'Standard' and taller sized trees will be used to supplement these plantings especially in the vicinity of residential areas. All planting mixes will comply with and include native and local species as identified in Chapter 6: Flora and Fauna. Tree species utilised will be selected from a list of primarily native, naturalised and indigenous species (except where the proposal is contiguous with existing plantations containing other species such as conifers or beech etc.), which will include alder, common ash, aspen, downy and silver birch, bird and wild cherry, mountain ash, pedunculate and sessile oaks, Scots pine and willow species. Planting sizes and spacing are outlined below.

The hedge planting will be primarily of blackthorn, hawthorn with hazel and other species planted at 600-900 mm heights at 400 mm centres and interspersed with taller semi-mature trees planted at 9 m centres with species such as oak. Shrub planting species utilised will be selected from a list of primarily native and indigenous species, which will include, blackthorn, crab apple, elder, hawthorn, hazel, holly, guelder rose, spindle, willows and other plants found naturalised in the affected localities.

In addition to the landscape mitigation measures, additional landscape is required in order to mitigate various ecological impacts. The landscaping associated with this ecological mitigation is included in Chapter 6 Flora and Fauna, and these have been considered in terms of their interaction with the scenic landscape.

A schedule of the trees/shrubs is listed in Table 11-7.

Table 11-7 Tree/shrub planting schedules

EW1					
Low canopy screen woodland with high percentage of evergreen species					
Species	% mix	Size	Girth	Planted	Planting centres (m)
Pinus sylvestris	20	60-90 cm	N/A	CG	1.5
Alnus glutinosa	8	60-90 cm	N/A	BR	1.5
Betula pendula	8	60-90 cm	N/A	BR	1.5
Prunus avium	8	60-90 cm	N/A	BR	1.5
Prunus padus	5	60-90 cm	N/A	BR	1.5
Corylus avellana	5	60-90 cm	N/A	BR	1.5
Crataegus monogyna	5	60-90 cm	N/A	BR	1.5
Ilex aquifolium	10	20-30 cm	N/A	CG	1.5
Malus sylvestris	3	60-90 cm	N/A	BR	1.5
Salix caprea	4	60-90 cm	N/A	BR	1.5
Salix cinnerea ssp. Oleifolia	4	60-90 cm	N/A	BR	1.5
Cytisus scoparius	4	60-90 cm	N/A	BR	1.5
Euonymus europaeus	4	60-90 cm	N/A	BR	1.5
Prunus spinosa	4	60-90 cm	N/A	BR	1.5
Sambucus nigra	4	60-90 cm	N/A	BR	1.5
Viburnum opulus	4	60-90 cm	N/A	BR	1.5
	100				
WL1					
Native Hedgerow					
Species	% mix	Size	Girth	Planted	Planting centres (m)
Crataegus monogyna	40	90-120 cm	N/A	BR	0.4 m double row staggered
Prunus spinosa	40	60-90 cm	N/A	BR	0.4 m double row staggered
Ilex aquifolium	10	20-30 cm	N/A	CG	0.4 m double row staggered
Corylus avellana	10	60-90 cm	N/A	BR	0.4 m double row staggered
	100				
EW1					
Corylus avellena	10	60-90 cm	N/A	BR	0.4 m double row staggered
	100				
WL2					
Native Hedgerow with trees					
Species	% mix	Size	Girth	Planted	Planting centres (m)
Quercus petraea	NA	4 m	14-16 cm	BR	9 m centres and 2m centres at 'hop over' points
Crataegus monogyna	40	90-120 cm	N/A	BR	0.4 m double row staggered
Prunus spinosa	40	60-90 cm	N/A	BR	0.4 m double row staggered
Ilex aquifolium	10	20-30 cm	N/A	CG	0.4 m double row staggered
Corylus avellena	10	60-90 cm	N/A	BR	0.4 m double row staggered
	100				
GM1					
River corridor planting					
Species	% mix	Height	Girth	Planted	Planting centres (m)
Alnus glutinosa	20	60-90 cm	N/A	BR	1.5
Betula pubescens	10	60-90 cm	N/A	BR	1.5
Corylus avellana	5	60-90 cm	N/A	BR	1.5
Crataegus monogyna	5	60-90 cm	N/A	BR	1.5
Salix cinera	15	60-90 cm	N/A	BR	1.5
Salix purpurea	15	60-90 cm	N/A	BR	1.5
Salix triandra	15	60-90 cm	N/A	BR	1.5
Salix viminalis	15	60-90 cm	N/A	BR	1.5
SLM 6.1-SLM 6.4					
'Hop over' points for Barn Owls.					
Species	Clear Stem	Height	Girth	Planted	Planting centres (m)
Alnus glutinosa	Multistem	5-6m	25-30	RB	@ 3m centres
Grass seed to road verges – low maintenance grass mix @35g/m2					
30% Dwarf Perennial Ryegrass (*Lolium perenne*), e.g. ESQUIRE, ESSENCE					
20% Strong Creeping Red Fescue (*Festuca rubra rubra*), e.g. CORAIL, MAXIMA					
20% Slender Creeping Red Fescue (*Festuca rubra trichlophylla),* e.g. BARCROWN					
20% Hard Fescue (*Festuca longifolia*), e.g. TRIANA					
10% Smooth Stalked Meadow Grass (*Poa pratensis*), e.g. MIRACLE					

All landscape works are to be carried out in accordance with the NRA Guidelines for Landscape Treatments for National Road Schemes in Ireland.

General grass areas will be seeded with a simple wildflower meadow mixture (e.g. WF01 mix from Wild Flowers Ireland or similar equal and approved). Specific seed mixtures will use a dry calcareous seed mixture (e.g. MM09 mix from Wild Flowers Ireland or similar equal and approved). Treatment wetlands will be specified in accordance with Chapter 4.5 of 'NRA: A Guide to Landscape Treatments for National Road Schemes in Ireland' and NRA's guidelines for Implementation of Landscape Treatments on National Road Schemes.

11.6 Residual Impacts

The low lying nature of the landscape of the study area has the capacity to absorb the proposed bypass and bridge crossing. Properties close to the proposed road and junctions will be visually significantly impacted upon. However, the landscape mitigation measures proposed will assist in reducing this impact to moderate at most (PR-04, PR07, PR-11, PR-15, PR-17, PR-26, and PR-31) with the exception PR-19 which will remain significant. Reduction of traffic in the town centre will improve the quality and environment of the town centre.

11.7 Difficulties Encountered in Compiling Information

There were no difficulties encountered in compiling information or in the assessment process of the landscape and visual impacts.

11.8 Cumulative Impacts and Impact Interrelations

The landscape and visual impact arising from the proposed scheme have a significant interaction with the cultural heritage and ecology of the surrounding landscape. These aspects are dealt with in detail in Chapters 12: Cultural Heritage and Chapter 6 Flora and Fauna.

11.9 References

Kerry County Development Plan 2009-2015

Kerry County Development Plan 2015-2021

Listowel Town Council, Town Development Plan 2009-2015

Guidelines for Landscape and Visual Impact Assessment; 3rd Edition written by Landscape Institute

NRA's guidelines for Implementation of Landscape Treatments on National Road Schemes

NRA: Environmental Impact Assessment of National Road Schemes- A Practical Guide 2008

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.

'Living with Nature - The Designation of Nature Conservation Sites in Ireland' published by Duchas

EPA: Guidelines on the Information to be contained in Environmental Impact Statements, 2002.

EPA: Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) 2003.

DOE (UK): Design Manual for Roads and Bridges.

Landscape Institute UK: Guidelines for Landscape and Visual Impact Assessment, 3rd Edition, 2013.

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12 Archaeology, Cultural Heritage and Architectural Heritage

12.1 Introduction

This chapter of the EIS 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 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').

12.2 Archaeology and Cultural Heritage

12.2.1 Introduction

In its 'Framework and Principles for the Protection of the Archaeological Heritage' (1999), the Department of Arts, Heritage, Gaeltacht and the Islands defined 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. For clarity, sites where the importance of their cultural or historical associations outweighed that of their physical remains have been treated as cultural heritage rather than archaeology.

(a) Baseline data gathering

For the purpose of this a study area was defined which extended 50 m beyond the footprint of the proposed development. The footprint of the proposed development was defined as the earthworks, carriageway, structures, attenuation treatment ponds and lands made available. This study area is wider than that recommended by the NRA guidance which suggests that the study area should be '*50 meters (though not limited to this width) either side of the centre line of the road*' (NRA 2005a, 35).

Baseline information for this area was gathered from the following sources of information:

- *Technical reports prepared during earlier assessments of the proposed development comprising the Phase 2 Route Selection Cultural Heritage Report (Kerry County Council and Kerry National Road Design Office 2011) and the N69 Listowel Bypass Phase 2 Preliminary Archaeological Assessment (Kerry County Council and Kerry National Road Design Office 2011);*
- *The Record of Monuments and Places (RMP) and Sites and Monuments Record (SMR) for information on architectural heritage sites;*
- *The list of National Monuments in State Care: Ownership and Guardianship (EHLG & NMS, 2009);*
- *The list of Preservation Orders held by the National Monuments Service (EHLG & NMS 2010);*
- *The Register of Historic Monuments provided in in the Draft Kerry County Development Plan 2015-2021, Volume 2;*
- *The National Roads Authority Archaeological Database;*
- *www.excavations.ie;*
- *First edition Ordnance Survey 6" and 25" mapping consulted at www.osi.ie;*
- *Down Survey available on line at www.downsurvey.tcd.ie;*
- *Griffith's Valuation available on line at www.askaboutireland.ie/griffith-valuation;*
- *Manuscript and published sources held by the National Library of Ireland;*
- *Published sources and historic maps held by the Kerry Local Studies and Archives Department;*
- *Aerial photographs taken for this project;*
- *National Inventory of Architectural Heritage (NIAH) Survey of Historic Gardens and Designed Landscapes;*
- *Records of the Schools Folklore Scheme (1937-38) held by the County Kerry Local Studies Library;*
- *Kerry County Development Plan 2009-2015 for relevant heritage policies;*
- Topographical Files held by the National Museum of Ireland consulted during the preparation of the Phase 2 Route Selection Report for the development (Kerry County Council 2011, 10); and
- A site inspection undertaken between the 9th and 11th of July 2013.

(b) Consultation

During the preparation of this report, consultation has been undertaken with the National Monuments Service of the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, Kerry County Council and the TII Project Archaeologist.

(c) 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). However, an assessment of the importance each archaeological or cultural heritage site within the study area was made on a four-point scale of Very High, High, Medium and Low. These assessments were based on professional judgment and experience guided by the criteria in Table 12-1 as set out in Appendix 2 of the NRA Guidelines (2005a, 51).

Table 12-1 Criteria for the assessment of importance of archaeological and 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.

12.2.2 Description of the Existing Environment

From the above sources, a total of 35 archaeological and cultural heritage sites were identified within the study area. These sites are listed in Table 12-2 below and shown on Figures 12.1.6 to 12.1.10 and detailed further in Appendix 12.1: Archaeology and Cultural Heritage Inventory.

Table 12-2 Archaeological and Cultural Heritage baseline conditions.

Site Number	Site Name	Site type	Designation	Importance
AR1	Townland boundary Coolnaleen Upper / Billeragh	Townland boundary	None	Low
AR3	Fulacht Fiadh, Coolnaleen Lower	Fulacht fiadh	Recorded Monument (KE010-074001)	High
AR4	Ringfort 2, Coolnaleen Lower	Ringfort	Recorded Monument (KE010-074)	High
AR5	Buildings (site of)	Building	None	Low
AR6	Cottage (site of) Coolnaleen Lower	Cottage	None	Low
AR7	Building (site of) 2, Coolnaleen Lower	Building	None	Low
AR8	Townland boundary Coolnaleen Lower / Garryantanvally	Townland boundary	None	Low
AR9	Farmstead (site of), Coolnaleen Lower	Farm	None	Low
AR10	Holy well, Coolnaleen Lower	Holy well	Recorded Monument (KE010-079)	High
AR11	Burnt spread, Coolnaleen Lower	Burnt spread	Recorded Monument (KE010-077)	High
AR12	Flood Defence Embankment (site of)	Flood Defence Embankment	None	Low
AR13	River Feale – Area of Archaeological Potential	Area of Archaeological Potential	None	Low
AR14	Townland boundary Scartleigh/Garryantanvally	Townland boundary	None	Low
AR15	Ford & footstick (site of)	Ford	None	Low
AR16	Townland boundary Drumloughra/Gortcurreen	Townland boundary	None	Low
AR17	Townland boundary Gortcurreen/Garryantanvally	Townland boundary	None	Low
AR18	Buildings (site of), Gortcurreen	Building	None	Low
AR19	Kilcreen Cottage gate lodge (site of)	Gatelodge	None	Low
AR20	Townland boundary Kilcreen/Gortcurreen & Mill Lead	Townland boundary	None	Medium
AR21	Buildings 2 (Site of), Gortcurreen	Building	None	Low
AR22	Buildings 3 (site of), Gortcurreen	Building	None	Low
AR23	Building 2 (site of), Gortcurreen	Building	None	Low
AR24	Building (site of), Gortcurreen	Building	None	Low
AR25	Building 3 (site of), Gortcurreen	Building	None	Low
AR26	Building 4 (site of), Gortcurreen	Building	None	Low
AR27	Limerick & Kerry Railway (site of)	Railway	None	Low
AR28	Building 1 (site of), Curraghatoosane	Building	None	Low
AR29	Well (site of)	Well	None	Low
AR30	Building 2 (site of), Curraghatoosane	Building	None	Low
AR32	Buildings (site of), Curraghatoosane	Building	None	Low
AR33	Building 3 (site of), Curraghatoosane	Building	None	Low
AR34	Buildings 4 (site of), Curraghatoosane	Building	None	Low
AR35	Pump (site of), Curraghatoosane	Pump	None	Low
AR36	Level crossing cottage (site of), Curraghtoosane	Level crossing cottage	None	Low
AR37	Townland boundary Curraghatoosane/Listowel	Townland boundary	None	Low

(a) Baseline conditions

The majority of archaeological and cultural heritage sites identified with the study area date to the Modern period (AD 1700 – Present). Sites, mainly townland boundaries, potentially dating to the Post Medieval period have been identified. Few sites dating to the medieval or Prehistoric periods have been identified within the study area. Additional information on all sites is presented in the in Appendix 12.1: Archaeology and Cultural Heritage Inventory while context for baseline sites is provided below.

(i) Prehistoric (7000 BC – AD 500)[46]

Fulachta fiadh are made up of three main elements; a hearth in which stones were heated, a trough in which water was heated using these stones, and a mound of discarded stones, burnt and shattered beyond use. The troughs often have a lining of wood or stone. Besides cooking, a variety of uses have been suggested for these sites including saunas (Buckley 1990; Barfield and Hodder 1987; 1991; Brindley 1989–90). Other semi-industrial activities include washing and dying cloth or wool, and leather working (Brindley 1989–90). Fulachta fiadh or Burnt Mounds are predominantly Bronze Age in date but are known to span from the Neolithic to the medieval period. They are now one of the most frequent monument types in the Irish countryside.

Two fulachta fiadh have been identified in the study area; *Coolnaleen Lower* (AR3) and a burnt spread thought to be the remains of a fulachta fiadh (AR11) also located in the same townland. AR3 is a Recorded Monument and the North Kerry Archaeological Survey (T1995) notes that the trough and a quantity of burnt stone was identified during the digging of a drain (1995, 55). The field was under crop at the time of the walkover survey and no surface evidence was identified. AR11 is located adjacent to a watercourse, approximately 11 m northwest of a holy well (AR10; see below). Burnt stone was identified during ploughing, but no structural remains were noted (Toal 1995, 55) and material that appeared to be burnt stone was identified in the watercourse during the site inspection in 2013. Archaeological testing in the vicinity of these monuments did not identify any remains of archaeological importance (Carroll 2013). Both AR3 and AR11 have been assessed to be of High importance.

(ii) Medieval (AD 500 – AD 1540)

Ringforts are undoubtedly the most widespread and characteristic archaeological field monument in the Irish countryside with over 45,000 recorded examples. They are usually known by the names ráth or lios and consist of a circular or roughly circular area enclosed by an earthen bank formed of material thrown up from a concentric fosse (or ditch) on its outside. Archaeological excavation has shown that the majority of ringforts were enclosed farmsteads which acted as a defence against natural predators like wolves, as well as against cattle raids. They were predominantly occupied during the early medieval period, though evidence for their continued use into the medieval period has also been documented, particularly in the west of Ireland.

One ringfort has been identified within the study area (AR4) which is designated as a Recorded Monument. AR4 is recorded as univallate[47] ringfort which has been largely levelled, with only slight evidence of a bank visible. At the time of the walkover study the field was under crop and no evidence of the structure was visible. This site has been assessed to be of High importance.

[46] The date range used is taken from the glossary in the NRA Guidelines (2005a)
[47] A ringfort defined by a single bank and ditch.

(iii) Post Medieval (AD 1540 – AD 1700)

(iii).1 Townland Boundaries

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 (Nolan 1982, 20-23). 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.

Seven townland boundaries have been identified within the study area (AR1, AR8, AR14, AR16, AR17, AR20, AR37). In some cases the boundary follows a road or stream, in others the line is marked by field boundaries. Townland boundary Coolnaleen Upper/ Billeragh (AR1) follows an earthen bank and a road. The boundary between Coolnaleen Lower and Garryantanvally (AR8) follows a watercourse shown on the 1st edition Ordnance Survey map. The boundary between Scartleigh and Garryantanvally (AR14) is in the area where the River Feale was realigned and no physical trace of this boundary now survives. The boundary between Gortcurreen and Garryantanvally (AR17) also followed the former course of the River Feale and now exists as a low earth bank lined with trees. Only a very short length of boundary between Drumloughra and Gortcurreen (AR16) is identified in the study area and no physical evidence for this was identified during the walkover survey. The boundary between Kilcreen/Gortcurrreen and Mill Lead (AR20) exists in part as the course of the mill stream, identified on the 1st edition Ordnance Survey map. The realignment of the river is likely to have removed any physical evidence of a bank or other upstanding earthwork. The area around the boundary between the townlands of Curraghatoosane and Listowel has been heavily modified in the 20th century; this survives as extant modern field boundaries.

The importance of townland boundaries lie in their historical and cultural associations rather than their physical remains which largely reflect the prevailing land divisions and natural features in the area. These sites have been assessed to be of Low value.

Information on the origin of townland names within the study area is presented in Table 12-3 below.

Table 12-3 Townlands within the study area

Townland	Parish	Barony	Meaning
Billeragh	Kilshenane	Clanmaurice	*Biolarac* A place abounding in water courses
Coolnaleen Lower	Kilshenane	Clanmaurice	*Cúil na Líon Iochtaragh* Nook of the nets, lower
Coolnaleen Upper	Kilshenane	Clanmaurice	*Cúil na Líon Iochtaragh* Nook of the nets, upper
Curraghatoosane	Listowel	Iraghticonnor	*Currac a tsuassin* Moor of the long thicket
Drumloughra	Dysert	Iraghticonnor	*Drom luacra* Rushy ridge or long hill of the rushes
Garryantanvally	Finuge	Clanmaurice	*Garraid an t-sean baile* Garden of the old town
Gortcurreen	Listowel	Iraghticonnor	*Gort Coirrín* Field of Coirrin – personal name
Islandganniv North	Listowel	Iraghticonnor	*Cilean a gainim* Sandy island or island of sand
Kilcreen	Kilcreen	Clanmaurice	*An Choill Chríon* Wood
Scartleigh	Dysert	Iraghticonnor	*Scairt Liat* Grey thicket

(iv) Modern (AD 1700 – Present)

The majority of the modern archaeological sites are the sites of buildings recorded on the 1st edition of the Ordnance Survey 6" map (AR5, AR6, AR7, AR9, AR18, AR21, AR22, AR23, AR24, AR25, AR26, AR28, AR30, AR32, AR33 and AR34). The buildings have been subsequently demolished and the plots have been redeveloped in the 20th century. These sites have been assessed to be of Low importance.

The site of the ford and footstick (a rough footbridge) was recorded on the 1st edition Ordnance Survey map (AR15). This has subsequently been demolished and replaced with a bridge and tarmac surfaced road. The site of a pump (AR35), a well (AR29) and a flood defence embankment (AR12) were also identified from the 1841-42 Ordnance Survey map, however, no evidence of these sites was identified by the walkover survey. These sites have been assessed to be of Low importance.

The site of the former Limerick and Kerry Railway (AR27) now forms part of a heritage trail around Listowel. After Limerick city had been connected to the Irish railway system in 1848, the onward link to Tralee was forged in three stages in the period 1858-80. Firstly, in 1858 the Limerick and Foynes Railway commenced operations via Ballingrane. This was followed some three years later by the Rathkeale and Newcastle Junction Railway from Newcastle to a junction with the Foynes line at Ballingrane; this opened on 1st January 1867. In 1865 the Limerick and Kerry Railway was proposed and in the late 1870's the 43 mile line from Newcastle to Tralee was built. It was opened on 20th December 1880 and included an intermediate station at Listowel. The railway infrastructure has now been removed and the former line is used as a footpath. The site of a cottage (AR36) is identified on the 1st edition 25" Ordnance Survey map next to a level crossing for the Limerick and Kerry Railway; this was likely to have been constructed as residence for the Level Crossing keeper. There is now no evidence of the original structure surviving. Sites AR27 and AR36 have both been assessed to be of Low importance.

(v) Uncertain

A holy well at Coolnaleen Lower (AR10) was identified in 1995 as part of the North Kerry Archaeological Survey (Toal 1995). The well description notes that it *'consists of a crescent-shaped depression within which is the well'. According to the landowner, this well is associated with St Brigid. The top of the well is mortared and below this is drystone walling'* (Toal 1995, 234). At the time of the walkover survey the area was very overgrown however the well appeared to be a concrete structure with a hole for a connecting pipe, capped with what appeared to be a large stone. No additional evidence that the well is used for the veneration of St Brigid (whose feast day is the 1st February) has been identified. The well is a Recorded Monument and has been assessed to be of High importance.

(vi) Archaeological Potential

The riverine environment is considered to be one of high archaeological potential, containing features such as fulachta fiadh, fords, ancient bridging sites, mills, and longphorts and producing archaeological artefacts such as log boats, organic material and votive offerings of axeheads and metalwork. Riverbank sites have been favoured for human occupation since prehistoric times for their proximity to rich food sources and fresh water and have additionally served as routeways, boundaries, defences and as a focus for ritual. One watercourse, the Feale River, runs through the study area. The original course of the River Feale is shown on 1st edition Ordnance Survey map of 1847 and was modified during that year. The pre-modification form of the river includes a curved meander to the north. An article in *The Tralee Chronicle*, dated Saturday 9th January 1847, records the submission of a report by Mr William Tabbot Crosbie and Mr Stephen Edward Collis to realign the River Feale to allow the reclamation of land. An article in the same paper, dated July 31 1847, records that the Board of Work approved the scheme, but there were issues over the monies required to complete it.

No other OSI named watercourses run through the study area.

An area of archaeological potential (AR13) has been defined to include both the earlier meander and the present course of the River Feale as well as the area of land modified as a result of the work. While riverine environments can be of high archaeological importance; within AR13 it is likely to be the location of the original Feale riverbank that contains the highest potential for sub-surface archaeological remains. This potential can only be elucidated by undertaking an archaeological assessment of the area, comprising a combination of geophysical survey and archaeological test trenching. The value of this site has therefore been assessed to be Unknown.

12.2.3 Appraisal Method used for Assessment of Impacts

(a) 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 below.

Table 12-4 Type of impacts

Direct Impact	Impacts arising as a consequence of the proposed 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.

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 12-5, based on those set out in Appendix 4 of the NRA Guidelines (2005a, 54):

Table 12-5 Quality of impacts

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 12-6 below:

Table 12-6 Criteria for the assessment of magnitude of impact for archaeological and cultural heritage sites

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 its 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 category of 'No Change' has been used for archaeological or cultural heritage sites that are within the study area but where no discernible impact will occur as a result of the proposed development.

(b) Assessment of Significance of Impact

The significance of impacts was assessed on a scale of Profound, Significant, Moderate, Slight and Imperceptible as defined in Appendix 4 of the NRA Guidelines (NRA 2005a, Appendix 4, 54) and set out in Table 12-7 below. An additional category of 'No Change' was also used for archaeological sites that are within the study area but where no measurable impact will occur as a result of the proposed development.

Table 12-7 Definitions of levels of significance of impact for archaeological and cultural heritage sites (NRA 2005a, Appendix 4, 54)

Profound	Applies where mitigation would be unlikely to remove negative 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.

The significance of impacts was assessed using professional judgement guided by the matrix at Table 12-8.

Table 12-8 Significance of Impacts matrix

Importance of Site	**Magnitude of Impact**				
	Very High	**High**	**Medium**	**Low**	**No Change**
Very High	Profound	Profound	Profound/Significant	Significant	Neutral
High	Profound	Profound/Significant	Significant	Moderate	Neutral
Medium	Significant	Moderate	Moderate/Slight	Slight	Neutral
Low	Moderate	Slight	Slight/ Imperceptible	Imperceptible	Neutral

12.2.4 Predicted Impacts of the Proposed Development

(a) "Do Minimum Scenario"

The "Do Minimum" scenario is the outcome that would be achieved if the proposed development was not constructed. The baseline archaeological and cultural heritage sites would remain in their current form and condition.

(b) Construction

Impacts resulting from the construction of the proposed development have been identified for 16 archaeological and cultural heritage sites, and are summarised in Table 12-9. No impacts on any other sites identified within the study area are predicted and these are not shown in Table 12-9.

Unless otherwise stated, all impacts are assessed to be negative and permanent.

Table 12-9 Predicted construction impacts on cultural heritage and archaeological sites

Site Number	Site Name	Importance	Magnitude of construction impact	Significance of construction impact
AR1	Townland boundary Coolnaleen Upper / Billeragh	Low	Low	Imperceptible
AR8	Townland boundary Coolnaleen Lower/Garryantanvally	Low	Low	Imperceptible
AR10	Holy well, Coolnaleen Lower	High	Very High	Profound
AR11	Burnt spread, Coolnaleen Lower	High	Very High	Profound
AR12	Flood Defence Embankment (site of)	Low	Low	Imperceptible
AR13	River Feale – Area of Archaeological Potential	Unknown	Medium	Unknown
AR16	Townland boundary Drumloughra/Gortcurreen	Low	Low	Imperceptible
AR17	Townland boundary between Gortcurreen and Garryantanvally	Low	Medium	Slight
AR21	Buildings 2 (site of), Gortcurreen	Low	Medium	Slight
AR23	Building 2 (site of), Gortcurreen	Low	Very High	Moderate
AR27	Limerick & Kerry Railway (site of)	Low	Medium	Slight
AR28	Building 1 (site of), Curraghtoosane	Low	Very High	Moderate
AR29	Well (site of) Curraghtoosane	Low	Very High	Moderate
AR33	Building 3 (site of), Curraghtoosane	Low	Very High	Moderate
AR36	Level crossing cottage (site of), Curraghtoosane	Low	Very High	Moderate
AR37	Townland boundary Curraghatoosane/Listowel	Low	Low	Imperceptible

Construction of the proposed development will remove extant remains and any buried archaeological remains associated with the holy well in Coolnaleen Lower (AR10). The magnitude of impact has been assessed as Very High and the significance of impact has been assessed as Profound.

Construction of the proposed development will remove any present remains associated with Coolanaleen Lower burnt spread (Site AR11). The magnitude of this impact has been assessed as Very High and the significance of impact as Profound.

Site AR23 is the site of two buildings shown on the 1st edition 6" Ordnance Survey map, which have been demolished. Any remains associated with these buildings will be wholly removed by the construction compound and as such the magnitude of impact has been assessed to be Very High and the significance of impact has been assessed to be Moderate.

Sites AR28, AR33 and AR36 are the sites of buildings depicted on the 1st edition 6" and 25" Ordnance Survey maps of 1840-1841 and 1888-1913 respectively, all of which have now been demolished. Construction of the proposed development would lead to the complete removal of any archaeological remains that may be present associated with these sites. The magnitude of these impacts has been assessed as Very High and the significance of impact has been assessed as Moderate.

Site AR29 is the site of a well shown on the 1st edition 25" Ordnance Survey map any remains of which will be wholly removed by the proposed development and as such the magnitude of impact has been assessed to be Very High and the significance of impact as Moderate.

Construction of the proposed development will impact on the townland boundary between Gortcurreen and Garryantanvally (AR17) which is defined by a low bank and line of trees. The proposed development will remove the boundary for a distance of 44 m, from a total length of 350 m. The magnitude of this impact has been assessed to be Medium, and the significance of impact has been assessed to be Slight.

Site AR21 is the site of buildings depicted on 1st edition of the Ordnance Survey 6" map laid out parallel to the road. Construction of the proposed development has the potential to remove part of the southern edge of these buildings as depicted on this map removing any archaeological remains that may be present. The magnitude of this impact has been assessed to be Medium and the significance of impact has been assessed to be Slight.

Construction of the proposed development will lead to the loss of c.1.1 km of the route of the site of the Limerick and Kerry railway (Site AR27). The route of the line remains clearly legible and understandable in the landscape. The magnitude of this impact has been assessed as Medium and the significance as Slight.

Site AR1 is the townland boundary between Coolnaleen Upper and Billeragh. Within the proposed footprint of the development it is defined by a modern road. The magnitude of impact is predicted as Low and the significance of impact as Imperceptible.

Site AR8 is the townland boundary between Coolnaleen Lower and Garryantanvally. While this site is located within the roadline it is defined by a road and the proposed development will comprise enhancements within the existing carriageway. The magnitude of impact is predicted as Low and the significance of impact as Imperceptible.

Site AR12 is the site of a possible flood defence embankment shown on the first edition of the Ordnance Survey 6" map. While no above ground trace of this site survives, any archaeological remains associated with this site will be partially removed by the development. The magnitude of this impact has been assessed as Medium and the significance of impact as Imperceptible.

Sites AR16 and AR37 are townland boundaries which have been identified from historic mapping. While no visible remains of the boundaries survive within the development footprint, any underground remains associated with these will be removed by the development. However only a small proportion of the overall length of these townland boundaries will be removed and as such the magnitude of these impacts has been assessed as Low and the significance of impact as Imperceptible.

Construction of the proposed development could lead to the loss of any palaeoenvironmental evidence or other archaeological remains within the area of archaeological potential associated with the current and former course of the River Feale (Site AR13) within the proposed development footprint. The magnitude of this impact has been assessed to be Medium. As the value of the site is Unknown, the significance of impact is also Unknown.

No impact is predicted on the remaining 19 sites and these are therefore not discussed further.

In the vicinity of AR6, AR7, AR18, AR22 and AR30, improvements associated with the proposed development are located within the existing roadline and will not result in any additional landtake (see Figures 12.1.7 – 12.1.10). As these sites have previously been impacted by construction of the current road, no impact is predicted.

Further details of the impact assessment for all sites are provided in Appendix 12.1: Archaeology and Cultural Heritage Inventory.

(c) Operation

During operation of the development, no impacts are predicted on cultural heritage and archaeological sites

AR4, a ringfort in Coolnaleen Lower, is not visible in visible in the landscape and the relationship between this and another ringfort (KE 010-075) located outside the study area in the same townland already been partially severed through the construction of farm buildings and the creation of the existing R577 regional road. The improvements to the R577 would not increase this severance and as such the magnitude of impact on AR4 has been assessed to be No Change and the significance of impact as Neutral.

The setting of the remaining archaeological assets in the study area cannot be readily appreciated by the observer, the value of these assets is derived from their physical remains rather than their setting. As a result, no impacts during the operation of the proposed development are predicted on the remaining archaeological and cultural heritage sites.

12.2.5 Proposed Mitigation and Avoidance Measures

Where preservation *in situ* is not feasible, preservation by record is recommended to mitigate identified impacts. This methodology is in accordance with the principles and recommendations outlined in the '*Framework and Principles for the Protection of the Archaeological Heritage*' (DAHGI 1999, 25). Preservation by record consists of fully recorded investigations in the field, followed by analyses, reporting and publication. The information gained will be widely disseminated by a series of printed and internet publications for the benefit of scholars and the general public.

Measures to avoid or reduce potential impacts on archaeological heritage sites have been considered throughout the route selection process and incorporated into the detailed design of the proposed development.

Archaeological investigation in the form of trial trenching is proposed ahead of construction. The aim of this is to confirm the presence or absence, nature and

importance of any archaeological remains that may be present. The results of trial trenching would allow the design of appropriate works to resolve identified impacts, possibly including resolution excavation. The geophysical survey of Sites AR10 Holy Well Coolnaleen Lower and AR11 Burnt Spread Coolnaleen Lower, in the vicinity of AR4 Ringfort Coolnaleen Lower was undertaken in August 2014 (Appendix 12.3 N69 Listowel Bypass, County Kerry. ArchaeologicalGeophysicalSurvey). This survey identified anomalies of possible archaeological origin that shall require pre-construction archaeological trial trenching to confirm results.

The location and extent of any trial trench array will be subject to approval of the TII Project Archaeologist in consultation with the National Monuments Service and the Director of the National Museum of Ireland. Testing will be carried out well in advance of road construction to allow sufficient time for archaeological mitigation be undertaken in the event of archaeological remains being identified.

Sites that have been assessed to be important for their cultural or historical significance rather than their physical remains will be subject to archaeological testing and mitigation at the same time and in the same manner as more 'traditional' archaeological sites.

A scheme of topographic survey and the preparation of a written and photographic record will be carried out to mitigate the impacts on all of the townland boundaries (AR1, AR8, AR16, AR17 and AR37). This will provide a permanent record of the boundaries and is considered to be adequate mitigation prior to test excavation.

A scheme of topographic surveys and the preparation of a written and photographic record will be undertaken to mitigate the impacts on the Limerick and Kerry Railway (Site AR27). This will provide a permanent record of the site of the railway and is considered to be adequate mitigation prior to the realignment of the existing footpath.

To address the archaeological potential of Site AR13, a programme of palaeoenvironmental assessment is proposed, in line with '*Guidelines for the Testing and Mitigation of the Wetland Archaeological Heritage*' (NRA 2005c). This may include specialist assessment, retrieval of cores from deposits of palaeoenvironmental potential, followed by analysis and reporting. Any further archaeological resolution measures arising from these assessments will be implemented, subject to the approval of the TII Project Archaeologist and the National Monuments Service, in consultation with the National Museum of Ireland. In addition, the former banks and course of the river will be examined by metal detector survey. The findspots of any archaeological objects recovered will be recorded and the finds conserved. The potential for the presence of archaeological deposits or finds adjacent to the earlier and current river courses will be addressed during test excavation.

All of the pre-construction testing and mitigation measures proposed will be subject to approval from the appointed TII Project Archaeologist in consultation with the National Monuments Service and the Director of the National Museum of Ireland as appropriate. Proposed mitigation measures will also comply with the National Monuments Acts (1930 – 2004) and the Code of Practice (2000) agreed between the NRA and the then Minister for Arts, Heritage and the Gaeltacht.

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 will be undertaken in accordance with the *Guidelines for Authors of Reports on Archaeological Excavations* published by the National Monuments Service of the Department of Environment, Heritage and Local Government in 2006.

12.2.6 Residual Impacts

Residual impacts predicted during construction of the proposed development are summarised in Table 12-10 below. No impact is predicted on the remaining 19 sites and these are not shown in Table 12-10.

No impacts on archaeological or cultural heritage sites are predicted during operation of the development.

Table 12-10 Residual construction impacts on cultural heritage and archaeological sites

Site No.	Site Name	Importance	Unmitigated significance of construction impact	Mitigation Measure	Residual magnitude of construction impact	Residual significance of construction impact
AR1	Townland boundary Coolnaleen Upper / Billeragh	Low	Imperceptible	• Topographic survey • Photographic survey	No change	Neutral
AR8	Townland boundary Coolnaleen Lower/Garry antanvally	Low	Imperceptible	• Topographic survey • Photographic survey	No change	Neutral
AR10	Holy well, Coolnaleen Lower	High	Profound	• Historic Building Recording • Test Excavation • Resolution Excavation as required	Low	Moderate
AR11	Burnt spread, Coolnaleen Lower	High	Profound	• Test Excavation • Resolution Excavation as required	Low	Moderate
AR12	Flood Defence Embankment (site of)	Low	Imperceptible	• Test Excavation • Resolution Excavation as required	No change	Neutral
AR13	River Feale – Area of Archaeological Potential	Low	Unknown	• Palaeoenvironmental Assessment • Metal detecting Survey • Test Excavation Resolution Excavation as required	Unknown	Unknown
AR16	Townland boundary Drumloughra /Gortcurreen	Low	Imperceptible	• Topographic survey • Photographic survey • Test Excavation • Resolution Excavation as required	No change	Neutral

Site No.	Site Name	Importance	Unmitigated significance of construction impact	Mitigation Measure	Residual magnitude of construction impact	Residual significance of construction impact
AR17	Townland boundary between Gortcurreen and Garryantanvally	Low	Slight	• Topographic survey • Photographic survey • Test Excavation • Resolution Excavation as required	Low	Imperceptible
AR21	Buildings 2 (site of), Gortcurreen	Low	Slight	• Test Excavation • Resolution Excavation as required	Low	Imperceptible
AR23	Building 2 (site of), Gortcurreen	Low	Moderate	• Test Excavation • Resolution Excavation as required	Medium	Slight
AR27	Limerick & Kerry Railway (site of)	Low	Slight	• Topographic Survey • Photographic Survey	Low	Imperceptible
AR28	Building (site of), Curraghtoosane	Low	Moderate	• Test Excavation • Resolution Excavation as required	Medium	Slight
AR29	Well (site of) Curraghtoosane	Low	Moderate	• Test Excavation • Resolution Excavation as required	No change	Neutral
AR33	Building (site of), Curraghtoosane	Low	Moderate	• Test Excavation • Resolution Excavation as required	Medium	Slight
AR36	Level crossing cottage (site of), Curraghtoosane	Low	Moderate	• Test Excavation • Resolution Excavation as required	Medium	Slight
AR37	Townland boundary Curraghatoosane / Listowel	Low	Imperceptible	• Topographic survey • Photographic survey • Test Excavation • Resolution Excavation as required	No change	Neutral

12.2.7 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 Kerry and Listowel Town Council has not identified any pending or granted planning applications for major development which has 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 Slight negative.

12.2.8 Residual Impacts

A total of 35 archaeological and cultural heritage sites were identified within the study area.

After mitigation the following impacts are predicted during construction:

- *Two Moderate negative impacts (Site AR10 and Site AR11);*
- *Slight negative impacts on four sites (Sites AR23, AR28, AR33 and AR36);*
- *Imperceptible impacts on three sites (Sites AR17 and AR21, and AR27);*
- *Neutral impacts on six sites (Sites AR1, AR8, AR12, AR16 AR29, and AR37) and*
- *The significance of the residual impact on Site AR13 is unknown.*

12.3 Architectural Heritage

12.3.1 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 'Guidelines for the Assessment of Architectural Heritage Impacts on National Road Schemes' (NRA 2005b).

12.3.2 Consultation

During the preparation of this report, consultation has been undertaken with the Conservation Officer for Kerry County Council in July 2013.

(a) Baseline Data Gathering

For the purposes of the EIA, a study area was defined extending 50 m from the footprint of the proposed development.

Baseline information for this area was gathered from the following sources of information:

- *Technical reports prepared during earlier assessments of the proposed development comprising the Phase 2 Route Selection Cultural Heritage Report (Kerry County Council and Kerry National Road Design Office 2011) and the N69 Listowel Bypass Phase 2 Preliminary Archaeological Assessment (Kerry County Council and Kerry National Road Design Office 2011);*
- *The Record of Monuments and Places (RMP) and Sites and Monuments Record (SMR) for information on architectural heritage sites;*
- *The list of National Monuments in State Care: Ownership and Guardianship (EHLG & NMS, 2009);*
- *First edition Ordnance Survey 6" and 25" mapping consulted at www.osi.ie;*
- *Down Survey available on line at www.downsurvey.tcd.ie;*
- *Griffith's Valuation available on line at www.askaboutireland.ie/griffith-valuation;*
- *Manuscript and published sources held by the National Library of Ireland;*
- *Published sources and historic maps held by the Kerry Local Studies and Archives Department;*
- *Aerial photographs taken for this project;*
- *The National Inventory of Architectural Heritage (NIAH) for County Kerry;*

- *National Inventory of Architectural Heritage (NIAH) Survey of Historic Gardens and Designed Landscapes;*
- *County Kerry Development Plan 2009 for the Record of Protected Structures, Architectural Conservation Areas and relevant heritage policies;*
- *Listowel Town Development Plan 2009 – 2015 for the Record of Protected Structures and relevant heritage policies; and*
- *A site inspection undertaken between the 9th – 11th of July 2013.*

A full list of the sources consulted is provided in the References at the end of this chapter.

Due to the potential for impacts on the setting of architectural heritage sites outside the study area to arise as a result of the proposed development, data gathered for the Scoping and Route Selection Report was reviewed. During the site inspection, assessment was undertaken to identify those sites outside the study area which may be impacted by the proposed development. No additional sites were identified for inclusion as part of this process.

(b) Assessment of Importance

Based on the requirements of the NRA guidelines (NRA 2005b, 14) and informed by the guidance provided in the NIAH Handbook (DAHG 2011), an assessment of the importance of architectural heritage sites was undertaken on a five point scale of International, National, Regional, Local and Record Only. 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, Local and Record Only importance, as summarised in Table 12-11 below.

Table 12-11 Criteria for the assessment of importance for architectural heritage sites (based on DAHG 2011, 22).

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 of the area. Such structures may have lost much of their original fabric.
Record Only	Structures or sites that are not deemed to have sufficient presence or inherent architectural or other importance at the time of recording to warrant a higher rating. It is acknowledged, however, that they might be considered further at a future time.

12.3.3 Description of the Existing Environment

From the above sources, a total of sixteen Architectural Heritage sites were identified within the study area. These sites are listed in Table 12-12 below and shown on Figures 12.1.2 – 12.1.5: and detailed further in Appendix 12.2: Architectural Heritage Inventory.

(a) Baseline Conditions

Table 12-12 Architectural Heritage baseline

Site Number	Site Name	Designation	Importance
AH1	Cottage, Billeragh	None	Local
AH2	Farmstead, Coolnaleen Lower	None	Record Only
AH3	Former Labourer's Cottage, Coolanleen Lower	None	Record Only
AH4	Kilcreen Cottage	None	Record Only
AH5	Former Labourer's Cottage, Scartleigh	None	Record Only
AH6	Greenville	None	Record Only
AH7	Smithy, Greenville	None	Local
AH8	Cottage 1, Curraghatoosane	None	Local
AH9	Cottage 2, Curraghatoosane	None	Local
AH10	Lartigue Monorailway	None	Local
AH11	Teampaillin Ban	None	Regional
AH12	Monorailway Bridge	None	Local
AH13	Goods Shed	Protected Structure	Regional
AH14	5 & 6 John B. Keane Grove	Protected Structure	Regional
AH15	Listowel	Architectural conservation area	Regional
AH16	Culvert	None	Low

The study area runs through the rural landscape to the north and west of Listowel and is characterised principally by rural buildings of 19th and early 20th century date.

Kilcreen Cottage (AH4) is documented from the early 19th century when it is recorded as the residence of a gentleman named Dr Ryan. The first edition 6" Ordnance Survey map depicts the land around Kilcreen Cottage as a designed landscape. This landscape was formerly centred on a substantial house of double cross plan, with a gate lodge located at the entrance to the site from the north (AR19). This house had been significantly altered by the time of the 25" Ordnance Survey map of 1888-1913, and a single-storey mud cottage was subsequently built on its site which remains today. To the rear of the cottage is a range of substantial outbuildings including a stable and tackroom, the scale of which provides an indication of the likely status and scale of the demolished house. Few historic features associated with the designed landscape now survive, with the exception of a thick stone wall with substantial piers to the southwest of the house, and specimen trees lining the driveway. The remainder of the site now comprises pasture or arable land. In consideration of the poor preservation of the site, Kilcreen Cottage has been assessed to be of Record Only importance.

The house of Greenville (AH6) was established for the Sandes family, and is recorded from the late 18th century. A designed landscape was established around the house and is depicted on the 1st edition 6" Ordnance Survey map of 1847. A fire in the early 20th century largely destroyed the main house, with the surviving rear portions being incorporated into a single-storey building which remains to the west of the site. Today little evidence remains of the formal design of the landscape, save for some stone walls to the east of the house and the layout of the driveway. The remainder of the site is under

pasture and does not retain any historic features. In consideration of its limited architectural interest, Greenville has been assessed to be of Record Only importance.

The architectural heritage of the study area is characterised principally by rural buildings such as cottages and farmsteads dating from the late 19th and early 20th century, which are typically located in small roadside plots. Although now disused and in disrepair, the pair of cottages in Curraghatoosane townland (AH8 and AH9) reflect the characteristic form of these cottages, comprising single-storey buildings, with attics, constructed of random rubble which was formerly rendered, with a pitched roof, now covered in corrugated metal. Cottage 2 (AH9) is of interest for the presence of a finely moulded stone gateway and arch over a watercourse separating the cottage from the adjacent road. No further information on the date or function of this gateway has been identified during the course of this study. In contrast to the simple and functional design of AH8 and AH9, the cottage in Billeragh (AH1) demonstrates a more self-consciously architectural treatment, through the use of a half hipped roof and contrasting brick lintels to create a pleasing aesthetic effect. Evidence of rural industry is provided by a former smithy located in Gortcurreen dating from the later 19th century (Site AH7). This is a compact single-storey structure constructed of coursed limestone with a slate roof, set in a roadside location with a well set within the small forecourt in front of the building. These sites have been assessed to be of Local importance due to their architectural and historic interest as evidence of rural residential, agricultural and agri-industrial buildings during the late 19th and early 20th century.

The remaining rural buildings comprise former labourer's cottages in Coolnaleen Lower and Scartleigh (AH3 and AH5) both of which have been subject to extension and modernisation, detracting from their historic and architectural interest, and two surviving rubble outbuildings from a farmstead, the farmhouse of which was rebuilt in the 1940s (AH2), diminishing the interest of the complex. These three sites have therefore been assessed to be of Record Only importance.

Located to the north of John B. Keane Road, Sites AH13 and AH14 comprise a goods shed and former railway station erected to serve the Limerick and Kerry Railway in 1880. The line was closed by 1977 after which the buildings fell into disrepair, before conversion to other uses in the early 21st century. The former station building (AH14) comprises a single storey stone station building, with two-storey station master's house adjoining to the west, and retains the original awning and platform along the north elevation of the building. Architectural elaboration of the building is provided by the use of rusticated quoins, shaped barge boards and round-headed windows to the first-floor of the station master's house. The former goods shed (AH13) is constructed of coursed rubble with a pitched roof, and tall arched doorways in the gable ends for entry of locomotives. The shed is now in use as part of the restored Lartigue Monorail (see AH10 below). Both AH13 and AH14 are designated as Protected Structures, are included on the National Inventory of Architectural Heritage, and have been assessed to be of Regional importance.

The Lartigue Monorail (AH10) opened in 1888. Based on a concept developed by the French engineer Charles Lartigue for use in the deserts of Algeria, the monorail ran on a single rail supported on an A-shaped truss raised c.1 m above the ground. This form of construction enabled the rapid erection and dismantling of the line, and allowed sharper curves and gradients to be traversed than with a standard railway line. Specially adapted locomotive engines, carriages and good wagons were constructed for use on the line which distributed their weight equally to either side of the central rail. The Lartigue Monorail ran for a distance of ten miles from Listowel to Ballybunion and operated for 36 years until 1924 when, following a period of declining passenger numbers, freight levels and revenue, and following damage during the Civil War, the line was dismantled. A replica of the line was built in 2003 extending c.500 m along the original line of the monorail. Footings of the original monorail have been exposed and are now on display to the north of Site AH14, however the most substantial original monorail structure to survive within the study area comprises an overbridge constructed to carry a local road over the line (AH12). The bridge comprises abutments constructed of random coursed ashlar with a fixed deck flanked by open steel parapets. The Lartigue Monorailway (AH10) and the Monorailway Bridge (AH12) have been assessed to be of Local importance due to their historic interest as evidence of an innovative though short-lived commercial railway unique to this region.

Located adjacent to the former route of the monorail is a stone-built culvert which carries a small watercourse under the R553 (AH15). The east face of the culvert has been altered with the insertion of a concrete lintel, however the west face retains a segmental stone arch over a stone-lined channel. The route of the R553 is shown on the first edition 6" Ordnance Survey map of 1847, and it is possible that the construction of the culvert dates from the 19th century. Site AH15 has been assessed to be of Local importance.

Listowel was at the centre of an area badly affected by the famine in the mid-19th century, indeed Gaughan (1973, 148) notes that Kerry was the fifth worst affected county in Ireland. Famine victims were initially buried in Gale Cemetery, however the number of burials was such that, at the height of the famine, a new graveyard was established at Teampaillin Ban (the Little White Churchyard (AH11)), located to the northwest of the town. It is estimated that c.2700 famine victims are buried here in mass graves, slightly more than half of which were under fifteen years old.[48] The site was subsequently used for pauper burials from the local workhouse, with a further 800 individuals estimated to be buried on the site. The graveyard is reached by a narrow track from the R553, flanked by a standing Celtic-style cross at its entrance. The trackway gives access to a rectangular grassed enclosure with a tree placed at its centre, and a small modern chapel located at its western end with Stations of the Cross arranged in front of the building. The graveyard is enclosed by tall hedges to the north, south and west, and a tree-lined fence to the east. Despite its location on the edge of Listowel, the graveyard retains a sense of seclusion and tranquillity. Teampaillan Ban is designated as a Protected Structure, is included on the national Inventory of Architectural Heritage, and has been assessed to be of Regional importance.

Listowel is a traditional market town, sited on the north bank of the River Feale (AH15). The settlement originated during the medieval period, the most visible reminder of which is Listowel Castle, a substantial keep of 15th - 16th date sited on the south side of the Square, overlooking the River Feale. The town today is characterised principally by buildings of 18th and 19th century date which form a mixture of two and three-storey buildings, often of individual construction and design, arranged in continuous terraces along the street front. Facades are generally rendered, brightly painted and often ornamented with elaborate plaster decoration. This decorative plasterwork is the work of Pat McAuliffe, a plasterer working in Listowel in the late 19th and early 20th century, whose work is characterised by exuberant designs inspired by nationalism, the Celtic revival, nature and the Art Nouveau style. Public structures, in contrast, tend to be stone-faced and monumental in scale, as demonstrated by St John's Church, Listowel Bridge and the National Bank. The Square in Listowel is identified as one of the country's most prestigious urban spaces in the Listowel Town Development Plan 2009-2015 (61). Currently the town experiences traffic levels that adversely affect the amenity of historic buildings within the town centre, and resulting in noise and visual intrusion on the historic town centre. The historic town is covered by nine Architectural Conservation Areas, and contains numerous Protected Structures. For the purpose of this assessment, all nine conservation areas have been included as a single site (AH15) which has been assessed to be of Regional importance.

[48] Information from interpretation board at the cemetery.

12.3.4 Appraisal Method used for Assessment of Impacts

(a) Description of Potential Impacts

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 given provided in the EPA guidelines: (EPA 2002, 33), as listed in Table 12-13.

Table 12-13 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.

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 12-14 (EPA 2002, 33) below.

Table 12-14 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

The type of impact predicted to result from the proposed development was considered in terms of being direct or indirect, as described in Table 12-15 (NRA 2005b, 21).

Table 12-15 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.

All distances described in the text below and in the inventory are measured from the edge of the footprint of the proposed development.

(b) Magnitude and Significance of Impacts

The magnitude of impact was assessed on a five point scale of Very High, High, Medium, Low and Neutral, based on consideration of the nature of the impact (e.g. demolition, visual intrusion, enhancement of amenity etc.) as well as quality, duration and type of impact.

The significance of impact was then assessed using professional judgement, guided by the matrix presented in Table 12-16. Five levels of significance were defined which apply equally to positive and negative impacts (NRA 2005b, 32; Table 11):

Table 12-16 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
Record Only	Slight	Slight	Imperceptible	Imperceptible	No Impact

Definitions of the levels of significance for architectural heritage impacts are described in Table 12-17 overleaf (NRA 2005b, 33).

Table 12-17 Definition of Levels of Significance of Impacts for Architectural Heritage

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 it 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.

12.3.5 Predicted Impacts of the Proposed Development

(a) "Do Minimum Scenario"

The "Do Minimum" 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. Listowel will continue to be adversely affected by noise and visual intrusion, and adverse impacts on the setting and amenity of historic buildings and conservation areas within Listowel as a result of rising traffic levels within the town centre.

(b) Construction

Impacts resulting from the construction of the proposed development have been identified on the setting of eleven architectural heritage sites. No direct physical impacts are predicted on historic buildings as a result of the proposed development. Predicted impacts during the construction phase are summarised in Table 12-18. No impacts on the remaining four sites identified in the baseline are predicted during construction.

Table 12-18 Predicted construction impacts on Architectural Heritage sites

Site Number	Site Name	Importance	Magnitude of construction impact	Significance of construction impact
AH1	Cottage, Billeragh	Local	Medium	Slight
AH2	Farmstead, Coolnaleen Lower	Record Only	Low	Imperceptible
AH3	Former Labourer's Cottage, Coolanleen Lower	Record Only	Medium	Imperceptible
AH5	Former Labourer's Cottage, Scartleigh	Record Only	Low	Imperceptible
AH6	Greenville Demesne	Record Only	Low	Imperceptible
AH8	Cottage 1, Curraghatoosane	Local	Low	Imperceptible
AH9	Cottage 2, Curraghatoosane	Local	Low	Imperceptible
AH11	Teampaillin Ban	Regional	Low	Slight
AH12	Monorailway Bridge	Local	Low	Imperceptible
AH13	Goods Shed	Regional	Low	Slight
AH14	5 & 6 John B. Keane Grove	Regional	Low	Slight

During the construction phase, there will be a temporary impact on the setting of the Cottage in Billeragh Townland (AH1) due to the construction of the proposed development directly in front of the cottage and to its north, resulting in the removal of existing screening between the cottage and the road, and temporary visual intrusion from construction activities, detracting from the rural roadside setting of the cottage. The magnitude of this temporary impact has been assessed to be Medium, and the significance of impact has been assessed to be Slight.

Construction of the proposed development will result in the construction of a new roundabout junction directly to the west of the entrance to Teampaillin Ban (AH11), and a new access track linking from the roundabout to the graveyard entrance. There would be no physical impact on the gateway to the cemetery or the cemetery itself. The presence of the construction works adjacent to the cemetery entrance would result in temporary noise and visual intrusion on its setting due to construction activities and the movement of construction vehicles. Views of the construction zone would be limited to the access track to the cemetery and would be not be possible from the graveyard itself. The magnitude of this temporary impact has been assessed to be Low, and the significance of impact has been assessed to be Slight.

The proposed development will be constructed across pasture fields c.92 m to the east of the farmstead in Coolnaleen Lower (AH2). Construction of the proposed development will result in temporary noise and visual intrusion on the setting of the site due to construction activities and introduce a new element of highways infrastructure into the site's setting with the construction of the proposed development across rural fields to the east of the farm buildings. The magnitude of this impact has been assessed to be Low, and the significance of impact has been assessed to be Imperceptible.

The proposed development will result in realignment of the road to the north of the former Labourer's Cottage in Coolnaleen Lower (AH3) and construction works to the road to its east. This will result in land take from the cottage garden, increasing intrusion from highways infrastructure on the building's setting, and temporary noise and visual intrusion due to construction activities. The magnitude of this impact has been assessed to be Medium, and the significance of impact has been assessed to be Imperceptible.

Impacts on the setting of the Former Labourer's Cottage in Scartleigh (AH5) would also occur during the construction phase due to the realignment of the Greenville Road (L-1011) and construction of Side Roads 5 and 5A. This would result in temporary noise and visual intrusion from construction activities, detracting from its rural roadside setting. The magnitude of this impact has been assessed to be Low, and the significance of impact has been assessed to be Imperceptible.

Construction of the proposed development will result in land take from the southeastern edge of Greenville (AH6), the removal of a gateway and wing walls of 20th century date and mature trees flanking the entrance to the driveway. Following the use of the site for agricultural use, its importance now lies principally in its historic interest. Whilst construction of the proposed development will reduce the size of the site, this will not detract from its historic interest. The magnitude of this impact has therefore been assessed to be Low, and the significance of impact has been assessed to be Imperceptible.

Temporary impacts on the setting of the cottages in Curraghatoosane (AH8 and AH9) will result from the construction of the proposed development, including temporary noise and visual intrusion on the setting of the buildings as a result of construction activities associated with the construction of Roundabout 2, and resurfacing along the existing carriageway to the east of the cottages. The magnitude of impact on both sites has been assessed to be Low, and the significance of impact has been assessed to be Imperceptible.

The construction works along the R553 will occur directly to the west of the Monorailway Bridge (AH12), however this will not result in any physical impacts on the structure. Temporary impacts on its setting will occur during the construction phase, resulting in noise and visual intrusion from construction works; however, this will not detract from the historic interest of the structure as part of the Listowel and Ballybunion Railway (AH10). The magnitude of this impact has therefore been assessed to be Low and the significance of impact has been assessed to be Imperceptible.

It is proposed that cyclists and pedestrians will use the existing lane to the rear (north) of Numbers 5 & 6 John B. Keane Grove (AH14) and the a gap will be opened in modern stone wall to the east to allow cyclist and pedestrian access to and from John B. Keane Road. There will be a temporary impact on the setting of these properties during the construction phase. This will not result in any physical impacts on the structures.

Temporary visual and noise intrusion from construction activities will result from the proposed works. Views of the construction zone will be limited to the access track to the rear of the properties and from an oblique angle at the east. These intrusions will not detract from the historic interest of these structures (formerly the railway station for the Limerick and Kerry Railway). The magnitude of this temporary impact has therefore been assessed to be Low, and the significance of impact has been assessed to be Slight.

Temporary impacts on the setting of the Goods Shed (AH13) will also occur during the construction phase, due to the construction of a shared cycle/pedestrian path and road removal/resurfacing to south of the shed. This will result in temporary noise and visual intrusion from construction activities, detracting from the setting of this building. The magnitude of this impact has been assessed to be Low, and the significance of impact has been assessed to be Slight.

No impacts are predicted on the remaining five sites (AH4, AH7, AH10, AH15 and AH16). Whilst the proposed development crosses the former route of the Listowel and Ballybunion Railway (AH10), no physical evidence of the line now survives in this area. No impact is therefore predicted. Online improvements to John B. Keane Road will comprise resurfacing works within the existing carriageway. Due to the short timescales for these works, no impact is predicted on the Lartigue Monorailway.

A detail of the impact assessment for all sites is contained in Appendix 12.2: Architectural Cultural Heritage Inventory.

(c) Operation

Impacts during operation of the proposed development have been identified for eight architectural heritage sites. Predicted impacts from operation are summarised in Table 12-19. No impacts on the other nine sites identified in the baseline are predicted.

Table 12-19 Predicted operation impacts on Architectural Heritage sites

Site Number	Site Name	Importance	Magnitude of operation impact	Significance of operation impact
AH1	Cottage, Billeragh	Local	Low	Imperceptible
AH2	Farmstead, Coolnaleen Lower	Record Only	Low	Imperceptible
AH3	Former Labourer's Cottage, Coolanleen Lower	Record Only	Low	Imperceptible
AH5	Former Labourer's Cottage, Scartleigh	Record Only	Low	Imperceptible
AH6	Greenville Demesne	Record Only	Low	Imperceptible
AH11	Teampaillin Ban	Regional	Low	Slight
AH13	Goods Shed	Regional	Low	Slight
AH14	5 & 6 John B. Keane Grove	Regional	Low	Slight

Operation of the proposed development will result in the presence of a roundabout and reorganisation of the access to Teampaillin Ban (AH11), introducing a new element of infrastructure into the setting of the cemetery. The new road will form a prominent element in the setting of the cemetery, and increase intrusion from highways infrastructure on its setting. The magnitude of this long term impact has been assessed to be Low and the significance of impact has been assessed to be Slight.

It is proposed that cyclists and pedestrians will use the existing lane to the rear (north) of Numbers 5 & 6 John B. Keane Grove (AH14). A gap will be opened in modern stone wall to the east to allow cyclist and pedestrian access to and from John B. Keane Road. This will introduce a new element of infrastructure into the setting of these properties. The dominance of highways infrastructure will be slightly increased due to the removal of a section of wall to the east of AH14. The proposed development will also slightly increase noise intrusion onto the setting. In consideration of the historic function of these buildings as a former railway station, the magnitude of this long-term impact has been assessed to be Low, and the significance of impact has been assessed to be Slight.

The Goods Shed (AH13) will remain in a roadside setting; however, the dominance of the road in this setting will remain the same. The footpath be slightly widened to include a cycle-path and removal of the pedestrian-only pavement directly in front of the building. This will reduce the delineation between the structure and the highway, increasing the intrusion on the setting of this building. Given the original function of AH13 as a goods shed attached to the former railway infrastructure, the magnitude of this long-term impact has been assessed to be Low and the significance of the impact has been assessed to be Slight.

The Cottage in Billeragh (AH1) will remain in a roadside setting, however the dominance of the road in this setting will be slightly increased due to the widening of the roadside verges directly in front of the building. This will remove the existing vegetation screening between the structure and the highway, increasing the visibility of traffic moving along the proposed development and intrusion on the setting of this small rural cottage. The magnitude of this long-term impact has been assessed to be Low, and the significance of impact has been assessed to be Imperceptible.

The embanked road and roundabout junction will form a prominent new feature within the rural landscape setting of the farmstead and cottage in Coolnaleen Lower townland (AH2 and AH3). Visual intrusion will result from the movement vehicles along the proposed development and the lighting of the roundabout junction. Operation of the proposed development will increase the prominence of and intrusion from highways infrastructure within the rural setting of these sites, and increase noise intrusion on the setting of the Farmstead in Coolnaleen Lower (Site AH2). In consideration of the fragmentary survival of the farmstead (AH2) and the historic function of AH3 as a modest roadside labourer's residence, the magnitude of this impact has been assessed to be Low and the significance of impact has been assessed to be Imperceptible for both assets.

Impacts on the Former Labourer's Cottage in Scartleigh (AH5) will result from the presence of the realigned roads in front of the cottage, the introduction of a lit, embanked roundabout in the arable fields c.200 m to the northeast and increased traffic levels along Grenville Road directly to the north of the cottage. This will increase the prominence of roads within the setting of the cottage and diminish its rural character. The magnitude of this impact has been assessed to be Low, and the significance of impact has been assessed to be Imperceptible.

During operation, impacts on the setting of Greenville (AH6) will result from the presence of the road and lighting of the roundabout junction, increasing the intrusion from highways infrastructure within the rural landscape setting of the site. In consideration of the existing condition of the site, 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 eight architectural heritage sites during operation of the proposed development (AH4, AH7, AH8, AH9, AH10, AH12, AH15 and AH16).

Details of the impact assessment for all sites are detailed further in Appendix 12.2: Architectural Cultural Heritage Inventory.

12.3.6 Proposed Mitigation and Avoidance Measures

Measures to avoid or reduce potential impacts on architectural heritage sites have been considered throughout the route selection process and incorporated into the detailed design of the proposed development. The following additional mitigation measures are proposed for architectural heritage:

- *Woodland planting around Proposed Roundabout 3 to reduce the visual impact of the junction on the setting of Teampillain Ban (AH11).*

(a) Residual impacts

Residual impacts predicted during construction of the proposed development are summarised in Table 12-20. Residual impacts on eleven sites during construction are predicted; no impact is predicted on the remaining four sites identified in the baseline.

Table 12-20 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
AH1	Cottage, Billeragh	Local	Slight	None proposed	Medium	Slight
AH2	Farmstead, Coolnaleen Lower	Record Only	Imperceptible	None proposed	Low	Imperceptible
AH3	Former Labourer's Cottage, Coolanleen Lower	Record Only	Imperceptible	None proposed	Medium	Imperceptible
AH5	Former Labourer's Cottage, Scartleigh	Record Only	Imperceptible	None proposed	Low	Imperceptible
AH6	Greenville	Record Only	Imperceptible	None proposed	Low	Imperceptible
AH8	Cottage 1, Curraghatoosane	Local	Imperceptible	None proposed	Low	Imperceptible
AH9	Cottage 2, Curraghatoosane	Local	Imperceptible	None proposed	Low	Imperceptible
AH11	Teampaillin Ban	Regional	Slight	None proposed	Low	Slight
AH12	Monorailway Bridge	Local	Imperceptible	None	Low	Imperceptible
AH13	Goods Shed	Regional	Slight	None proposed	Low	Slight
AH14	5 & 6 John B. Keane Grove	Regional	Slight	None proposed	Low	Slight

Residual impacts during operation of the proposed development are summarised in Table 12-21. During operation residual impacts on eight sites are predicted; no impacts on the remaining seven sites are predicted.

Table 12-21 Residual operation impacts on Architectural Heritage sites

Site Number	Site Name	Importance	Unmitigated significance of operation impact	Mitigation Measure	Residual magnitude of operation impact	Residual significance of operation impact
AH1	Cottage, Billeragh	Local	Imperceptible	None proposed	Low	Imperceptible
AH2	Farmstead, Coolnaleen Lower	Record Only	Imperceptible	None proposed	Low	Imperceptible
AH3	Former Labourer's Cottage, Coolanleen Lower	Record Only	Imperceptible	None proposed	Low	Imperceptible
AH5	Former Labourer's Cottage, Scartleigh	Record Only	Imperceptible	None proposed	Low	Imperceptible
AH6	Greenville	Record Only	Imperceptible	None proposed	Low	Imperceptible
AH11	Teampaillin Ban	Regional	Slight	Landscape planting	Neutral	No Impact
AH13	Goods Shed	Regional	Slight	None proposed	Low	Slight
AH14	5 & 6 John B. Keane Grove	Regional	Slight	None proposed	Low	Slight

12.3.7 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.

Review of the online planning systems for County Kerry has not identified any pending or granted planning applications for major development which has 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 Slight negative.

12.3.8 Residual Impacts

A total of fifteen architectural heritage sites were identified within the study area.

During construction, potential impacts on the setting of nine sites were identified. After mitigation, the following residual impacts are predicted:

- *Slight impacts on four sites (AH1 and AH11, AH13 and AH14); and*
- *Imperceptible impacts on seven sites (AH2, AH3, AH5, AH6, AH8, AH9 and AH12).*

During operation, potential impacts on the setting of eight sites were identified. After mitigation, the following residual impacts are predicted:

- *Slight impacts on two sites (AH 13 and AH14);*
- *Imperceptible impacts on five sites (AH1, AH2, AH3, AH5 and AH6); and*
- *No impact on one site (AH11).*

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Ms. 2770	"*Photostat" copy of a survey by William Raymond and Thomas Ledman of Lord Kenmare's estate in the baronies of Magunihy, Clanmaurice, Corkaguiny and Iveragh, Co. Kerry, 1725. "Photostat" copies of surveys of Kenmare's estates in the barony of Smallcounty, Co. Limerick by R. Bourke, 1720, E. Vaughan, 1748 and R. Frizell, 1766.*
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13 Waste Management

13.1 Introduction

This chapter of the EIS considers and assesses the anticipated types of waste and the impacts of same, associated with both the construction and operation of the proposed development.

13.2 Description of the Existing Environment

Typical waste associated with existing roads is primarily associated with litter and maintenance of drainage waste. The waste generated by the existing N69 and John B. Keane Road would not be considered a significant quantity.

Note that the 'Evaluation of the Replacement Waste Management Plan' for the Limerick/Clare/Kerry Region 2006-2011 acknowledges that a significant decline in the amount of waste generated in Kerry County is a result of the decline in construction activity due to the economic downturn. This was replaced by the Southern Region Waste Management Plan 2015-2021 which state "Nationally the quantities of C&D waste managed peaked in 2007 and decreased year on year during the period 2007–2011, mirroring the national economic downturn." The plan outlines the bulk of the C&D waste collected was soil and stones, accounting for approximately 68%, with the remaining 32% consisting of materials such as rubble, metals, timber, plastic, glass, wood, contaminated soils and mixed C&D waste. The soil and stone waste collected within the region was primarily managed at local authority permitted infill sites, with the other C&D waste types primarily managed at EPA licensed activities. Contaminated soils are treated at appropriately licensed hazardous waste sites in the southern region.

The 'Kerry County Council County Development Plan 2015 to 2021', has a number of Objectives in relation to waste management and infrastructure however, no specific in relation to C&D waste.

13.3 Appraisal Method used for Assessment of Impacts

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 "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 below:

(a) Quality of impacts

- ***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 removing nuisances; or improving amenities);*
- ***Neutral Impact:*** *A change which does not affect the quality of the environment; and*
- ***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).*

(b) Significance of impacts

- ***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; and*
- ***Profound impact:*** *An impact which obliterates sensitive characteristics.*

(c) Duration of impacts

- ***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; and*
- ***Permanent Impact:*** *Impact lasting over sixty years.*

13.4 Predicted Impacts of the Proposed Development

13.4.1 Do Minimum Scenario

In the event that the proposed development is not progressed, it is assumed that the existing N69 and John B. Keane Road will continue to operate and function as they generally do at present. The predicted impact of the Do Minimum scenario is therefore assessed as Neutral with an imperceptible significance.

13.4.2 Do Something Scenario

In terms of the Do Something scenario, i.e. the proposed development, wastes will arise as a result of the construction of the proposed development, and to a lesser extent during the operation of the proposed development due to the increased length of road network.

13.4.3 Construction Phase Impacts

In the absence of mitigation, all potential construction phase impacts are considered Negative and Short Term.

(a) Excavated Materials / Demolished Structures

The proposed development will result in a net import of material due to the construction of the required road embankments, in particular those embankments associated with the approach to the River Feale bridge. However, approximately 64,000 m^3 of material will be removed as part of the site clearance works, the reconstructive and resurfacing works on the John B. Keane Road and topsoil strip works. It is likely that this material will be unacceptable for reuse in road embankments in fill areas, but is likely to be acceptable for reuse as landscaping material. On this basis it is estimated that approximately all of this excavated material will be reused. No existing buildings or structures will be demolished as part of the development. The impact significance of excavated material is therefore assessed as slight as the material will be reused as part of the proposed development.

(b) Pile Arisings

Soil arisings will be generated from pile bores for bridge structures. The majority of the excavated material will be soils, but the pile arisings will also contain sands and gravels. It is expected that bored pile arisings will total approximately 2,500 m^3.

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 surrounding environment.

(c) Surplus material

Surplus material and waste may occur where material supply exceeds material demand. Some surplus 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 re-used 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 be primarily associated with the production, movement and transport, processing and disposal of the materials on and off site and, if required, the disposal of the wastes at licenced/permitted facilities. On this basis, the impact significance of surplus material is assessed as Slight.

(d) Waste Management

Where waste materials are not stored, handled, transported or disposed of correctly, there is the potential for the pollution of air, soil, groundwater and/or surface waters to occur. Such effects could occur by, for example, locating unmanaged stockpiles of wastes close to watercourses or drainage networks.

On this basis, without waste management plans on site, the impact significance of waste management is assessed as Moderate due to the potential to cause pollution of the surrounding environment.

(e) Made Ground /Land Contamination

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. No significant land contamination has been identified within the study area following desk based studies and a site investigation, refer to Chapter 7: Geology, Soils and Hydrogeology.

Should previously unidentified contamination be found during the construction phase, the proposed management/mitigation measures in Section 13.5.1(e) 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.

13.4.4 Operational Phase Impacts

The main potential impacts from the operational phase of the proposed development will arise from road attenuation 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 low volume of maintenance wastes and the high proportion of such being green, biodegradable wastes.

13.5 Proposed Mitigation and Avoidance Measures

13.5.1 Construction Phase

(a) Excavated materials

It is anticipated that some of the excavated material will be acceptable for reuse in road landscaping. 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 waste facilities which will accept it. Where practicable, the closest suitable facilities to the proposed development will be selected to reduce impacts associated with vehicle movements such as air emissions.

(b) Pile Arisings

The contractor will store, handle, and transport 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, C692, 2010 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 be sampled, tested and disposed of, to a licensed waste management facility.

(c) Surplus Materials

Any surplus material generated by excavation of cuttings, which cannot be used for landscaping or as fill for road embankments, will be sampled, tested and disposed of to a licensed waste management facility.

(d) Waste Management

The contractor will ensure that any facility to which waste is brought is licensed/permitted in compliance with waste management legislation.

To manage waste arising from the proposed development a Construction and Demolition Waste Management Plan will be prepared for the provision of waste management during the construction phase of the proposed development. The plan will take into account the following guidance documents 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.*

An Environmental Operating Plan in accordance with the Guidelines for the Creation and Maintenance of an Environmental Operating Plan (NRA, 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 plans will include:

- *Appointment of an Environmental Manger by the main 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 main contractor's staff having regard to the main contractor's organisational structure;*
- *Incorporation of procedures for communicating with the public and communicating within the main 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 regard to the effectiveness of the plan.*

(e) Made Ground/Land Contamination Management/Mitigation Measures

It should be noted that no contamination was recorded within the soil at the site above assessment criteria and no asbestos was identified, see Chapter 7 Geology, Soils and Hydrogeology. Concentrations of petroleum hydrocarbons were recorded in boreholes BH104s and BH102. However, soil analyses from the boreholes and test pits detected no hydrocarbon chains above the method detection limit in the soil (See Section 7.2 Soils and Geology). These findings suggest that there are no detectable freephase hydrocarbons sitting on top of the shallow water table.

There is a possibility of encountering potential contamination (including asbestos) at the site during construction particularly in areas not previously investigated. 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 whether the soils require remediation to make them 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 to licensed hazardous material disposal facilities. 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 avoid cross-contamination of re-usable soil with contaminated material;

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 the waste;

No asbestos containing materials have been found in any of the site ground investigations. However, if previously unidentified asbestos is encountered during construction, specialist asbestos contractors will be engaged to arrange appropriate removal, testing 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.

A C1 form will required for the movement of any hazardous waste within Ireland and the trans-frontier shipment (TFS) of waste is subject to control procedures under EU and national legislation and guidance, such as the Waste Management (Transfrontier Shipment of Waste) Regulations, 2007.

13.5.2 Operational Phase

Management of wastes arising during the operational phase of the proposed development will be the responsibility of the Kerry County Council or contractors appointed to provide waste management and landscaping services.

Waste silts and hydrocarbons/oily waters collecting in the onsite drainage interceptors will be disposed of through hiring of specialist contractors as and when required. The specialist contractors will be appointed to clean out the interceptors and the waste material will be sent to a suitable licensed facility for treatment and/or disposal.

13.5.3 Residual Impacts

The residual impacts associated with the proposed development after adherence to the mitigation measures during construction phase are summarised in Table 13-1.

Table 13-1 Residual Impact after Mitigation Measures

Impact	Significance pre mitigation	Significance post mitigation
Construction		
Excavated Material	Slight	Imperceptible
Pile Arisings	Moderate	Imperceptible
Surplus Material	Slight	Imperceptible
Waste Management	Moderate	Imperceptible
Made Ground /Land Contamination	Moderate	Slight
Operation	Imperceptible	Imperceptible

13.6 Difficulties Encountered in Compiling Information

There were no difficulties encountered during the assessment of waste.

13.7 References

- *Evaluation of the Replacement Waste Management Plan for the Limerick/Clare/Kerry Region 2006-2011(2012).*

14 Material Assets

14.1 Introduction

This chapter of the EIS 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.*

This chapter provides a description of the existing major utilities and required imported material in the area, and a statement of the likely significant impacts associated with both the construction and operational phases of the proposed development on these aspects. Measures to mitigate the likely significant impacts of the proposed development are proposed, and residual impacts described. Agricultural assets are covered in Chapter 5: Agronomy and Cultural Heritage Assets are covered in Chapter 12: Archaeology and Cultural Heritage.

14.2 Description of the Existing Environment

14.2.1 Major Utilities

A number of utility providers have installations in the existing area and these are summarised below in Table 14-1.

Table 14-1 Summary of Existing Utilities in the Existing Environment

Ref No	Utility Provider	Service Type	Location	Description
1	ESB Transmission	Electrical LV Line	Section A - Ch. 30 m	10kV (low voltage)
2			Side Road 2 - Ch. 230 m	10kV (low voltage)
3			Side Road 2 - Ch. 200 m – 230 m	230V (low voltage)
4			Side Road 2A – Ch. 45 m	230V (low voltage)
5			Side Road 3 – Ch. 130 m	230V (low voltage)
6			Section B – Ch. 1,270 m	10kV (low voltage)
7			Side Road 4- Ch. 200 m	230V (low voltage)
8			Side Road 5 – Ch. 360 m	230V (low voltage)
9			Section C – Ch. 3,170 m	10kV (low voltage)
10			Section C – Ch. 3,330 m and Side Road 6.	10kV (low voltage)
11			Section C – Ch. 4,040 m	10kV (low voltage)
12			Section C – Ch. 4,440 m	230V (low voltage)
13			Section D – Ch. 5,060 m	230V (low voltage)
14			Section D – Ch. 5,150 m	10kV (low voltage)
1			Section D – Ch. 5,300 m	10kV (low voltage)
15			Ballylongford Road Roundabout	10kV (low voltage)
16	Irish Water (formerly Kerry Co Co)	Water Services	Section A – Ch. 0 m – 400 m	150 mm PVC
17			Side Road 2 - Ch. 100 m – 245 m	150 mm PVC
18			Side Road 2 – Side Road 3	New 150 mm PVC
19			Side Road 4 – Side Road 5	75 mm PVC
20			Side Road 4 – Side Road 5	600 mm Ductile Iron Rising Main
21			Section C – Ch. 3,270 and Side Road 6 – Ch.350 m – 390 m	50 mm UPVC
22			Section C – Ch. 3,430 m	600 mm Ductile Iron Rising Main
23			Side Road 7 – Ch 0 – 90 m and Section D – Ch. 160 m	100 mm PVC
24			R552 Ballylongford Road Junction	100mm PVC
25			Section D – Ch. 6,090m	100mm PVC
26			Section D – Ch. 6,270m	100mm PVC
27			Ballygologue Junction	250mm Asbestos
28			N69 Tarbert Road Roundabout	100mm PVC
29	Irish Water (formerly Kerry Co Co)	Foul Sewer	Side Road 4 – Side Road 5	600 mm A/C Sewer
30			Side Road 7 – Ch 0 – 90 m and Section D – Ch. 160 m	100 mm Ductile Iron Pumped Sewer
31			Side Road 9	Foul Sewer, Gravity
32			Section D – Ch. 5,610m	Foul Sewer
33			Section D – Ch. 5,790m/5,890m	Likely diverted from 5,790m to 5,890m
34			Section D – 6,620m Ballygologue Road Junction	250mm AC Sewer
35			Section D – Ch 6,620m – 7,057m	150mm PVC

Ref No	Utility Provider	Service Type	Location	Description
36			Section D – Ch 7,057m	9 inch Sewer
37	Various	Telecommunications	Section A - Ch. 0m - 330m. Side Road 1.	Underground & Overhead Services
38			Roundabout 1 & Side Road 2.	Underground Fiber and Overhead Services
39			Roundabout 2 & Side Road 4, 5 & 6	Overground Services
40			Roundabout 3	Underground Fiber and Underground Services
41			Section D – Ch 5000m – 5870m	Underground Fiber and Underground Services
42			Section D – Ch 5,170m	Underground Services
43			Section D – Ch 5,550m	Underground Services
44			R552 Ballylongford Road Roundabout	Underground Fiber and Underground Services
45			Section D – Ch 5900m – 7050m	Underground Fiber and Underground Services
46			Section D – Ch 6,030m	Underground Road Crossing
47			Section D – Ch 6,200m	Underground Road Crossing
48			Section D – Ch 6,260m – 6,330m	Underground Services
49			Section D – Ch 6,580m	Underground Road Crossing
50			Ballygologue Road Junction	Underground Services
51			Section D – Ch7,020m	Underground Road Crossing
52			Section C - Ch. 3,600m – Ch.4,300m	Fiber Services
53			Section D, Dwelling Access (Sect D 5,120m) and road crossing	Fiber Services
54			Section D, Dwelling Access (Sect D 5,870m)	Fiber Services
55			R552 Ballylongford Road Roundabout	Underground Fiber
56			Section D – Ch5,900m	Underground Road Crossing
57			Section D – Ch 6,705m	Underground Road Crossing

14.3 Appraisal Method used for Assessment of Impacts

14.3.1 Introduction

The assessment of the impact of the proposed development 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. Consultation was undertaken with each of the utility providers to assess the potential impact of the proposed development on their respective utilities.

14.3.2 Standards and Guidelines

The material assets assessment has been undertaken with reference to the following main standards and guidelines;

- *EPA: Guidelines on the Information to be contained in Environmental Impact Statements, 2002;*
- *EPA: Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) 2003; and*
- *NRA: Environmental Impact Assessment of National Road Schemes- A Practical Guide.*

14.3.3 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 14-2 below:

Table 14-2 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).

14.4 Predicted Impacts of the Proposed Development

14.4.1 Utilities

The proposed development will impact those utility services listed in Table 14-3. Impact to the utility 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 which has not already been considered as part of the construction phase.

14.4.2 Imported Material

A large volume of imported material will be required for the proposed development particularly for the construction of road embankments, notably those embankments on

approach to the River Feale bridge. It is anticipated that approximately 200,000 m^3 of fill material will be required.

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 in the area will be increased when transporting the imported material to site. Due to the significant volume of material to be transported to site, an approximate additional 120 heavy goods vehicles will be accessing the location of the proposed development daily over an approximate 8 month period during the construction of the main embankments. The impact significance of imported material is assessed as Moderate due to these increased heavy goods vehicle movements.

14.5 Proposed Mitigation and Avoidance Measures

The following mitigation measures will be implemented for the proposed development during the construction and operational phases.

14.5.1 Utilities

A summary of the mitigation measures for the utility services are listed below in Table 14-3.

When the mitigation is implemented, the magnitude of impact is reduced to Imperceptible as the services will have been satisfactorily diverted, and will therefore continue to operate in their current form.

14.5.2 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. These include but are 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. The impact associated with imported materials will reduce to Slight.

14.5.3 Operational Phase

As there are no operational phase impacts on utilities or imported material associated with the proposed development, no mitigation measures are required.

14.5.4 Residual Impacts

There will be an imperceptible impact on utilities during construction. Residual impacts on imported material will be Slight (during construction).

14.6 Difficulties Encountered in Compiling Information

There were no difficulties encountered in compiling information.

14.7 Cumulative Impacts and Impact Interrelations

No cumulative material assets impacts will occur as a result of the proposed development.

Table 14-3 Utility Mitigation Measures

Ref No	Utility Provider	Service Type/Description	Mitigation Measure
1	ESB	Electrical LV Line 10kV (low voltage)	Divert Existing OH line UG. UG ducting must be adequately protected. Erect 2 new poles and associated stays.
2		Electrical LV Line 10kV (low voltage)	Divert Existing OH line UG. UG ducting must be adequately protected. Erect 2 new poles and associated stays. Relocate existing fuses to pole in adjoining field.
3		Electrical LV Line 230V (low voltage)	Existing OH line from North to be removed. House supply via UG along verge from side road 2A.
4		Electrical LV Line 230V (low voltage)	Relocate existing pole outside property boundary.
5		Electrical LV Line 230V (low voltage)	Divert Existing OH line UG. UG ducting must be adequately protected. Erect new Steel Pole in verge.
6		Electrical LV Line 10kV (low voltage)	Divert Existing OH line UG. UG ducting must be adequately protected. Erect 2 new poles and associated stays.
7		Electrical LV Line 230V (low voltage)	Existing OH to remain OH. Erect 1 New Pole and 1 new Steel Pole.
8		Electrical LV Line 230V (low voltage)	Divert Existing OH line UG. UG ducting must be adequately protected. Erect 1 new pole and 1 new steel pole.
9		Electrical LV Line 10kV (low voltage)	Divert Existing OH line UG. UG ducting must be adequately protected. Erect 2 new poles and associated stays.
10		Electrical LV Line 10kV (low voltage)	Divert Existing OH line UG. UG ducting must be adequately protected. Erect 2 new poles and associated stays. Erect 1 new pole to accommodate fuses. Erect 1 new steel pole. UG supply to house to south of mainline.
11		Electrical LV Line 10kV (low voltage)	Existing OH to remain OH. Erect 1 new pole.
12		Electrical LV Line 230V (low voltage)	Divert Existing OH line UG. UG ducting must be adequately protected. Erect 1 new pole and associated stay.
13		Electrical LV Line 230V (low voltage)	Maintain service OH, check clearance and provide new poles if required.
14		Electrical LV Line 10kV (low voltage)	Divert Existing OH line UG. UG ducting must be adequately protected. Erect 1 new pole and associated stay. Maintain service OH, check clearance and provide new poles if required
15		Electrical LV Line 10kV (low voltage)	Locate and Protect Existing UG Service.
16	Irish Water (formally Kerry Co Co)	Water Services 150 mm PVC	Watermain to be relocated to verge. All fittings and connections to be marked and reinstated.
17		Water Services 150 mm PVC	Watermain to be relocated to verge. All fittings and connections to be marked and reinstated.
18		Water Services New 150 mm PVC	Link Watermain on Side Road 2 to existing service on Side Road 3 Ch 185 m
19		Water Services 75 mm PVC	Watermain to be relocated to verge. All fittings and connections to be marked and reinstated.
20		Water Services 600 mm Ductile Iron Rising Main	Ensure road crossing has sufficient cover and provide additional protection to road crossing if required.
21		Water Services 50 mm UPVC	Ensure road crossing has sufficient cover and provide additional protection to road crossing if required. All fittings and connections to be marked and reinstated.
22		Water Services 600 mm Ductile Iron Rising Main	Ensure road crossing has sufficient cover and provide additional protection to road crossing if required.
23		Water Services 100 mm PVC	Watermain to be relocated to verge. All fittings and connections to be marked and reinstated.
24		100mm PVC	Ensure road crossing has sufficient cover and provide additional protection to road crossing if required.
25		100mm PVC	Ensure road crossing has sufficient cover and provide additional protection to road crossing if required.
26		100mm PVC	Ensure road crossing has sufficient cover and provide additional protection to road crossing if required.
27		600 mm A/C Sewer	Ensure road crossing has sufficient cover and provide additional protection to road crossing if required.
28		100 mm Ductile Iron Pumped Sewer	Ensure road crossing has sufficient cover and provide additional protection to road crossing if required.
29	Kerry County Council	Foul Sewer, Gravity	Ensure road crossing has sufficient cover and provide additional protection to road crossing if required
30		Foul Sewer	Ensure road crossing has sufficient cover and provide additional protection to road crossing if required.
		Likely diverted from 5,790m to 5,890m	Ensure road crossing has sufficient cover and provide additional protection to road crossing if required. Relocate manholes to verge.
31		250mm AC Sewer	Ensure road crossing has sufficient cover and provide additional protection to road crossing if required.
32		150mm PVC	Ensure road crossing has sufficient cover and provide additional protection to road crossing if required.
33		9 inch Sewer	Ensure road crossing has sufficient cover and provide additional protection to road crossing if required.
37	Various	Underground &Overhead Services	Divert UG services to verge. Divert SR1 OH UG. Maintain service to dwelling OH. Ensure Sufficient Clearance to OH services. Chambers, Ducting and Poles per eircom requirements.
38		Underground Fiber and Overhead Services	Additional Protection to be provided for Fiber Services. Diversion at Roundabout 1. Maintain dwelling connections OH. Ensure Sufficient Clearance to OH services. Chambers, Ducting and Poles per eircom requirements
39		Overground Services	OH services UG. Maintain dwelling connections OH. Ensure Sufficient Clearance to OH services. Chambers, Ducting and Poles per eircom requirements.
40		Underground Fiber and Underground Services	Additional Protection to be provided for Fiber Services. Diversion at Roundabout 1. Chambers, Ducting and Poles per eircom requirements.
41		Underground Fiber and Underground Services	Divert Existing services to verges. Chambers, Ducting and Poles per eircom requirements. Services on Left and Right from Ch. 5,800m.
42		Underground Services	Locate and protect to Eircom Specifications
43		Underground Services	Locate and protect to Eircom Specifications
44		Underground Fiber and Underground Services	Divert Existing services to verges. Chambers, Ducting and Poles per eircom requirements.
45		Underground Fiber and Underground Services	Located in left hand verge and left hand footpath. Locate and protect. Covers to Eircom Specifications.
46		Underground Road Crossing	Locate and protect to Eircom Specifications.

Ref No	Utility Provider	Service Type/Description	Mitigation Measure
47		Underground Road Crossing	Locate and protect to Eircom Specifications.
48		Underground Services	2 Road Crossings and services in footpath on left and right hand side. Locate and protect to Eircom Sepcifications.
49		Underground Road Crossing	
50		Underground Services	Divert Existing services to verges. Chambers, Ducting and Poles per eircom requirements.
51		Underground Road Crossing	Locate and protect to Eircom Specifications.
52		Fiber Services	Additional Protection to be provided for Fiber Services. Section C Ch. 3,600m – Ch. 4,300m, Divert service to verge. Chambers and Ducting as per Irish Rail requirements. New ducting along mainline verge
53		Fiber Services	Locate and Protect to CIE Specifications. New ducting along the mainline verge.
54		Fiber Services	Road Crossings at R552 Ballylongford Road Junction. Service continues witin southern footpath. Locate and protect to CIE Specifications.
55		Underground Fiber	Additional Protection to be provided for Fiber Services. Protection as per Enet requirements
56		Underground Road Crossing	Locate and protect to Enet Specifications.
57		Underground Road Crossing	Locate and protect to Enet Specifications.

15 Inter-relationships between Environmental Factors

15.1 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. This chapter identifies the impacts of the mitigation measures included in this EIS on interdependencies in the existing environment. These interactions were integrated into the individual sub-sections from Chapters 4 to 14 of this EIS. In addition, a summary of the general interactions is presented in Table 15-1 and the detail of the interactions in Table 15-2.

Table 15-1 Relationships between the Environmental Aspects

Inter-Relationship Matrix – Environmental Elements	Socio-Economic	Flora & Fauna	Hydrology, Geomorphology and Hydromorphology	Geology, Soils & Hydrogeology	Air Quality & Climate	Noise and Vibration	Landscape and Visual	Archaeology, Cultural and Architectural Heritage	Waste	Material Assets
Socio-Economic										✓
Flora & Fauna			✓	✓		✓	✓			
Hydrology, Geomorphology and Hydromorphology	✓	✓		✓						
Geology, Soils & Hydrogeology	✓	✓	✓						✓	
Air Quality & Climate	✓	✓							✓	
Noise and Vibration	✓	✓								
Landscape and Visual	✓	✓							✓	
Archaeology, Cultural and Architectural Heritage	✓					✓	✓			
Waste	✓			✓	✓		✓			
Material Assets	✓									

Table 15-2 Explanatory Notes on the Relationships between the Environmental Aspects

Typical Inter-Relationship Matrix – Environmental Elements	Socio-Economic	Flora & Fauna	Hydrology, Geomorphology and Hydromorphology	Geology, Soils & Hydrogeology	Air Quality & Climate	Noise and Vibration	Landscape and Visual	Archaeology, Cultural and Architectural Heritage	Waste	Material Assets
Socio-Economic										Reduced amenity area, e.g. land take from Sive Walkway
Flora & Fauna			Surface water quality effect on flora and fauna	Ground water quality effect on flora and fauna		Noise disturbance to fauna	Visual impacts e.g. landscape planting and fencing for otter conservation			
Hydrology, Geomorphology and Hydromorphology	Surface water quality of streams / river e.g. River Feale	Surface water quality on flora and fauna		Pollutant pathway between surface water and groundwater (e.g. potential Karst regions in places)						
Geology, Soils & Hydrogeology	Groundwater quality and availability impacting residents with private water supplies (wells)	Local change to soil and change to groundwater quality on flora and fauna	Pollutant pathway between surface water and groundwater (e.g. potential Karst regions in places)						Waste arising from construction works	
Air Quality & Climate	Air quality changes effect on communities	Air quality effect on sensitive flora and fauna							Stockpiles and dust effects	
Noise and Vibration	Increase in noise effect on local communities	Disturbance from noise and vibration effect on local fauna.								
Landscape and Visual	Visual impact effect to amenity areas – e.g. Sive Walkway	Landscaping can effect commuting route of protect mammals							Stockpile storage effect on visual amenity	
Archaeology, Cultural and Architectural Heritage	Amenity value of heritage areas to the local community and tourism					Vibration and noise impact on heritage assets	Visual impact on nearby heritage assets			
Waste	Storage and stockpiling of material effect on the community			Waste arising from construction works such as excavated materials	Stockpiling and dust effects		Stockpiling effect on visual amenity			
Material Assets	Impacts to utilities will effect human beings									

16 Schedule of Environmental Commitments

16.1 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 EIS.

16.2 Socio-Economic

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
Socio-Economic				
1.	4.5	Signage will be installed and maintained to ensure visitors are aware of access arrangements to this feature (Sive Walk).	Impact on access to the Sive Walk	Operation

16.3 Agronomy

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
Agronomy				
2.	5.5.1	Good communication with farmers will facilitate the organisation of farm enterprises, so that vulnerable livestock are kept as far away as feasible from the construction work during critical times. To ensure this communication is facilitated between affected landowners and the contractor during the construction phase a contact person will be appointed by the contractor. This appointed person will inform members of the community directly affected by the construction phase on schedules for any activity of a particularly disruptive nature which is likely to impinge on their property (e.g. demolition, pile driving) and any mitigating actions that are being taken (e.g. shielding, restriction on work hours, etc.) to minimise such disruption to the landowners and local community.	Construction Noise and Dust	Construction
3.	5.5.1	To avoid adverse impacts to livestock from noise and dust the contractor will inform farmers affected by the construction phase on schedules for any activity of a particularly disruptive nature (i.e. demolition, pile driving) so that livestock are kept as far away as possible from the construction work during critical times.	Construction Noise and Dust	Construction
4.	5.5.2	To avoid disruption to access during construction the contractor will maintain access to sub-divided land parcels at all times during the construction of the proposed development until such time as the permanent access arrangements are in place and operational, unless agreed otherwise in writing by the landowner and / or occupier. Temporary fencing will be erected to facilitate the use of affected areas during construction	Restricted access to Sub-Divided Land Parcels	Construction
5.	5.5.3	To avoid the disturbance to drainage systems the contractor will maintain continuity of all existing ground and surface water drainage systems, such as lands drains, ditches and private outfalls, affected by the proposed development until the permanent drainage systems for the proposed development are installed and functioning satisfactorily.	Disturbance to Drainage Systems	Construction
6.	5.5.3	To avoid the disturbance to services the Contractor will maintain continuity of all existing services (e.g. electricity supply, mains water supply) affected by the proposed development until the permanent supply systems for the proposed development are installed and functioning satisfactorily.	Disturbance to Services	Construction
7.	5.6.4	The permanent boundary fence between the proposed development and the agricultural lands will consist of a timber post and rail fence that will be stockproof and timber treatment which will be appropriate for the type of livestock present. The local authority will maintain the fence along the national road element of the proposed development. It will be the responsibility of the landowners to maintain the fence along regional, local and accommodation roads.	Severance and Restricted access	Operation
8.	5.6.4	Ducting will be provided for the restoration of water and electricity supplies, with the agreement of the landowner.	Severance and Restricted access	Operation
9.	5.6.4	Access will be restored to lands where it is impacted by the proposed development. In most	Severance and Restricted access	Operation

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
		cases this is restoring existing farm access points or providing new gateways, the location of which will be with the agreement of the landowner. This is true for nine land parcels (Parcel 2, 3, 4, 8, 9a, 10, 11, 12 and 20), where the existing access point will be affected, a new access point off an existing road will be required. On land parcels where sub-division occurs the provision of an underpass is required. Three underpasses are being provided in total along the proposed development. On Farm 4, one livestock underpass is being provided. On Farm 8, one livestock underpass and one farm machinery underpass is being provided. The structures included within the design are described in Table 5-7 of this EIS. see also Figure 2.1.1 to 2.1.5		

16.4 Flora and Fauna

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
Flora and Fauna				
10.	6.6.1(a)	The mitigation measures as they relate to the protection of the Lower River Shannon cSAC during construction are detailed in the NIS see Appendix 6.4 and these will be implemented by the contractor during construction. They include • *Measures to Minimise Habitat Loss within the cSAC – the on the ground working area within the cSAC will be clearly delineated and fenced off at the outset of works and maintained for the duration of the construction programme to minimise the on the ground working area within the cSAC boundary. No works on the grond within the cSAC boundary will be undertaken outside of this clearly delineated zone. No Annex I or qualifying interest habitats exist within the delineated zone.* • *Mitigation Measures to Reduce the Potential for Impacts to Water Quality in Receiving Watercourses - prior to commencement of construction, the contractor will implement a range of measures through a detailed Erosion and Sediment Control Plan (dESCP) based on the preliminary ESCP contained in Appendix 8.5 to ensure protection of the receiving water environment.* • *Monitoring during Construction for Impacts to Water Quality in Receiving Watercourses – this will be carried out as outlined in the preliminary ESCP contained in Appendix 8.5. This monitoring programme will be required at the pre-construction and construction stage to monitor water quality up and downstream of the proposed crossing points (River Feale, WF0, WF1, WF4 and WF5) to confirm the baseline water quality conditions prior to the construction. The construction stage monitoring results will be compared with those results established in pre-construction monitoring to allow the contractor to demonstrate the success of the mitigation measures employed. In the event that monitoring indicates a reduction in water quality, works in the vicinity of the River Feale will cease, sampling will be immediately undertaken and an investigation of the potential cause will be undertaken by the contractor, see Appendix 8.5.* • *Mitigation Measures to Control and Prevent the Spread of Invasive Plant Species - all invasive plant species will be permanently removed from the working area at the construction stage in accordance with the Guidelines on the Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads (National Roads Authority, 2010) ensuring that any established populations present within the boundary of the proposed development are not caused to spread in undertaking works. An Outline Invasive Species Management Plan has*	Impacts on the Lower River Shannon cSAC	Construction

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
		been prepared (see Appendix 6.8) and will be implemented sufficiently far in advance of the proposed construction works commencing so as to allow time to adequately control all invasive species populations within the zone of influence of the proposed development, having regard to the specific timing/seasonal constraints that apply in relation to each individual species. As species may spread, or their distribution change, between the habitat surveys carried out for this EIS and the commencement of construction works, the implementation of the Outline Invasive Species Management Plan will include a pre-construction re-survey within the CPO boundary. In accordance with the NRA guidance (NRA, 2010) this survey will include accurate 1:5,000 scale mapping for the precise location of invasive species. The pre-construction surveys will be undertaken by suitable experts with competence in identifying the species concerned.		
11.	6.6.1(a)(i)	Prior to commencement of construction, the contractor will implement a range of measures through a detailed Erosion and sediment Control Plan (dESCP) based on the preliminary ESCP contained in Appendix 8.5 to ensure protection of the receiving water environment. A water quality monitoring programme will be implemented by the contractor as detailed in in the preliminary ESCP contained in Appendix 8.5. The construction contractor will implement the following mitigation measures, via the detailed Erosion and Sediment Control Plan, (see also the Preliminary Erosion and Sediment Control Plan in Appendix 8.5): • *A temporary impervious barrier will be installed to ensure that all works associated with the bridge pier construction at the River Feale are protected against the 1:100 year return period flood event to ensure that there is no hydraulic connectivity between the temporary works and the River Feale during construction (see Appendix 6.4 NIS Figure 8: River Feale Temporary Works);* • *Suite of measures to prevent the release of sediment over baseline conditions[49] to the River Feale, Galey River (or their tributaries) during the construction work. Baseline conditions will be established in accordance with details provided in Chapter 8 Hydrology, Geomorphology & Hydromorphology and more specifically the preliminary ESCP contained in Appendix 8.5. These measures will include but not be limited to silt fences, silt curtains, settlement lagoons, filter materials, and stockpile seeding;* • *Suite of measures to minimise the release of sediment from the newly excavated attenuation and constructed wetland areas to the River Feale, Galey River (or their tributaries) These measures will include but not be limited to silt fences, silt curtains, settlement lagoons, filter materials, and stockpile seeding;* • *Suite of measures to minimise the displacement and subsequent erosion and release of soft sediment during bridge and structure installation works. These measures will include but not be limited to silt fences, silt curtains, settlement lagoons, filter materials, and stockpile seeding;* • *Suite of measures to handle, store and re-use where feasible material removed from the bank of the River Feale;* • *Provision of exclusion zones and barriers (sediment fences) between earthworks, stockpiles and temporary surfaces and watercourses to prevent sediment washing into watercourses, or into drainage features that are*	Impacts to the Water Quality of the Cashen River Estuary pNHA	Construction

[49] Baseline suspended sediment levels in the River Feale will be established as outlined in Chapter 8 Hydrology, Hydromorphology and Geomorphology.

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
		connected to watercourses; • *Temporary construction of surface drainage and sediment control measures will be in place before earthworks commence;* • *Pouring of cement based materials 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 discharges to watercourses, or to drainage features that are connected to watercourses. Mixer washings and excess concrete will not be discharged to any surface water or drainage features;* • *No storage of hydrocarbons or any polluting chemicals will occur within 50 m of a 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 trained in the emergency procedures;* • *Implementation of measures to minimise waste and ensure correct handling, storage and disposal of waste (most notably wet concrete, pile arisings and asphalt);* • *Response measures for potential pollution incidents;* • *Methods to stabilise watercourse banks that have been cleared of vegetation;* • *Maintenance of machinery to be used in-stream; and* • *Removal and replacement of stream bed material in diverted watercourses;* *See also Chapter 8 Hydrology, Geomorphology & Hydromorphology mitigation.*		
12.	6.6.1(a)(i)	The mitigation strategy in relation to invasive plant species is based on the *Guidelines on the Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads* (National Roads Authority, 2010a) with the objectives of permanently removing all invasive plant species from the working area and preventing the spread of any established populations present with the boundary of the proposed development. An Outline Invasive Species Management Plan has been prepared (see Appendix 6.8) and will be implemented sufficiently far in advance of the proposed construction works commencing so as to allow time to adequately control all invasive species populations within the zone of influence of the proposed development, having regard to the specific timing/seasonal constraints that apply in relation to each individual species. The Outline Invasive Species Management Plan will need to be revised and finalised by the appointed contractor once precise methods of control identified in the Outline Invasive Species Management Plan are determined. The final Invasive Species Management Plan assist the construction contractor in implementing the specific mitigation measures required in relation to individual invasive plant species. As species may have spread, or their distribution may have changed, between the habitat surveys carried out for this EIS and the commencement of construction works, the implementation of the Outline Invasive Species Management Plan will include a pre-construction re-survey within the CPO boundary. In accordance with the NRA guidance (NRA, 2010) this survey will include accurate 1:5,000 scale mapping for the precise location of invasive species. The pre-construction surveys will be undertaken by suitable experts with competence in identifying the species concerned.	Designated Sites (the Cashen River Estuary pNHA) specifically the spread of Invasive Species	Construction
13.	6.6.1(c)	Any trees, hedgerows or scrub adjacent to, or within, the development boundary which are to be retained shall be afforded adequate protection during the construction phase in accordance with the *Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub Prior to, During and Post Construction of National Road Schemes* (National Roads Authority, 2006b), as follows:	Habitats - Impacts on Treelines, Hedgerows and Scrub	Construction

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
		• *All trees along the proposed development boundary that are to be retained, both within and adjacent to the development boundary (where the root protection area of the tree extends into the proposed road development boundary), will be fenced off at the outset of works and for the duration of construction to avoid structural damage to the trunk, branches or root systems of the trees. Temporary fencing will be erected at a sufficient distance from the tree so as to enclose the root protection area (RPA) of the tree. In general the RPA covers an area equivalent to a circle with a radius 12 times the stem diameter (measured at 1.5 m above ground level for single stemmed trees, or above the root flare for multi-stemmed trees);* • *Where fencing is not feasible due to insufficient space, protection for the tree/hedgerow will be afforded by wrapping hessian sacking (or equivalent) around the trunk of the tree and strapping stout buffer timbers around it.* • *The area within the RPA will not be used for vehicle parking or the storage of materials (including soils, oils and chemicals). The storage of hazardous materials (e.g. hydrocarbons) or concrete washout areas will not be undertaken within 10 m of any retained trees, hedgerows and treelines;* • *A qualified arborist shall assess the condition of, and advise on any repair works necessary to, any trees which are to be retained or that lie outside of the proposed development boundary but whose RPA is impacted by the works. Any remedial works required will be carried out by a qualified arborist;* • A buffer zone of at least 5 m will be maintained between construction works and retained hedgerows to ensure that the root protection areas are not damaged.		
14.	6.6.1(d)(i)	The hedgerow/treelines which contain badger setts S2, S3, S4, S4a and S22 are to be retained (see ecology mitigation figures 6.1.29 – 6.1.33). The mitigation measures that apply in relation to each Badger sett within the ZoI of the proposed development are provided in Table 6-23 of this EIS.	Protected Mammals- Badgers	Construction
15.	6.6.1(d)(i)	The hedgerow/treeline which contains otter holts are to be retained (see ecology mitigation Figures 6.1.29 – 6.1.32). The mitigation measures that apply in relation to the potential Otter holt sites within the ZoI of the proposed development are provided in Table 6-24 of this EIS.	Protected Mammals- Otters	Construction
16.	6.6.1(d)(ii)	The following mitigation measures are proposed in relation to those trees identified as having the potential to support roosting bats: *Trees with Features of High to Moderate Suitability for Roosting Bats:* Only one tree impacted by the proposed development is considered to have high or moderate suitability for roosting bats, with obvious potential roosting features present. Bats could occupy suitable roosting features at any time prior to the commencement of works. Therefore there is an inherent risk that bats could be affected by the proposed works. Tree felling will be undertaken during the period May to September as during this period bats are capable of flight and can avoid the risks of tree felling if proper measures are undertaken. If trees are to be felled during this period a dawn and dusk detector survey will be carried out on the night immediately preceding the felling operation to ensure that there are no bats present. If there is any indication that there is a maternity roost present, then the trees will not be felled from June through to mid-August to ensure that breeding populations of bats are protected. Such trees will be felled using heavy plant to push over the tree. In order to ensure the optimum warning for any roosting bats that may still be present, the tree will be pushed	Impacts on Trees with Bat Roosting Potential	Construction

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
		lightly two to three times, with a pause of approximately 30 seconds between each nudge to allow bats to become active. The tree will then be pushed to the ground slowly and will remain in place until it is inspected by a bat specialist. If the tree is to be felled by chainsaw, it is important to ensure that the rate of fall is not accelerated by the use of a chain and vehicle (e.g. tractor). It is unlikely that a bat would survive such a heavy impact. Where possible the tree shall be felled in sections with a bat specialist present to check the tree sections on the ground for bats prior to removal or mulching. *Trees with Features of Low Suitability for Roosting Bats:* These trees are considered to have some features present, which may have limited potential to support roosting bats. These trees will be control felled using heavy plant to push over the tree. Where this is not possible and trees must be felled with a chainsaw, it is important to ensure that the rate of fall is not accelerated by the use of a chain and vehicle (e.g. tractor), as it is unlikely that a bat would survive such a heavy impact. Once these trees are on the ground, they will be left *in-situ* for a period of at least 24 hours to allow any bats that may be present to escape. Where remedial works (*e.g.* pruning of limbs) is to be undertaken to trees considered suitable for roosting bats, the affected sections of the tree will be checked by a bat specialist for potential roost features before removal. For limbs high in the tree canopy, this will necessitate the lowering of the limb to the ground (with the potential roost feature intact) for inspection by the bat specialist before it is cut up or mulched. If bats are found to be present, they will be removed by a bat specialist licenced to handle bats and released in the area the next night. If a bat roost is confirmed, and will be removed by the proposed works, then appropriate alternative roosting sites will be provided in the form of bat boxes erected on suitable trees in the vicinity. The type and siting of any bat boxes required will be determined by the bat specialist at that time. Removal of any confirmed bat roosts must be undertaken under derogation licence from the NPWS.		
17.	6.6.1(d)(iv)	If works to clear the drainage ditches are to begin during the season where frogspawn/tadpoles may be present (February – July) a pre-construction survey will be undertaken to determine whether breeding amphibians are present. If found to be present, the species will be removed by hand net and translocated to the nearest available habitat that is suitable, under licence from the NPWS. There is an abundance of suitable receptor habitat in the immediate locality in the form of field boundary drainage ditches and the bog complex which lies *c.* 600m to the north-west. This will be monitored and reported to the NPWS.	Impacts to the Common frog	Construction
18.	6.6.1(d)(vii)	Vegetation (e.g. hedgerows, trees, scrub and grassland) will not be removed, between the 1st March and the 31st August, to avoid impacts on nesting birds. Although the Wildlife Acts provide an exemption from this seasonal restriction to vegetation removal for approved road construction, there is no exemption provided for the destruction of nest sites. Where the construction programme does not allow this seasonal restriction to be observed, then these areas will be inspected by a suitably qualified ecologist for the presence of breeding birds prior to clearance. Where nests are present, a licence may be required for removal of vegetation containing these nests. Areas found not to contain nests must be cleared within 3 days of the survey, otherwise repeat surveys will be required.	Impacts on Breeding Birds	Construction

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
		With regards to sand martins, which were observed nesting within the vicinity of the proposed crossing of the River Feale at Finuge, it is proposed that substantive works commence at the river between 1st October and 28th February. Where this seasonal restriction cannot be adhered to (e.g. due to elevated water levels), it is proposed that a licence application will be submitted to the NPWS to permit the temporary obstruction of the sand martin nests and the remaining area of suitable nesting habitat along the bank of the River Feale. The temporary obstruction of the nests and suitable habitat would commence outside of the bird breeding season to avoid directly impacing on breeding birds.		
19.	6.6.1(d)(viii)	The following measures will be implemented to mitigate the potential for impacts to fish species: • *maintaining water quality in the surface water network;* • *maintaining fish passage at the proposed crossing points of watercourses (with regard to the design of both temporary installations and permanent structures);* • *maintaining or in the case of realigned sections of stream/river channel, reinstating, the existing profile and character of the river channel at each of the proposed crossing points (substrate, gradient, riparian vegetation etc.)* All works will be carried out in accordance with the requirements of IFI as set out in *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (Inland Fisheries Ireland, 2016). Instream works will only be carried out during the period May to September (inclusive). Any instream works outside of this period must be agreed in writing with IFI. The realignments proposed for the Mill Stream Lower (200 m section) and the Ballygrenane Stream (45 m section) will be designed in accordance with the requirements of IFI.	Impacts on Fish Species	Construction
20.	6.6.2(a)	The mitigation measures as they relate to the protection of the Lower River Shannon cSAC during operation are detailed in the NIS in Appendix 6.4 of the EIS and these will be implemented by the contractor, the propose development design and the local authority as required.	Impacts on the Lower River Shannon cSAC	Operation
21.	6.6.2(c)	If found to be present vegetation in the affected area shall be treated *in-situ* to remove the plant species. If maintenance must be carried out before the invasive species is eradicated, then contaminated material will be dealt with in accordance with the handling and disposal measures described in the *Guidelines on the Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads* (National Roads Authority, 2010a) or, in the case of species not covered under this guidance, the accepted published best practice methods available at the time. The full control measures are detailed in the Outline Invasive Species Management Plan in Appendix 6.8.	Spread of Invasive Plant Species during routine maintenance works	Operation
22.	6.6.2(d)(i)	To avoid badger road casualties mammal underpasses will be provided at strategic locations along the alignment of the proposed development. Underpasses will be constructed in accordance with the *Guidelines for the Treatment of Badgers during the Construction of National Road Schemes* (National Roads Authority, 2006c). Where engineering constraints conflict with the recommended locations, underpasses can be moved to the nearest most suitable location, but not more than *c.*250 m away. The locations where Badger passage facilities will be provided are listed	Protected Mammals - Badgers	Operation

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
		below in Table 6-26 and are shown on Figures 6.1.29-6.1.32 in Volume 3 of this EIS. Mammal-resistant fencing will be required to guide badgers to the underpasses and will be installed in accordance with the specification outlined in the guidance listed in Section 6.2.1 (a)(ii) and will include badger proofing of emergency access roads and other similar access points, where located along areas where badger fencing is to be installed. The locations where mammal-resistant fencing is to be installed are shown on Figures 6.1.29-6.1.32 in Volume 3 of this EIS. In accordance with the recommendations described in the *Guidelines for the Treatment of Badgers during the Construction of National Road Schemes* (National Roads Authority, 2005), quarterly monitoring of the effectiveness of the mitigation measures will be undertaken in the first year after the completion of construction works.		
23.	6.6.2(d)(i)	To avoid otter road casualties, otter passage facilities (raised ledges within structures or separate dry 600 mm pipes) will be provided at watercourses used by otter. Underpasses will be constructed in accordance with the *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes* (National Roads Authority, 2008b). The locations where Otter passage facilities will be provided are listed above in Table 6-26 and are shown on Figures 6.1.29-6.1.32 in Volume 3 of this EIS. Otter-resistant fencing will be required to guide Otters to the underpasses and will be installed in accordance with the specification outlined in *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes* (National Roads Authority, 2008b) and at the request of the NPWS will include the 45-degree overhang specified by the UK Highways Agency, (2001a). Quarterly monitoring of the effectiveness of the mitigation measures will be undertaken in the first year after the completion of construction works.	Protected Mammals - Otters	Operation
24.	6.6.2(d)(ii)	Areas where replacement or supplementary planting is required for bats is detailed on Figures 6.1.29-6.1.32 in Volume 3 and are shown on the landscape drawings (Figures 11.1.5 to 11.1.7) of this EIS.	Habitat Loss on Bats	Operation
25.	6.6.2(d)(ii)	Artificial light can create a barrier to commuting bats and can displace bats from important feeding areas. As such, lighting will be kept to a minimum along the proposed development, designed to meet the lowest light levels permitted under health and safety standards, and confined to areas where it is required for health and safety reasons. The proposed new River Feale Bridge and the surrounding river corridor will not be lit. Where lighting is required, directional lighting (using accessories such as cowls, louvres and shields) shall be used to focus light onto areas where it is needed and minimise the amount of light spill into habitats adjacent to the finished road surface. In areas where a lighting impact is likely (Proposed Roundabout 1 and Proposed Roundabout 2) landscape planting will serve to replace the vegetation being lost and reduce the effects of any light spill.	Effects of lighting on Bats	Operation
26. 6.6.2(d)(vii)	6.6.2(d)(vii)	Planting of woodland, hedgerow and grassland habitats along the proposed development as detailed in the landscape drawings (Figure 11.1.5 to 11.1.7) will provide compensatory habitat for some bird species, but many species may not nest within the vicinity of a road development due to drowning out of bird song by traffic noise. A total of 20 nest boxes will be erected by an ecologist in suitable locations away from the busy	Impact of Disturbance Breeding Birds	Operation

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operation
		junctions/roadways. A total of 20 nest boxes will be erected by an ecologist on trees away from the busy junctions/roadways. The siting and type of nest boxes will be decided on by an ecologist at locations where trees will be planted along the proposed development; as shown on the Landscape and Visual Assessment drawings.		
27.	6.6.2(d)(vii)	In areas where there is a high probability that barn owls will regularly attempt to cross the proposed development , lines of closely spaced (approximately 2 m centres) trees, greater than 3 m in height, will be planted along the top of the road embankments; outside of the safety barrier and clear zone as shown on Figures 6.1.28 – 6.1.33 (and refer to typical cross-section sketches in Appendix 9.10). The intention of this mitigation measure is to deflect the flight path of barn owls above the height of traffic. Sections along the proposed development where the road is on embankment, will be planted with dense low growing scrub cover (*e.g.* native species such as hawthorn, blackthorn, gorse etc.), while grass verges will be maintained short through an intensive mowing regime. Both of these measures are proposed to discourage barn owls from foraging near the road. All mitigatory planting will be in place at the earliest feasible stage during construction to ensure that the mitigation is implemented before opening of the road. The locations where planting will be used to reduce the risk of barn owl mortality from road traffic are shown on Figures 6.1.29-6.1.33 in Volume 3 and on the landscape drawings (Figures11.1.5 to 11.1.7). Refer to typical cross-section sketches in Appendix 6.10. Following implementation of all mitigation measures and completion of construction of the proposed development, the following monitoring measures are proposed: • *Surveys will be undertaken of roadside planting schemes at the end of years one and two with the objective of identifying and replacing failed plantings.* • *A road casualty survey to record barn owl mortalities along the proposed route will be conducted once per week for a period of two years by a suitably qualified and experienced ornithologist. The bypass route will be driven at a steady pace in both directions so that all sections and both sides of the route will be covered. Where noted, all barn owl mortalities will be assigned to either the "breeding" season (March to July) or "non-breeding" season (August to January). Location details of the casualty will be recorded, including a 10-digit GPS co-ordinate, position on the route (central median, hard shoulder, or verge) and orientation (southbound, northbound, eastbound, and westbound). The age class of the bird will be determined and classed as either "pre-breeding" if first or second calendar year recovered before March, or "adult" if the bird is second calendar year recovered later than March or older. The adjacent habitat feature will be noted. This methodology is in line with that utilised for Barn Owl population status and the extent of road mortalities in relation to the Tralee Bypass (O'Clery et al., 2016);* • *Monitoring to determine activity and breeding status of all active sites within 5km of the proposed development over two breeding seasons (March to July). This will be carried out concurrently with the road casualty survey, and will involve visits to known and potential nesting sites to determine brood size and breeding success. Where accessible, nests will be visited in order to ring owlets (subject to an appropriate licence from the NPWS).* A report summarising the findings of the above monitoring will be submitted at the end of year two to the the NPWS. The report may include further recommendations pending survey outcomes.	Measures to Reduce the Risk of Barn Owl Mortality from Road Traffic	Operation

16.5 Geology, Soils and Hydrogeology

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
Soils, Geology and Hydrogeology				
28.	7.2.5	For all aspects of the construction phase of the proposed development, the contractor is required to produce a site and work specific Environmental Operating Plan (EOP) for all construction activities. This will be produced in line with the 'Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan (NRA 2007)'. In line with this guidance, the contractor will also be required to maintain a construction and demolition waste management plan.	Pollution of groundwater bodies	Construction
29.	7.2.5(a)(i)	Ground engineering solutions will be required where peats and compressible soils are present to avoid excessive settlement.	Differential Settlement	Construction
30.	7.2.5(b)(i)	To mitigate the risk to human health the contractor the contractor will apply best practice control measures such as correct use of Personal Protective Equipment (PPE), adoption of good working practices and appropriate health and safety risk assessments. To mitigate the risk to human health from contaminated land if any significant areas of suspect contamination are identified through visual or olfactory evidence during the construction works, then representative samples will be taken by a suitably qualified person and sent for laboratory analysis, in order to determine the risk to receptors and the potential for reuse within the proposed development or disposal off site. If significant contamination is found where ground works cannot be avoided, then the material will be taken off-site (for disposal in an appropriate waste treatment facility) and replaced with clean material prior to any groundwork commencing. The contractor will produce an Environmental Operating Plan (EOP) detailing the response procedure to be undertaken in the event of encountering significant land contamination. Based on the ground investigation findings, asbestos was not detected in any of the locations. However, the potential to encounter asbestos cannot be ruled out if contaminated material is encountered. To mitigate the risk to Human Health from exposure to asbestos prior to the construction works, a response procedure will be developed in the event that suspected asbestos is identified during construction works. To prevent the importation of contaminated and unsuitable fill materials to the site, representative sampling of imported materials and materials excavated from the site (other than materials known to be uncontaminated) for re-use within the proposed development, will require chemical contamination testing for a range of soil and soil leachate analytical suites and assessed against the limit values for surface and groundwater features and human health. For materials to be acceptable for either importation to site or re-use of excavated materials within the proposed development, the chemical testing results must be below the specified limits for risk to human health and surface and groundwater features. There is potential for construction workers to encounter and inhale ground gases when undertaking works in potential confined spaces particularly in areas where peat and alluvial deposits are present. To mitigate the risk to human health from exposure to ground gases a procedure for working in confined spaces will be developed by the contractor as part of the health and safety risk assessment process for the works.	Risk to human health – Construction workers	Construction
31.	7.2.5(b)(ii)	Maintenance works are anticipated to be carried out periodically along the route during operation and may require occasional work in confined spaces. No significant risk associated with ground gases are expected however, the potential for maintenance workers to encounter	Risk to Human Health – Maintenance Workers	Operation

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
		and inhale ground gases when undertaking works in confined spaces such as culverts cannot be completely ruled out. To mitigate the risk to human health from exposure to ground gases during maintenance a procedure for working in confined spaces should be developed by the maintenance contractor a as part of the health and safety risk assessment process.		
32.	7.3.4(a)(i)	To avoid impacts to groundwater or groundwater fed attributes from piling activities piling will be completed in accordance with Environment Agency (England and Wales) (2001) Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention. Although no contamination has been identified in the areas to be piled based on the available ground investigation date and desk study undertaken, the below mitigation measures are included in the event of encountering contamination not identified during the ground investigation works: • *A piling risk assessment will be developed by the Contractor;* • *In the event of potential contamination being found, remediate shallow groundwater prior to piling;* • *Immobilise or remediate potential contaminants in soil through which piles pass;* • *Isolate potential contamination around piles from groundwater flow and infiltration (e.g. surface cover, in ground barriers);* • *Use of bentonite during boring or driving;* • *Grout pile or stone column after installation;* • *Use of a permanent or temporary casing; and* • *Use piles with pointed or convex butt ends or driving shoes.*	Groundwater flow disturbance and groundwater contamination	Construction
33.	7.3.4(a)(ii)	Contaminated groundwater will not be discharged on site and will be tankered off site to an licenced facility.	Ground and surface water contamination	Construction
34.	7.3.4(a)(iv)	Works will comply with the following guidelines; • *CIRIA (2002). Control of Water Pollution from Construction Sites - Guide to good Practice; and* • *Working at Construction and Demolition Sites: PPG6 – Pollution Prevention Guidelines (available at* http://www.environment-agency.gov.uk *)* Temporary construction surface drainage and sediment control measures will be in place before earthworks commence. Groundwater intercepted at the proposed underpass ST11 will be tested and if found to be contaminated will need to be tankered off site to an appropriate facility. No storage of hydrocarbons or any toxic chemicals will occur within 50 m of a 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 procedure; and.	Ground and surface water contamination	Construction
35.	7.3.4(a)(v)	In addition to the mitigation measures proposed, the water quality of wells PWS W03, W05 and W06 will be monitored and analysed monthly for quality purposes by the contractor prior to the commencement of and during the construction works to ensure no detrimental affects to these supplies. The groundwater quality during construction will be compared to the EIS and pre-construction monitoring result on a monthly basis by the contractor in the form of analysis by a suitably qualified hydrogeologist. This assessment will be undertaken and sent to the client representative on a monthly basis for review. Any operational well (PWS W03, W05 and W06) whose quality has been deemed to be adversely impacted by the construction activities will be replaced or connection to the mains water supply will be provided by the	Disturbance to Private water supplies	Construction

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
		contractor, subject to agreement with the landowner.		
36.	7.3.4(b)(i)	To avoid impact to groundwater resources from road runoff during the operation of the proposed development: • *The road drainage network will be lined in its entire length. Oil interceptors will be installed before the construction of the attenuation ponds on all six outfalls;* • *The attenuation ponds and the constructed wetlands will be lined and have a penstock valve to contain any accidental spillage;* • *A contaminant spill emergency plan will be put in place to contain, remove or remediate any catastrophic spill before it reaches any groundwater or surface water receptor. Emergency equipment/spill kits to facilitate the implementation of such plan will be made available in secured locations within the area; and* • *The water quality of wells PWS W03, W05 and W06 will be analysed monthly as carried out during the construction phase during the first year of the proposed developments operation.*	Pollution of groundwater bodies by carriageway run off	Operation

16.6 Hydrology, Geomorphology and Hydromorphology

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
Hydrology, Geomorphology and Hydrogeomorphology				

37.	8.2.10(a)	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); and*
		• *'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";*
		• *UK Environment Agency:*
		  ○ *PPG5 Pollution Prevention Guidelines Works and Maintenance in/ or near Water.*
		  ○ *PPG21 Incident Response Planning*
		  ○ *PPG22 Dealing with Spills*
		  ○ *PPG26 Drums and Intermediate Bulk Containers*
			Pollution of watercourses	Construction

38.	8.2.10(a)	The Local Authority shall employ an Environmental Assurance Officer (EAO) who will be based on-site for the duration of the construction works and will form part of the Employer's Site Representative Team. The EAO shall have suitable environmental qualifications. The Local Authority will ensure that the EAO is delegated sufficient powers under the construction contract so that he/ she will be able to instruct the contractor to stop works and to direct the carrying out of emergency mitigation/ clean-up operations. The EAO will also be responsible for consultation with environmental bodies including the NPWS and IFI. The EAO shall be responsible for carrying out regular Audits of the Contractor's EOP on behalf of the Local Authority. To avoid the pollution of watercourses during the construction phase a preliminary Erosion and Sediment Control Plan (pESCP) has been developed and is contained in Appendix 8.5. This pESCP is intended to be a working document and will be updated by the contractor to	Pollution of watercourses due to sediment/silt release	Construction

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
		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 and this will be subject to approval by the Local Authority. 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: • *Provision of measures to prevent the release of sediment concentrations over baseline conditions to the River Feale 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 WF0, WF1, WF4 and WF5. These measures will include but not be limited to silt curtains, settlement lagoons, filter materials and stockpile seeding; and* • *Provision of exclusion zones and barriers (sediment fences) between earthworks, stockpiles and temporary surfaces and watercourses to prevent sediment washing into the watercourses.* • *A temporary impervious barrier will be installed to ensure that all works associated with the bridge pier construction at the River Feale are protected against the 1:100 year return period flood event to ensure that there is no hydraulic connectivity between the temporary works and the River Feale during construction, see Appendix 8.5.* • *No waste material will be discharge into any watercourse during the works.* • *Temporary construction surface drainage and sediment control measures will be in place before earthworks commence.* • *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.* • *No storage of hydrocarbons or any toxic chemicals will occur within 50 m of a 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.* • *Works within and adjacent to watercourses will only be conducted during forecast low flow periods.*		
39.	8.2.10(a)	The contractor shall consult with the NPWS and IFI in relation to the dESCP and shall include their requirements in this regard.	Pollution of watercourses due to sediment/silt release	Construction
40.	8.2.10(a)	To avoid potential impacts on the water abstraction point the contractor will liaise with Kerry County Council Water Services Division and/or Irish Water on a weekly basis 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 River Feale Bridge; and* • *Construction works within and adjacent to watercourses including provision of culverts and watercourse realignments.*	Pollution of watercourses due to sediment/silt release	Construction
41.	8.2.10(a)	Contact will be made by the contractor with permission of the Local Authority with the Kerry County Council Water Services Division, Environment Division and Irish Water immediately in the event of a spillage or other pollution risk to the River Feale. This shall be detailed in the contractor's emergency plan and will include contact names and telephone numbers. The emergency plan will form part of the overall contractor's EOP.	Pollution of watercourses	Construction

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
42.	8.2.10(a)	As requested by the IFI during consultation, the following measures will apply during the construction stage: • *The contractor shall ensure that the construction methodologies used will ensure no wastes will be discharged to the Feale; and* • *Consultation will be undertaking with the IFI prior to any advanced works including archaeological.*	Pollution of watercourses	Construction
43.	8.2.10(a)(i)	A monitoring programme will be required at the pre-construction and construction stage. Pre-construction water quality monitoring will be undertaken once a week for a six 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 proposed crossing points (River Feale, WF0, WF1, WF4 and WF5) to build upon the baseline monitoring carried out a the EIA stage and in order to further establish the baseline water quality conditions prior to the construction. For turbidity, pH, DO and temperature samples will be taken in situ, samples for Suspended Sediments and hydrocarbons will be sent to an accredited laboratory for analysis.	Pollution of watercourses due to sediment/silt release	Pre-Construction
44.	8.2.10(a)(i)	Weekly during construction the contractor will monitor the levels of TSS, turbidity, pH, temperature, DO and hydrocarbons at locations to be agreed with Kerry County Council upstream and downstream 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 River Feale Bridge; and* • *Construction works within and adjacent to watercourses including provision of culverts and watercourse realignments.* 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 addition, real-time telemetric monitoring will be used by the contractor to measure turbidity upstream and downstream of the River Feale Bridge. The turbidity level recorded downstream shall not exceed the upstream level by 10%. In the event of an exceedance, an investigation will be carried out to determine the cause and contact will be made with the Kerry Water Services and the Irish Water Environment Division immediately. These results will be compared by the contractor to the weekly turbidity results and reported to KCC. In addition, daily visual inspections of the surface drainage and sediment control measures and the watercourses will be undertaken by the contractor and these inspections shall be recorded and reported to the EAO. 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.*	Pollution of watercourses	Construction

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
		In the event that such indicators are observed in the River Feale and if the EAO directs 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. Where the works are identified as the source of the exceedance the following will apply: • *Contact will be made with the Kerry Water Services and/ or Irish Water, the NPWS and IFI.* • *Works capable of generating sediment into the waterecoure shall be stopped immediately.* • *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 be having on water quality so 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 values established. Further requirements in relation to monitoring are outlined in the pESCP contained in Appendix 8.5.		
45.	8.2.10(b)	Measures to attenuate and treat the carriageway runoff have been incorporated into the drainage design of the proposed development. The likelihood of a serous pollution incident is low This is less than 0.5% in all cases therefore, however 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. If lowered in time prior to discharge of significant quantities, penstocks can potentially retain 100% of spilled material. In addition, in line with IFI requirements the drainage system used shall ensure a standard of 10-15 mg/l for suspended solids to inform retention time needed within the system. All other requirements of the IFI, as set out in their response in Appendix 6.1, will be implemented in the final drainage design. In order to ensure the drainage system is working to the required standard, Kerry County Council will monitor on a twice yearly basis the water quality at the inlet and outlet to the attenuation/treatment ponds as undertaken for the EIS and compare these to the standards in the European Communities Environmental Objective (Surface Water) Regulations, S.I. 272 of 2009. If exceedance are found remediation measures will be undertaken by Kerry County Council as appropriate. In order to avoid adverse impacts to watercourse due to a spill a contaminant spill emergency plan will be put in place by the local Authority 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 by the local Authority in secured locations within the area. In order to avoid adverse impacts to the drinking water abstraction source (the River Feale) due to a potential spill on the proposed development, and following on from consultation with Irish Water, an automated abstraction control system linked to the SCADA (supervisory control and data acquisition) system that continuously monitors for hydrocarbon, turbidity and ammonia will be installed by the contractor at the Scartleigh abstraction point. This system will automatically shut the abstraction in the event of pollution incidences, including any incidences arising from the proposed development	Pollution of watercourses by carriageway run off	Operation
46.	8.2.10(c)	Mitigation measures are included the design see Figures 2.1.1-2.1.5 Overall Scheme Plan and are described in full in Appendix 8.2 of this EIS.	Increase to Flood Risk	Operation
47.	8.3.5(a)	Construction phase mitigation for geomorphology and hydromorphology is detailed in Section	River channel/bank disturbance	Construction

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
		8.2.10(a) under the hydrology assessment. Further specific mitigation for geomorphology and hydromorphology include: • *In-channel working and channel realignments will be minimised as far as possible to reduce the exposure of bare ground, reducing the amount of fine sediment released into the channel. Channel realignment greater than 5 m in length will be constructed one growing season (growing season is March to April) before the flow is diverted into the new channel to allow vegetation to colonise the bank face; and* • *The extent of channel/bank disturbance shall be limited.*		
48.	8.3.5(b)	The position of structures such as headwalls and wingwalls should be designed to limit the potential for scour. Outfall placement will be such that no significant alteration to flow patterns, leading to turbulence and/or excessive deflection of flow towards the bed or banks, would occur. The structures will not encroach into the channel and will not be located where flow converges (i.e. where the river has higher shear stresses). Culvert design will create or maintain a natural bed where possible. The width of the culverts, particularly the low flow (Q95) channel width, and the gradient will be maintained to prevent or minimise a change to the sediment regime. Channel realignments will be minimised to reduce or remove the impact on gradient and the resultant flow dynamics and sediment regime. Opportunities to improve the morphology of the channel will be taken, such as an increase of the sinuosity of the channel, creation of low flow channel to reduce siltation potential, and cut back of vegetation where overgrown, where feasible within the landtake. For the bridge crossing of the River Feale, the design of the southern bridge abutment would incorporate a line of erosion protection around the toe of the structure. This would be set back from the channel edge as close to the new structure as practicable. Although it is not anticipated that excessive erosion would occur of the left bank, based on baseline conditions, the additional measure would provide some protection if the channel does begin to adjust. If the river channel erodes back to the protection, it is not anticipated that this would lead to any significant changes to the downstream processes, with flows already deflecting from the left bank downstream.	Alteration of watercourses by structures.	Operation

16.7 Air Quality and Climate

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
Air Quality and Climate				
49.	9.5.1	A dust minimisation plan will be formulated for the construction phase of the project, as construction activities are likely to generate some dust emissions. In order to ensure that no dust nuisance occurs, a series of measures will be implemented. Full details of the recommendation for the dust minimisation plan are included in Appendix 9.2 The dust minimisation procedures put in place will be monitored and assessed by the contractor. These measures will be included in the EOP. In the event of dust nuisance occurring outside the site boundary, the effectiveness of existing measures will be reviewed and the above mitigation regime intensified in terms of frequency of cleaning, misting and sweeping etc. to rectify the problem.	Nuisance Dust	Construction
50.	9.5.1	Emissions of carbon dioxide will be mitigated by appropriate scheduling of construction activities to minimise duration and the shutting off of equipment during periods of inactivity.	Release of Greenhouse Gas Emissions	Construction

16.8 Noise and Vibration

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
Noise and Vibration				
51.	10.6	Mitigation measures required shall include a combination of acoustic barriers and low noise road surfacing. Low noise road surfacing will be provided between chainage 5000 to 5440. Table 10-5 of this EIS shows the Extent of Noise Mitigation Required. The required acoustic barriers shall have a surface density of at least 10kg/m2 and meet category A3 in terms of absorptive characteristics as tested in accordance with BS EN 1793-1:2012 Road Traffic Noise Reducing Devices; Test Method for Determining the Acoustic Performance Intrinsic Characteristics of Sound Absorption. For barriers no. 10, 12 and 13 (due to the absence of sufficient space to install new barriers) it will be necessary to increase the height of the existing boundary walls.	Road traffic Noise	Operation
52.	10.7.1	As per NRA guidance noise levels associated with construction may be calculated in accordance with guidance set out in BS 5228: 2009: Code of practice for noise and vibration control on construction and open sites – Part 1: 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 generally not possible to conduct detailed prediction calculations for the construction phase of a project pre-construction. This is due to the fact that the programme for construction works has not been established in detail. Under such circumstances, best practice involves the consideration of appropriate mitigation measures. The NRA guidance document specifies noise levels that it typically deems acceptable in terms of construction noise. These limits are set out in Table 10-7 of this EIS. It may be appropriate to apply more stringent limits in areas where pre-existing noise levels are low. Therefore the adopted construction noise criteria will be cross referenced against the "ABC" Method as outlined in Annex E3.2 of *BS5228:2009+2014:A1*. This method is outlined in Table 10-8 of this EIS.	Construction Noise	Construction
53.	10.7.3	The contract documents will 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 BS 5228: Part 1 and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations, 2001. These measures will ensure that: • *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 07:00hrs or after 19:00hrs will be surrounded by an acoustic enclosure or portable screen.* • *During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Table 10-7 using methods outlined in BS 5228 "Noise and Vibration Control on Construction and open sites", Annex E. It should be*	Construction Noise	Construction

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
		noted that BS 5228 does not detail any specific noise limits in relation to construction noise. Normal working times will be 07:00 to 19:00hrs Monday to Friday and 08:00 to 16:30hrs 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 the Contracting Authority. This permission, if granted, 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 the Contracting Authority. Night is defined as 19:00 to 07:00hrs. Emergency work 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 with working on public roads. When overtime and shift work is permitted, the hauling of spoil and delivery of materials outside normal working hours is prohibited and the noise limits outlined in Table 10-7 will apply.		
54.	10.8.4	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 10-9 Allowable Vibration during Construction Phase Measures shall be taken 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

16.9 Landscape and Visual

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
Landscape and Visual				
55.	11.5.1(c)	A number of specific landscape mitigation measures will be implemented per Figures 11.1.5 – 11.1.7: Landscape Mitigation and Table 11-6 Specific landscape measures.	Visual Intrusion	Operation
56.	11.5.1(d)	Contracts will be framed to ensure good working practices that will reduce any adverse impacts arising from construction to the lowest possible level. The NRAs '*Guidelines on the Implementation of Landscape Treatments on National Road Schemes'* is used as a reference for implementing the works. Storage areas will be so located to avoid impacting on existing residential properties, trees, hedgerows, drainage patterns etc. and such areas will be fully re-instated prior to or at the end of the construction contract.	Visual Intrusion	Operation
57.	11.5.1(e)	Landscape mitigation measures are illustrated on Figures 11.1.6 – 11.1.9. Higher percentages of evergreen trees will be planted at sensitive locations to reduce visual impact. In particular, this will be provided at the Bridge abutments at the River and the three roundabout junctions. Standard woodland planting mixtures will be used elsewhere with semi-mature specimen trees used at road junctions, avoiding road sightlines, to give immediate impact.	Visual Intrusion	Operation

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
		The proposed planting will generally be established with forestry planting techniques, i.e. bare root transplants, whips and feathered trees which adapt readily to disturbed ground conditions. A proportion of 'Standard' and taller sized trees will be used to supplement these plantings especially in the vicinity of residential areas. All planting mixes will comply with and include native and local species as identified in Chapter 6: Flora and Fauna. Tree species utilised will be selected from a list of primarily native, naturalised and indigenous species (except where the proposal is contiguous with existing plantations containing other species such as conifers or beech etc.), which will include alder, common ash, aspen, downy and silver birch, bird and wild cherry, mountain ash, pedunculate and sessile oaks, Scots pine and willow species. Planting sizes and spacing are outlined below. The hedge planting will be primarily of blackthorn, hawthorn with hazel and other species planted at 600-900 mm heights at 400 mm centres and interspersed with taller semi-mature trees planted at 9 m centres with species such as oak. Shrub planting species utilised will be selected from a list of primarily native and indigenous species, which will include, blackthorn, crab apple, elder, hawthorn, hazel, holly, guelder rose, spindle, willows and other plants found naturalised in the affected localities. In addition to the landscape mitigation proposals, additional landscape is required in order to mitigate various ecological impacts. The landscaping associated with this ecological mitigation is included in Chapter 6 Flora and Fauna, and these have been considered in terms of their interaction with the scenic landscape. A schedule of the required trees/shrubs is listed in Table 11-7 of this EIS. All landscape works are to be carried out in accordance with the NRA Guidelines for Landscape Treatments for National Road Schemes in Ireland. General grass areas will be seeded with a simple wildflower meadow mixture (e.g. WF01 mix from Wild Flowers Ireland or similar equal and approved). Specific seed mixtures will use a dry calcareous seed mixture (e.g. MM09 mix from Wild Flowers Ireland or similar equal and approved). Treatment wetlands will be specified in accordance with Chapter 4.5 of 'NRA: A Guide to Landscape Treatments for National Road Schemes in Ireland' and NRA's guidelines for Implementation of Landscape Treatments on National Road Schemes.		

16.10 Archaeology, Cultural Heritage and Architectural Heritage

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
Archaeology, Cultural Heritage and Architectural Heritage				
58.	12.2.5	Archaeological investigation through a combination of geophysical survey and trial trenching is proposed ahead of construction. The aim of this is to confirm the presence or absence, nature and importance of any archaeological remains that may be present. The results of trial trenching would allow the design of appropriate works to resolve identified impacts, possibly including resolution excavation. The geophysical survey of Sites AR10 Holy Well Coolnaleen Lower and AR11 Burnt Spread Coolnaleen Lower, in the vicinity of AR4 Ringfort Coolnaleen Lower was undertaken in August 2014 (Appendix 12.3 N69 Listowel Bypass, County Kerry. Archaeological Geophysical Survey). This survey identified anomalies of possible archaeological origin that shall require pre-construction archaeological trial trenching to confirm results.	Loss of archaeological/cultural heritage	Operation

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
		The location and extent of any trial trench array will be subject to approval of the NRA Project Archaeologist in consultation with the National Monuments Service and the Director of the National Museum of Ireland. Testing will be carried out well in advance of road construction to allow sufficient time for archaeological mitigation be undertaken in the event of archaeological remains being identified. A scheme of topographic survey and the preparation of a written and photographic record will be carried out to mitigate the impacts on all of the townland boundaries (AR1, AR8, AR16, AR17 and AR37). This will provide a permanent record of the boundaries and is considered to be adequate mitigation prior to test excavation. A scheme of topographic surveys and the preparation of a written and photographic record will be undertaken to mitigate the impacts on the Limerick and Kerry Railway (Site AR27). This will provide a permanent record of the site of the railway and is considered to be adequate mitigation prior to the realignment of the existing footpath. To address the archaeological potential of Site AR13, a programme of palaeoenvironmental assessment is proposed, in line with '*Guidelines for the Testing and Mitigation of the Wetland Archaeological Heritage*' (NRA 2005c). This may include specialist assessment, retrieval of cores from deposits of palaeoenvironmental potential, followed by analysis and reporting. Any further archaeological resolution measures arising from these assessments will be implemented, subject to the approval of the TII Project Archaeologist and the National Monuments Service, in consultation with the National Museum of Ireland. In addition, the former banks and course of the river will be examined by metal detector survey. The findspots of any archaeological objects recovered will be recorded and the finds conserved. The potential for the presence of archaeological deposits or finds adjacent to the earlier and current river courses will be addressed during test excavation. All of the pre-construction testing and mitigation measures proposed will be subject to approval from the appointed TII Project Archaeologist in consultation with the National Monuments Service and the Director of the National Museum of Ireland as appropriate. Proposed mitigation measures will also comply with the National Monuments Acts (1930 – 2004) and the Code of Practice (2000) agreed between the NRA and the then Minister for Arts, Heritage and the Gaeltacht. 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 will be undertaken in accordance with the *Guidelines for Authors of Reports on Archaeological Excavations* published by the National Monuments Service of the Department of Environment, Heritage and Local Government in 2006.		
59.	12.3.6	Figures 11.1.6 – 11.1.9: Landscape Mitigation has included Woodland planting around Proposed Roundabout 3 to reduce the visual impact of the junction on the setting of Teampillain Ban (AH11).	Impact on the setting of Teampillain Ban	Operation

16.11 Waste

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
Waste				
60.	13.5.1(a)	It is anticipated that some of the excavated material will be acceptable for reuse in road landscaping. 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 waste facilities which will accept it. Where practicable, the closest suitable facilities to the proposed development will be selected to reduce impacts associated with vehicle movements such as air emissions.	Pollution of the environment with waste materials	Construction
61.	13.5.1(b)	The contractor will store, handle, and transport 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, C692, 2010 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 be sampled, tested and disposed of, to a licensed waste management facility.	Contamination of surface water, groundwater and soils with concrete / cementitious materials from bored piles	Construction
62.	13.5.1(c)	Any surplus material generated by excavation of cuttings, which cannot be used 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
63.	13.5.1(d)	The Contractor will ensure that any facility to which waste is brought is licensed/permitted in compliance with Waste Management Legislation.	Disposal of material at an inappropriate facility / pollution of the environment with waste materials	Construction
64.	13.5.1(d)	A Construction and Demolition Waste Management Plan will be prepared for the provision of waste management during the construction phase of the proposed development. The plan will take into account the following guidance documents 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 material at an inappropriate facility / pollution of the environment with waste materials	Construction
65.	13.5.1(d)	An Environmental Operating Plan in accordance with the Guidelines for the Creation and Maintenance of an Environmental Operating Plan (NRA, 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 plans will include: • *Appointment of an Environmental Manger by the main 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 main contractor's staff having regard to the*	Disposal of material at an inappropriate facility / pollution of the environment with waste materials	Construction

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
		main contractor's organisational structure; • *Incorporation of procedures for communicating with the public and communicating within the main 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 regard to the effectiveness of the plan.*		
66.	13.5.1(e)	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 whether the soils require remediation to make them suitable for reuse or need to be disposed of to a licensed facility off-site.	Further contamination of soils / groundwater / surface water with contaminated soils Cross contamination of stockpiled materials	Construction
67.	13.5.1(e)	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 licensed hazardous material disposal facilities. Any such material will be managed in accordance with waste management legislation and the following requirements.	Further contamination of soils / groundwater / surface water with contaminated soils Cross contamination of stockpiled materials	Construction
68.	13.5.1(e)	Soil excavation will be targeted and stockpiling will be managed in order to avoid cross-contamination of re-usable soil with contaminated material.	Further contamination of soils / groundwater / surface water with contaminated soils Cross contamination of stockpiled materials	Construction
69.	13.5.1(e)	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 the waste.	Further contamination of soils / groundwater / surface water with contaminated soils Cross contamination of stockpiled materials	Construction
70.	13.5.1(e)	No asbestos containing materials have been found in any of the site ground investigations. However, if previously unidentified asbestos is encountered during construction, specialist asbestos contractors will be engaged to arrange appropriate removal, testing and disposal to a licensed facility.	Further contamination of soils / groundwater / surface water with contaminated soils Cross contamination of stockpiled materials	Construction
71.	13.5.1(e)	Waste records will be maintained in relation to all hazardous waste materials generated on site including; stockpile locations, volumes, origins and additional testing undertaken.	Further contamination of soils / groundwater / surface water with contaminated soils. Cross contamination of stockpiled material	Construction
72.	13.5.1(e)	A C1 form will required for the movement of any hazardous waste within Ireland and the trans-frontier shipment (TFS) of waste is subject to control procedures under EU and national legislation and guidance, such as the Waste Management (Transfrontier Shipment of Waste) Regulations, 2007.	Further contamination of soils / groundwater / surface water with contaminated soils. Cross contamination of stockpiled materials	Construction
73.	13.5.2	Management of wastes arising during the operational phase of the proposed development will be the responsibility of the Kerry County Council or contractors appointed to provide waste management and landscaping services. Waste silts and hydrocarbons/oily waters collecting in the onsite drainage interceptors will be disposed of through hiring of specialist contractors as and when required. The specialist contractors will be appointed to clean out the interceptors and the waste material will be sent to a suitable licensed facility for treatment and/or disposal.	Incorrect disposal of wastes from the operational phase causing contamination of the environment	Operation

16.12 Material Assets

Mitigation No.	EIS Section Reference	Description of Mitigation Measure / Environmental Commitments	Specific Adverse Impact Mitigated Against	Stage of Impact i.e. Construction or Operational
Material Assets				
74.	14.5.1	A summary of the mitigation measures for the utility provider's services are listed in Table 14 3 of this EIS.	Severance of utility providers' services	Construction
75.	14.5.2	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. These include but are 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	Operation