An Roinn Iompair Turasóireachta agus Spóirt
Department of Transport, Tourism and Sport

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

RPS

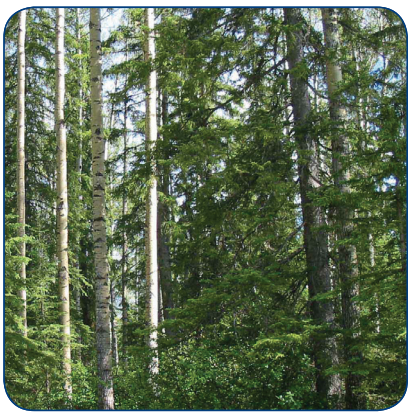
M28 Cork to Ringaskiddy Project

Environmental Impact Statement

Volume 2

May 2017





M28 Cork to Ringaskiddy Project

Environmental Impact Statement

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ENVIRONMENTAL IMPACT STATEMENT DOCUMENTS

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VOLUME 2	**MAIN REPORT**
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	Chapter 2: Planning and Policy Context
	Chapter 3: Description of the Proposed Road Development
	Chapter 4: Outline of Alternatives
	Chapter 5: Traffic and Transportation
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GLOSSARY

Term	Meaning
AADT	Annual Average Daily Traffic (expressed in vehicles per day)
ABP	An Bord Pleanála
AFA	Area for Further Assessment
AONB	Areas of Outstanding Natural Beauty
Aquifer	A subsurface layer or layers of rock that store and transmit water in significant quantities.
At Grade Junction	Junction where roads meet at the same level.
Attenuation Pond	Pond used for the purpose of reducing the rate of run-off discharged to the receiving watercourses.
Base Year	Base Year (2014)
BCR	Benefit to Cost Ratio
BoCCI	Birds of Conservation Concern in Ireland
C_6H_6	Benzene
CASP	Cork Area Strategic Plan
Catchment	An area of land contributing to a river, lake or other water body.
CBA	Cost-Benefit Analysis
CCC	Cork County Council
Cork CDP	Cork County Development Plan 2014-2020
CEF	Connecting Europe Facility
CFRAM Study	Catchment Flood Risk Assessment and Management Study
Ch.	Chainage
CIRIA	Construction Industry Research and Information Association

Term	Meaning
CMP	Construction Management Plan
CMRC	Coastal and Marine Resources Centre
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CPO	Compulsory Purchase Order
cSAC	Candidate Special Area of Conservation
CSO	Central Statistics Office
Cumulative Impacts	The addition of many small effects to create one larger, more significant, effects.
CWB	Coastal Water Body
DAHRRGA	Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs
DAU	Development Applications Unit
dB(A)	Unit used to measure the intensity of sound. The "A" denotes that levels were "A" weighted"
DEFRA	Department for Environment Food & Rural Affairs
DEPER	Department of Public Enterprise and Reform
Design Year	Design Year (2035)
DMRB	Design Manual for Roads and Bridges
DMS	Demand Management Study
DTM	Digital Terrain Model
"Do-Nothing" Scenario	The environment as it would be in the future should the proposed road not be developed.
"Do-Something" Scenario	The environment should the proposed M28 Road Project be developed.
DTTAS	Department of Transport, Tourism and Sport

Term	Meaning
DVO	District Veterinary Office
EcIA	Ecological Impact Assessment
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMCs	Even Mean Concentrations
EPA	Environmental Protection Agency
EQS	Environmental Quality Standards
FDI	Foreign Direct Investment
FRA	Flood Risk Assessment
FRS	Flood Relief Scheme
GEP	Good Ecological Potential
GES	Good Ecological Status
GHG	Greenhouse Gases
GNI	Gas Network Ireland
GPR	Groundwater Protection Response
GPR	Ground Penetrating Radar
Grade Separated	Junction where one road passes over another.
GSI	Geological Survey of Ireland
GWDTE	Ground Water Dependent Terrestrial Ecosystems
ha	One hectare is equal to 10,000 square meters
HAWRAT	Highways Agency Water Risk Assessment Tool
HEFS	High End Future Scenario which represents a more extreme potential future scenario.
HGV	Heavy Goods Vehicle
HMRC	Hydraulics and Maritime Research Centre
Horizontal Alignment	Direction and course of the roadway in plan.
HRA	Hot-Rolled Asphalt

Term	Meaning
Hz	Hertz
IFI	Inland Fisheries Ireland
IMERC	Irish Maritime and Energy Cluster Ireland
Imperceptible Impact	An impact capable of measurement but without noticeable consequences.
Indirect Impact	An impact which is caused by the interaction of impacts, or by associated or off-site projects.
IRSG	Irish Raptor Study Group
ITS	Intelligent Transport Systems
KERs	Key Ecological Receptors
km	Kilometres
kph	Kilometres Per Hour
L_A	Denotes, measurements were made using the A-weighting network. The A-weighting represents the response of the human ear to sound.
$L_{A10,T}$	The noise level exceeded for 10% of the measurement over a period of time (T). This is normally used as a measure of road traffic noise.
$L_{A90,T}$	The A-weighted noise level exceeded for 90% of the measurement over a period of time (T). This is normally used to indicate background noise.
$L_{Aeq,T}$	The continuous equivalent A-weighted sound pressure level. This is an “average” of the sound pressure level over a period of time (T).
$L_{Amax,T}$	Is the maximum A-weighted sound level measured during a period of time (T).
$L_{Amin,T}$	Is the minimum A-weighted sound level measured during a period of time (T).
Landscape Capacity	The capacity of a particular type of landscape to absorb change without unacceptable adverse

Term	Meaning
	effects on its character.
Landscape Character Area	Distinct types of landscape which are generic in character in that they may occur in different parts of the country, but wherever they are they share broadly similar combinations of geology, topography, drainage patterns, vegetation and historical land use and settlement pattern.
Landscape Fabric	Is the physical pattern of elements and features such as vegetation, landform and land use that combine to create landscape character.
Landscape Quality (or Condition)	Is based on judgements about the physical state of the landscape, and about its intactness, from visual, functional, and ecological perspectives.
Landscape Resource	The combination of elements that contribute to landscape context, character and value.
Landscape Value	The importance attached to a landscape (often as a basis for designation or recognition) that expresses national or local consensus, because of its quality, cultural associations, scenic or aesthetic characteristics.
LAP	Local Area Plan
LMA	Lands Made Available
LO	Liaison Officer
LOS	Level of Service for a road is typically defined in the US Highway Capacity Manual as a quality measure describing operational conditions within a traffic stream.
Luft	TA Luft Guidance Technical Instructions on Air Quality Control
LV	Low Voltage Electricity Cables

Term	Meaning
LVIA	Landscape and Visual Impact Assessment
M28	Proposed M28
Magnitude	Size, extent and duration of an impact.
mbgl	Metres below ground level
Mitigation Measures	Measures which would avoid, reduce, or remediate the impact.
Moderate Impact	An impact that alters the character of the environment in a manner that is consistent with existing and emerging trends
MRFS	Mid Range Future Scenario which represents a 'likely' future scenario.
MV	Medium Voltage Electricity Cables
N28	Existing N28 Cork to Ringaskiddy Road
NBDC	National Biodiversity Data Centre
NDP	National Development Plan
NHA	Natural Heritage Areas
NIAH	National Inventory of Architectural Heritage
NIS	Natura Impact Statement
NMCI	National Maritime College of Ireland
NMUs	Motorway Service Users
NO_2	Nitrogen Dioxide
Not Significant Impact	An impact which causes noticeable changes in the character of the environment but without noticeable consequences.
NO_X	Nitrogen Oxides
NPF	National Planning Framework
NPP	National Ports Policy
NPWS	National Parks and Wildlife Service

Term	Meaning
NRA	National Roads Authority
NSL	Noise Sensitive Location
NSS	National Spatial Strategy
NTS	Non-Technical Summary
OD	Ordnance Datum
OPW	The Office of Public Works
OSi	Ordnance Survey Ireland
PAG	Project Appraisal Guidelines
PAHs	Polycyclic Aromatic Hydrocarbons
PM_{10}	Particulate matter measuring 10 micrometers or less in diameter.
$PM_{2.5}$	Particulate matter measuring 2.5 micrometers or less in diameter.
Pb	Lead
PMGs	Project Management Guidelines
pNHA	Proposed Natural Heritage Areas
PRF	Potential Roost Features
Profound Impact	An impact which obliterates sensitive characteristics.
Protected Road	Protected Road as defined under the Roads Act
PVB	Present Value Benefits
RBMP	River Basin Management Plan
Residual Impacts	Residual impacts are the final impacts that occur after the proposed mitigation measures have been put into place, as planned.
RFC	Ratio of Flow to Capacity
RMP	Record of Monuments and Places
Ro-Ro	Roll-On Roll-Off

Term	Meaning
RPS	Record of Protected Structures
RRTs	Road Railway Terminals
RSA	Road Safety Authority
RW	Retaining Wall
SAC	Special Area of Conservation
SATURN Software	Simulation and Assignment of Traffic to Urban Road Networks Software
SCI	Special Conservation Interests
SDLAP	South Docks Local Area Plan 2008-2018
Sensitive Receptor	Physical or natural resource, special interest or viewer group that will experience an impact.
Sensitivity	Vulnerability of a sensitive receptor to change.
SEVESO	SEVESO Site
SFILT	Strategic Framework on Investment in Land Transport
SI	Site Investigation
Significant Impact	An impact which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Slight Impact	An impact which causes noticeable changes in the character of the environment without affecting its sensitivities.
SLM	Specific Landscape Mitigation
SMR	Sites and Monuments Record
SO_2	Sulphur Dioxide
SPA	Special Protection Area
SuDS	Sustainable Drainage System
Swallow Hole	A place where surface stream disappears underground in a limestone region.

Term	Meaning
TBT	Tributylin
TEN-T	Trans-European Network-Transport
TII	Transport Infrastructure Ireland
TMA	Traffic Management Alternative
TWB	Transitional Water Body
UG	Underground Electricity Cables
V/C Ratio	Volume of Flow to Capacity Ratio
Vertical Alignment	Direction and course of the roadway in profile.
Very Significant Impact	An impact which, by its character, magnitude, duration or intensity significantly alters the majority of a sensitive aspect of the environment.
Visual Amenity	The value of a particular area or view in terms of what is seen.
Visual Character	When a viewer experiences the visual environment, it is not observed as one aspect at a time, but rather as an integrated whole. The viewer's visual understanding of an area is based on the visual character of visible features and aspects and the relationships between them. The visual character is descriptive and not evaluative.
Visual Effect	Is a change to an existing view as a result of development or the loss of particular landscape elements or features already present in the view.
Visual Quality	Although the interpretation of viewers' experience can have preferential and subjective components, there is generally clear public agreement that the visual resources of certain landscapes have high visual quality. The visual quality of a landscape will reflect the physical state of individual features or elements.
Visual Resources	The visual resources of the landscape are the stimuli upon which actual visual experience is based. They are a combination of visual character and visual quality.
VOC	Volatile Organic Compound
VP	Vantage Point
WFD	Water Framework Directive
WHO	World Health Organisation
WWTP	Waste Water Treatment Plan
ZoI	Zone of Influence
ZTV	Zone of Theoretical Visibility

1 INTRODUCTION TO SCHEMES AND PROPOSED ROAD DEVELOPMENT

1.1 INTRODUCTION

1.1.1 General Overview of Proposed Road Development and Context

Cork County Council (CCC), on behalf of the National Roads Authority (NRA), (known for operational purposes as Transport Infrastructure Ireland (TII)) proposes to upgrade approximately 12.5km of the N28 National Primary Route from the N28/N40 South Ring Road Bloomfield Interchange to the Port of Cork in Ringaskiddy, together with consequential and ancillary works.

CCC has made a Motorway Scheme, a Protected Road Scheme and a Service Area Scheme which are being submitted for Approval to An Bord Pleanála under Section 49 of the Roads Act 1993 as amended.

The proposed road project, to which the Motorway Scheme, Protected Road Scheme and Service Area Scheme relates, is one for which approval is required under Section 51 of the Roads Act 1993 as amended and which requires the submission of an Environmental Impact Statement (EIS). Mandatory Environmental Impact Assessment (EIA) is required because the proposed road development includes a motorway and service area (as well as a protected road).

Concurrently, an application is being made to An Bord Pleanála for consent for the proposed development pursuant to Part XAB of the Planning and Development Acts 2000-2016 for which a Natura Impact Statement (NIS) has been prepared for the purposes of Article 6 of the Habitats Directive.

The concurrent applications to An Bord Pleanála involve public consultation, published notices in relation to the Schemes, the EIS and NIS, the service of notice on landowners affected by the Schemes and the making of objections, submissions and observations from stakeholders as part of the statutory process. An Bord Pleanála may conduct an oral hearing and may seek additional information as part of the statutory processes.

The proposed road development is referred to in this EIS and in the NIS as the M28 Cork to Ringaskiddy Project (or the M28 Road Project).

In summary, the proposed road project comprises a motorway route from the interchange with the N40 (Bloomfield Interchange) to the R613 Carrigaline to Ringaskiddy Road at Barnahely. From Barnahely, it comprises a single carriageway which will link to the east side of Ringaskiddy village and be a Protected Road as defined under the Roads Act which will be designated 'Clearway' as defined in the Road Traffic Act (prohibits parking and stopping) in order to meet TEN-T requirements for the Core road network. Together, the M28 road project and the N28 single carriageway national road will form the TEN-T route to the Port of Cork complex at Ringaskiddy.

The proposed M28 Road Project is substantially on-line between Bloomfield and Carr's Hill and will require widening of the existing N28 road. South of Carr's Hill the route extends to the western side of the existing N28 to Shannonpark where it turns in an easterly direction and continues south of the existing road as far as the R613 at Barnahely. From, the R613 junction at Barnahely there will be two

routes to Ringaskiddy, one route along the existing R613 to the existing N28 providing access to the western entrance to the Port of Cork, and a second new route comprising a new single carriageway, extending immediately to the south of Ringaskiddy Village which will turn eastwards and access to a proposed new eastern entrance to the Port of Cork facility located on the eastern side of Ringaskiddy Village. A proposed Service Area will be located within the Port of Cork lands at Ringaskiddy which will primarily serve as a refuelling and rest area for commercial vehicles. The designated TEN-T route is the route from the Bloomfield Interchange to the eastern entrance of the port and to the proposed Service Area.

An overview of the location of the proposed Road Project in a regional and local context is presented in **Figure 1.1**. **Figure 1.2** illustrates the location of the existing N28 relative to the main existing settlements, the Port of Cork at Ringaskiddy and local businesses and industries. The layout of the proposed road is illustrated on **Figure 1.3**. Detailed drawings are contained within **Volume 5**.

1.2 EIA REQUIREMENTS

Environmental Impact Assessment (EIA) is defined as "*the process of examining the environmental effects of the development from consideration of the environmental aspects at design stage, through to the preparation of an Environmental Impact Statement, evaluation of the EIS by a competent authority and the subsequent decision as to whether the development should be permitted to proceed, also encompassing public response to that decision*".[1]

Insofar as roads are concerned, the EIA Directive is transposed into law in Ireland through the Roads Act, 1993 (No. 14 of 1993) as amended. The current requirements for EIA are set out in Part IV of the Roads Act, 1993 and Part V of the Roads Regulations, 1994 (S.I. No. 119 of 1994). In particular, sections 50 and 51 of the Act, as amended, deal with EIA. These provisions have been subject to amendments including inter-alia:-

- The Roads Act, 2007, (34/2007);
- The European Communities (Environmental Impact Assessment) (Amendment) Regulations, 1999 (S.I. No. 93 of 1999);
- The European Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. No. 477 of 2011); the Planning and Development (Strategic Infrastructure) Act, 2006 (27/2006);
- The European Communities (Environmental Impact Assessment) Amendment Regulations, 1998 (S.I. No. 351of 1998); and
- The European Communities (Public Participation) Regulations, 2010 (S.I. No. 352 of 2010).

1.2.1 Proposed M28 Road Project Objectives

The key objectives of this Proposed M28 Road Project are defined under environment, safety, economy, accessibility and social inclusion and integration as set out below.

[1] Guidelines on the information to be contained in Environmental Impact Statements, EPA (2002)

Environment Objective

- To facilitate a reduction in the traffic-related impact of the existing N28 on the human environment in the communities through which the road passes; and
- To minimise the impact of any improvement works on nearby environmentally-sensitive sites.

Safety Objective

- To improve road safety by reducing the number of road collisions and associated injuries/fatalities in the N28 corridor.

Economy Objective

- To facilitate strategic development at the Port of Cork facilities at Ringaskiddy by improving access for port-related traffic along the N28 corridor;
- To reduce peak hour congestion and travel delays in the N28 corridor, at an investment cost that offers good value for money; and
- To facilitate general economic development within the Cork Gateway and Ringaskiddy Strategic Employment Area by improving journey time reliability on the N28 corridor at an investment cost that offers good value for money.

Accessibility and Social Inclusion Objective

- To facilitate improved accessibility to the Ringaskiddy peninsula and associated employment opportunities for cyclists and other vulnerable road users; and
- To return to communities along the route such as Shanbally, easier and safer access to their local facilities by the removal of strategic and through traffic from their environment.

Integration Objective

- To support the *National Ports Policy* (NPP)(2013) *and Trans-European Network - Transport* (TEN-T) policy by creating a High-Quality Route from the Port at Ringaskiddy to the N40 South Ring Road.

1.2.2 Sustainable Transport

The Proposed M28 Road Project has been developed in line with national policy with regard to sustainable transport as detailed in *Smarter Travel - A Sustainable Transport Future, A New Transport Policy for Ireland 2009 - 2020* (2009). This policy identifies forty nine Actions that should be implemented to enhance sustainable transport in terms of reduced distance travelled by private car, availability of transport alternatives to the car, transport efficiency and strengthening institutional arrangements.

The provision of the Proposed M28 Road Project makes significant contributions to the Smarter Travel policy (refer **to Chapter 2: Planning and Policy Context**). The motorway is considered critical to creating alternative sustainable travel opportunities and removing large volumes of traffic from the existing N28 and relocating them onto the new route resulting in a transformation of the villages of Shanbally and Ringaskiddy, which are currently subject to congestion on a daily basis.

The key elements of the proposed M28 Road Project which will deliver or facilitate the policy of sustainable and smarter travel are detailed in **Chapter 3: Description of Proposed Road Development** and **Chapter 5: Traffic and Transportation** and summarised as follows and presented on **Figure 1.4** in **Volume 5**.

- Facilitates enhanced bus use, both express buses and local or rural bus services in response to Actions 12, 13 and 14;
- Provides an opportunity for the provision of improved walking and cycling along the existing N28 route, which will be particularly beneficial to the villages of Shanbally and Ringaskiddy in response to Actions 15 and 16;
- Provides for cycle and walking connectivity across the corridor at a number of locations to tie in with existing and future cycle plans/initiatives including Cork County and City Council's *Cycle Network Plan for Metropolitan Cork Area*, again in response to Actions 15 and 16 (refer to **Chapter 5: Traffic and Transportation**);
- Facilitates the construction of a Greenway Link from Ringaskiddy and Shanbally to the proposed Cork Harbour Greenway at Raffeen allowing for high quality connectivity for walking and cycling to Carrigaline and Crosshaven in one direction and Passage West and Cork City in the other, once the Greenway is constructed;
- Creates opportunities for sustainable commuting to and from Ringaskiddy over relatively short distances from Carrigaline and from the Douglas/Rochestown areas. Sustainable commuting for these types of trip could be by cycling/local bus or by car-pooling/car sharing type arrangements. The Proposed M28 Road Project and its associated reclassification of the existing N28 affords significant opportunities to support such initiatives and therefore supports the achievement of high levels of commuting to Ringaskiddy by sustainable modes in response to Action 23; and
- Provides a high quality link from the Port of Cork facility and the pharmaceutical industries at Ringaskiddy to the national road network. This is the most sustainable way to cater for freight traffic in response to Action 10.

1.2.3 Study Area

County Cork is located in the Southern Region of Ireland and the location of the N28 in the context of the national road network in the Cork area is illustrated in **Figure 1.2.** The study area for the proposed M28 Road Project is outlined in red on **Figure 1.2.** This **Figure 1.2** also presents the main settlements within the study area including Douglas and Rochestown in the north, Carrigaline in the south and Shanbally and Ringaskiddy in the south east.

The existing N28 national road provides access to a large number of diverse strategic land uses in Cork, namely, the metropolitan town of Carrigaline (14,775 pop); the Ringaskiddy Strategic Employment Area, the Irish Naval Service on Haulbowline; the National Maritime College of Ireland (NMCI) and associated technology campus; the Port of Cork complex; existing large scale biological and life sciences companies and the two villages of Shanbally and Ringaskiddy.

The Proposed M28 Road Project will cater for port related traffic, providing priority access and increased capacity between the Port, as well as other major employers in Ringaskiddy, and the National Road Network, bypassing the villages of Shanbally and Ringaskiddy. The location of the Proposed M28 Road Project is presented in **Figure 1.2** and the layout of the proposed M28 Road Project is illustrated in **Figure 1.3.** A more detailed description of the Proposed M28 Road Project is provided in **Chapter 3: Description of Proposed Road Development** of this Environmental Impact Statement (EIS) and the presented on the General Layout Drawings in **Volume 5**.

Figure 1.1: N28 in a Regional Context

Figure 1.2: Proposed M28 Road Project Location

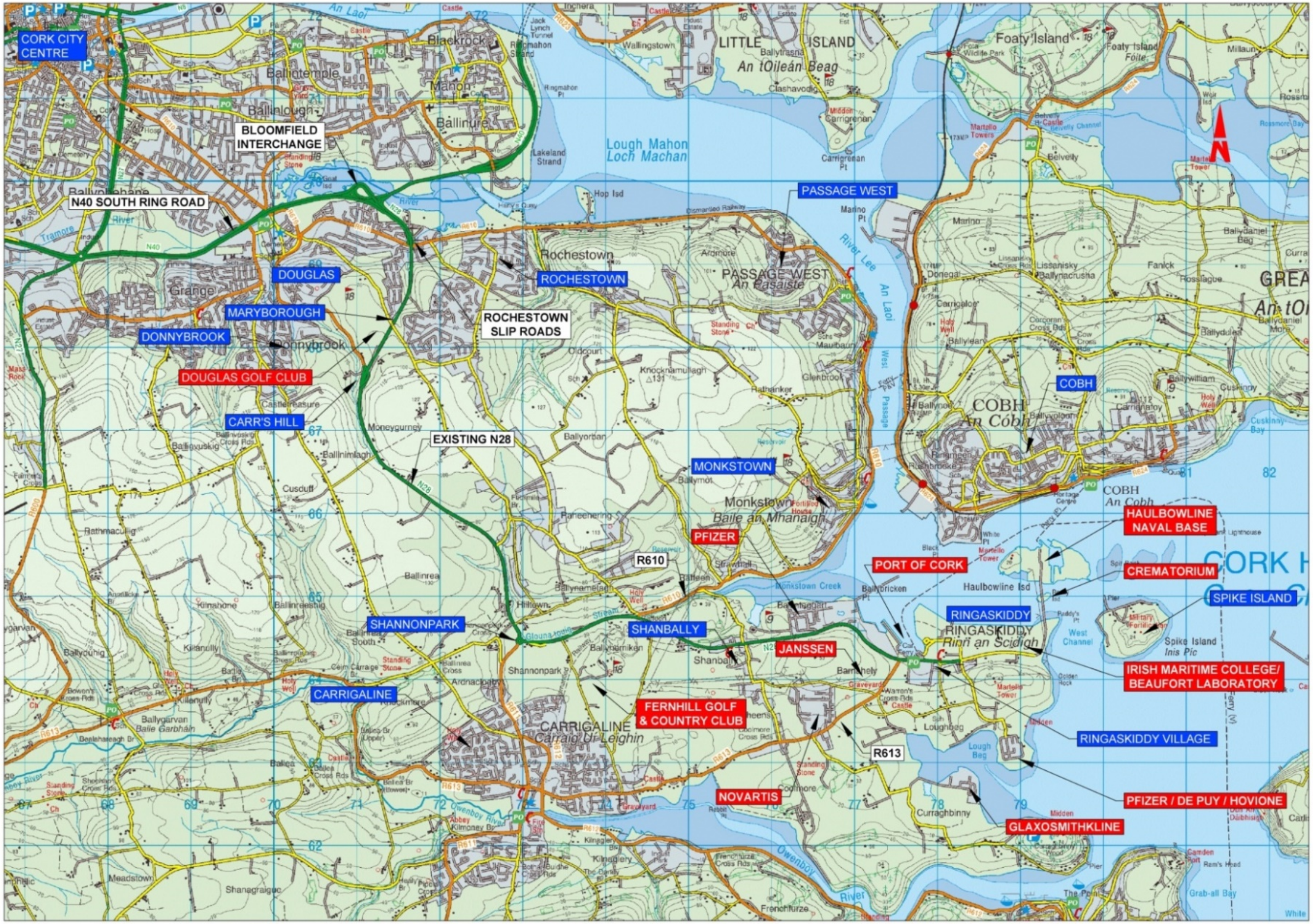


Figure 1.3: Outline of Proposed M28 Road Project

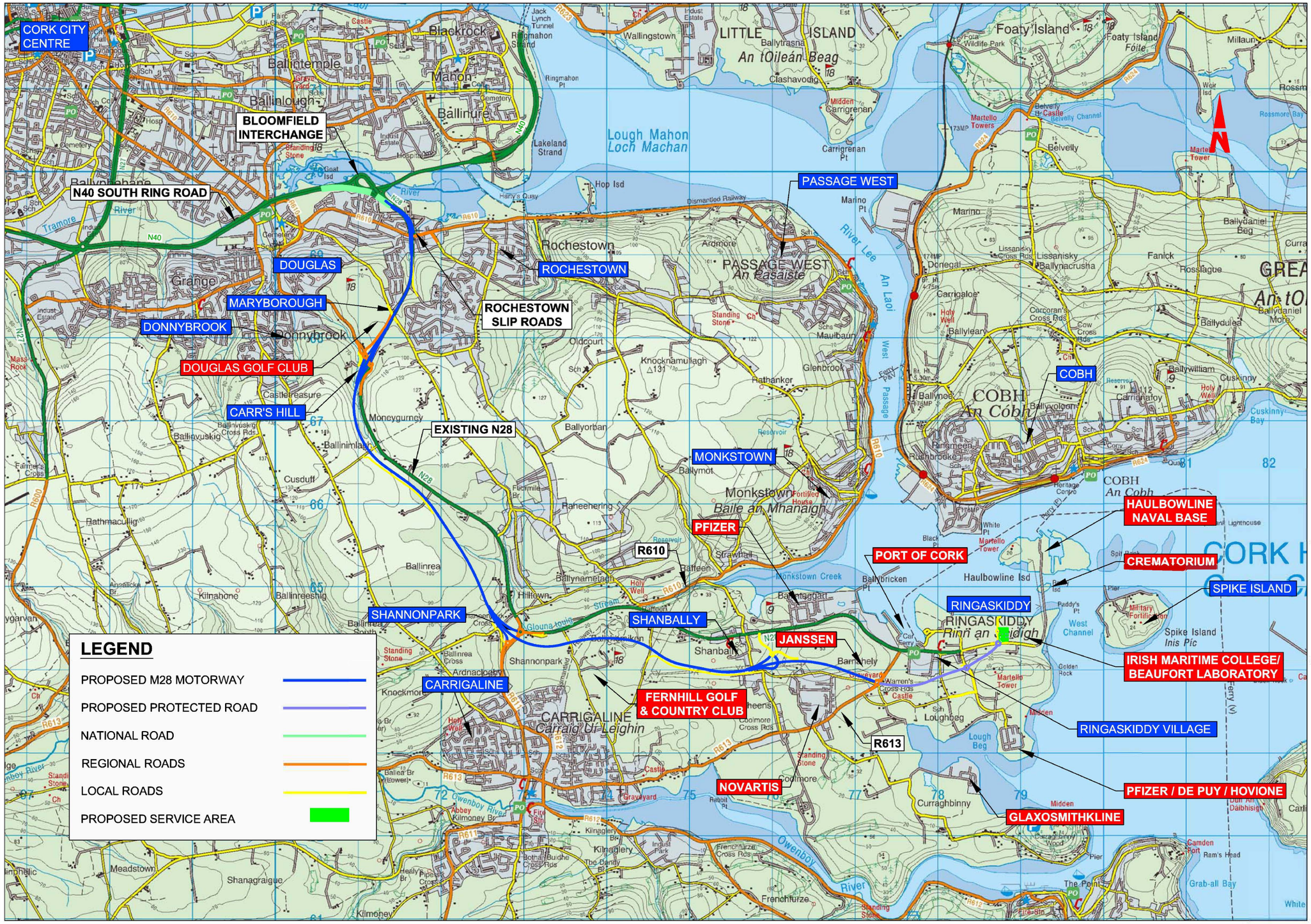


Figure 1.4: Sustainable Travel

Please refer to **Volume 5** for A3 size figures.

1.3 NEED FOR THE PROPOSED ROAD PROJECT

The need for the Proposed M28 Road Project derives from the requirements of European and National Transportation and Port Access policies and is strongly underpinned in national, regional and local planning policy.

The policy basis for the need for the Proposed M28 Road Project is set out in more detail in **Chapter 2: Planning and Policy Context** of this EIS.

1.3.1 Integration with Trans-European Network – Transport (TEN-T) Policy

On 30th May 2013, the European Commission, the Council of Europe and the European Parliament agreed a policy for a united transport network (TEN-T) to transform the connectivity of the existing patchwork of European roads, railways, airports and canals. The agreement establishes a core transport network to be established by 2030 to act as the backbone for transportation within the Single Market. Transport financing under the Connecting Europe Facility (for the period 2014–2020) also focuses on this core transport network, filling in cross-border missing links, removing bottlenecks and making the network smarter.

The core TEN-T network will be supported by a comprehensive network of routes, feeding into the core network at regional and national level. This will largely be financed by member states, with some EU transport and regional funding support, including new innovative financing instruments. The aim is to ensure that progressively, the great majority of Europe's citizens and businesses will be no more than 30 minutes' travel time from this comprehensive network by 2050.

Ireland has one core network corridor crossing the country: **The North Sea-Mediterranean Corridor,** which extends from Belfast in the north of Ireland and connects the Irish ports of Cork, Foynes/Limerick and Dublin. It also extends from the northern UK ports of Glasgow and Edinburgh through the UK and on through Belgium, with a branch from Amsterdam and Rotterdam, via Luxembourg to Strasbourg and Basel and via Lyon to the southern French ports of Fos/Marseille. The North Sea Mediterranean Corridor of the TEN-T network also incorporates rail, road, airports, ports, Road Railway Terminals (RRTs) and the Dutch-Belgian inland waterway system, as well as the Rhône River as set out in **Figure 1.5**. This core TEN-T network serves core Irish airports and ports at Belfast, Dublin, Cork and Limerick and connects to the rest of the country by the comprehensive National road network.

The N28 is part of the TEN-T core network and it has been identified as a critical part of the road network supporting the core maritime port at Ringaskiddy. TEN-T policy requires that the route to the core port shall be a high quality route and constructed to the standard set out below.

According to **REGULATION (EU) No 1315/2013, Chapters II** and **III, Articles 17** and **39,** the TEN-T core network shall consist of an express road or motorway as defined in the TEN-T Regulations. To summarise, the route must:-

- Be designed for motor traffic, accessible primarily from interchanges or controlled junctions; and
- Prohibit stopping and parking on the running carriageway.

Figure 1.5: Comprehensive & Core Network: Roads, Ports, Rail-road Terminals and Airports (source TEN-T Regulations Maps)

Section 2.1.3 of this EIS describes the requirements of TEN-T Regulation 1315/2013 in more detail.

The existing N28 does not achieve the specified standards and is in need of significant upgrade. TEN-T requirements for route protection, prohibition and design for motor traffic are achieved by motorway status as defined by the Roads Act 1993. The requirements are also achieved by Protected Road designation as per the Roads Act 1993 in combination with Clearway status as per the Road Traffic Act.

1.3.2 Integration with National, Regional and Local Planning Policy and Planning Need

Chapter 2: Planning and Policy Context of this EIS sets out in detail the planning policy and context of the Proposed M28 Road Project. This section summarises the key drivers behind the planning and policy need for the project by:-

- Highlighting the value of the new road to support the port as an economic driver to the future growth of Cork;
- Identifying the value of the new road to support further Foreign Direct Investment (FDI) in Ringaskiddy in order to stimulate growth in employment levels and protect existing development and the value thereof; and
- Promoting the sustainable development of the area through improved mobility, accessibility and potential for smarter travel options on the existing N28 for residents and employees within the area.

The Proposed M28 Road Project is fully supported in all the planning policy documents at national, regional and local levels as set out below.

1.3.2.1 National Policy

Specifically, at the National level, the National Development Plan (NDP) 2007-2013 and the National Spatial Strategy (NSS) (2002-2020) both recognise the importance of the effective connections to port and its associated industrial zones (refer to **Section 2.2.1** and **Section 2.2.3** of **Chapter 2: Planning and Policy Context**). The National Planning Framework Plan (NPF) is due to be adopted in Q4 of 2017 and will supersede the NSS. Cork County and City Council have prepared a joint submission to the NPF entitled "*Cork 2050 Realising the Full Potential (March 2017)"*. This document sets out various strategies for the comprehensive and evidence based approach to the future development of Cork. The Transport Strategy within the submission recognises the need for the M28 to connect Ringaskiddy Port to the N40 as one of National importance.

The Proposed M28 Road Project is part of the Irish *National Ports Policy* (2013). Under this policy the maritime port of Cork is a Port of National Significance, Tier 1. Thus, it is a priority to progress the development of the M28 to facilitate the development of the port at Ringaskiddy (refer to **Section 2.1.4** of **Chapter 2: Planning and Policy Context**).

The Proposed M28 Road Project is identified in the recent *Building on Recovery: Infrastructure and Capital Investment 2016-2021* published by the Department of Public Expenditure and Reform which sets out the Government's framework for infrastructure investment up to 2021. One of the priorities of the Plan is "*targeting the improvement of specific road segments where there is a clear economic justification*" and specifically makes provisions for the Proposed M28 (refer to **Section 2.2.2** of **Chapter 2: Planning and Policy Context**).

The need for the Proposed M28 Road Project is also supported by policy as set out in the following documents: *Department of Transport – Statement of Strategy 2016 to 2019* (2016), *Investing in our Transport Future: Strategic Framework for Investment in Land Transport* (2015), the *National Spatial Strategy 2002 to 2020* (2002), *Our Sustainable Future: A Framework for Sustainable Development* (2020) and *Smarter Travel – A Sustainable Transport Future, New Transport Policy for Ireland*, *2009 - 2020* (2009) (refer to **Chapter 2: Planning and Policy Context** for further details).

1.3.2.2 Regional Policy

Regional policy is principally set out in the *Regional Planning Guidelines for the South West Region 2010 – 2022*, which identifies that *integral to both the expansion of the Port of Cork and the planned redevelopment of the City Docklands is the relocation of port activities and related uses from the City Docklands and Tivoli to new sustainable locations in the harbour*', supported by improved transport networks (refer to **Section 2.2.6** of **Chapter 2: Planning and Policy Context**).

1.3.2.3 Local Policy

Local policy is set out in the *Cork County Development Plan (CDP) 2014 – 2020*, the *Cork Area Strategic Plan (CASP): Strategy of Additional Economic and Population Growth* – Update 2008 and in the *Carrigaline Electoral Area Local Area Plan 2011* (as amended, currently being updated as the *Ballincollig – Carrigaline Municipal District Local Area Plan* (Draft 2016)). These local planning policies strongly support the development of the port and the strategically zoned areas in Ringaskiddy, the sustainability of which is contingent on the provision of improved transport access to the area. **Chapter 2: Planning and Policy Context** clearly sets out how each of these plans supports the development of the Proposed M28 Road Project.

The *CASP* Update 2008 identifies the upgrading of the N28 road access to Ringaskiddy Port and its associated industrial zone as key development priorities for the Cork Gateway as identified in the *NDP 2007-2013*. The plan proposes that the upgrading of the N28 be included in Tranche 2 (2008-2013) of the plans phasing as it is critical and essential to the growth and development of the CASP region and the achievement of the CASP goals.

The *CASP* Update 2008 highlights the fact that the Port of Cork and Cork Airport are two major economic factors in the CASP region and their efficient operation at a strategic level is based on their accessibility and connectivity with the wider region, primarily, though not exclusively by, the National roads network. The Port of Cork relies heavily on Heavy Goods Vehicles (HGVs) traffic to deliver and distribute goods by the national roads network and is thus strategically reliant on the provision of a high quality national road network in the CASP area. Of particular importance are the implementation of the Proposed M28 Road Project and the full completion of the North Ring Road (East and West sections) in order to relieve pressure on the Jack Lynch Tunnel.

The proposed spatial strategy in the *CASP* Update 2008 supports the development of Ringaskiddy as a Strategic Employment Area, focused on industry. The *CASP* update considers the N28 Ringaskiddy Port Access Route *"to be critical and essential to the growth and development of the CASP region and achievement of the CASP goals" as outlined in* **Section 2.2.7** of **Chapter 2: Planning and Policy Context**.

The *CDP 2014-2020* also supports development of the road infrastructure with Policy TM 3-1 specifically supporting the Transport Infrastructure Ireland /National Roads Authority's targets for the road network, which includes the N28 as a project critical to the delivery of planned development (Refer to **Section 2.2.9** of **Chapter 2: Planning and Policy Context)**.

Cork County Council recently published the draft Ballincollig-Carrigaline Municipal District Local Area Plan, which is due to be adopted in August 2017. The plan supports the proposed road development as an important catalyst for the economic development of Cork and the South West region. It further states that it '*is critical that the M28 project be finalised as quickly as possible in order to bring certainty and assurance of commitment to existing and future investment in the Ringaskiddy area"* (Section 3.7.37).

1.3.3 Economy

1.3.3.1 Proposed M28 Road Project

There are strong economic arguments for prioritising investment into the upgrade of the N28 route as a key infrastructural corridor of international as well as national and regional importance. In 2014, Cork Chamber of Commerce commissioned a report 'CORK TO THE WORLD – Updated Economic Assessment of the N28 Cork to Ringaskiddy Road Project'. This report strongly promotes the proposed upgrade of the N28, specifically citing that the economic assessment carried out for the report demonstrates that the proposed road project represents an important catalyst project for the economic development of Cork and the South-West region through the reinforcement of internal and external connectivity and the removal of a significant constraint to the international competitiveness of the region.

Ringaskiddy is the location of modern deep-water port facilities, a naval and marine training institution and has, over the years, successfully attracted major, large scale, high technology manufacturing plants. Outside of the Greater Dublin Area, Ringaskiddy has the largest direct investment employment centre in Ireland. Many of the top world leading pharmaceutical companies are located here. Over 8,800 people are employed in the area. Ringaskiddy is a significant centre of pharmaceutical manufacturing which within the global community, has earned an international reputation as a location of choice for mobile pharmaceutical investment. These characteristics create high-quality employment opportunities while contributing to both the local and national economy. The IDA has a number of existing clients/companies in Ringaskiddy; namely:-

> Janssen Biologics (J&J); DePuy (J&J); GlaxoSmithKline; Moog; Novartis (int. Pharma Branch Ireland); Novartis Ringaskiddy; Pfizer Ireland Pharmaceuticals – Ringaskiddy API; Pfizer Ireland Drug Product Plant (Loughbeg); Pfizer Operations Support group; Recordati; Hovione; and Biomarin.

Ringaskiddy is a textbook example of clustering, a theory that contends that where one industry is established supplier industries soon follow, as does investment in education, training, research and development and infrastructure.

Five of the major employers within the development boundary of Ringaskiddy are designated under the Major Accidents (Seveso II) Directive. These are Novartis Ringaskiddy Ltd, Pfizer Ireland Pharmaceuticals Ringaskiddy API Plant, Hovione Limited, Carbon Chemicals and GlaxoSmithKline, SmithKline Beecham (Cork) Ltd. A Seveso Report has been prepared to accompany the planning application and is included in the **Appendix 1A.**

In addition to the biological and life science industry, a €52 million state of the art National Maritime College of Ireland (NMCI) opened its doors to students in October 2004. Located near the bridge to Haulbowline Island on a Naval Service site, the college is one of the most sophisticated centres of its kind in the world. Some 750 full-time students can be offered training at the National Maritime College through the Public Private Partnership of the Irish Naval Service, Cork Institute of Technology and the private partner FOCUS Education. This model allows the college management and teaching staff to concentrate on education while the private partner is responsible for services to the college and the maintenance of facilities.

This is the first third level College to be delivered under the Public Private Partnership model. The National Maritime College offers naval training/education using Navy staff and Merchant Navy staff from the Cork Institute of Technology. Equipment complementing all courses is state-of-the-art and includes simulation in the areas of navigation, bridge training, communications, engineering/ machinery operations, liquid cargo handling, liquid cargo damage control and vessel traffic systems. The college offers a comprehensive workshop for seamanship and mechanical engineering, jetty and lifeboat facilities and facilities for survival training.

Work has recently been completed on expanding this educational campus eastwards, the new Beaufort building accommodates the Irish Maritime and Energy Cluster Ireland (IMERC) and includes facilities for University College Cork's Coastal and Marine Resources Centre (CMRC) and Hydraulics and Maritime Research Centre (HMRC), as well as Maritime IT, incubator and marine business accommodation. Renewable ocean energy is seen as one of the niche areas the campus will focus on initially.

In previous plans there were 344ha of land zoned for business use in Ringaskiddy with 236ha of this undeveloped, part of which is set aside for large stand-alone development. The land remaining under the ownership of IDA is approximately 170ha available for marketing in 6 sites: - Loughbeg West – 54ha; Martello Tower – 29ha; Shanbally – 27ha; Upper Shanbally – 18.2ha; Castlewarren – 29ha and Coolmore –13ha.

The quality of access to the peninsula (access to the labour force in the Cork Metropolitan Area, access to Cork airport for international business travel, access to the motorway network for onward travel to markets in the rest of Ireland) is currently poor by international standards. In terms of day to day performance, the N28 is subject to significant recurrent peak hour delays and queuing, and (for example) is frequently mentioned on national radio traffic bulletins as a congestion "hotspot". The recurring delays and congestion reduces transport efficiency and the competitiveness of the region due to poor internal and external connectivity.

The Proposed M28 Road Project is a critical factor in maintaining and increasing the creation of employment opportunities in this key industrial area.

1.3.3.2 Port of Cork

The Port of Cork's deepwater berth at Ringaskiddy is of major importance to the region both from a commercial and a tourism perspective. Current facilities at the deepwater berth can handle a range of cargo types, including roll-on roll-off (Ro-Ro), lift-on lift-off and dry bulk. Brittany Ferries sail from Ringaskiddy to Roscoff, France for six months of the year.

Cork Harbour is the second most significant port in the state. It is critical to the economic success of the South West Region. The port's activities are divided between several locations in the harbour, including traditional open wharves and container facilities on the eastern approaches to the city at Tivoli and a modern deep-water facility with 'Ro-Ro' facilities and car/passenger links to France at Ringaskiddy. There are a number of specialised facilities for oil and petroleum at Whitegate and general cargo at Passage West. Disused facilities at Marino Point have immediate potential to handle bulk cargo transported to or from the port by rail. Handling non-rail cargo's at this location will require the upgrading of the R624, linking the site to the N25.

Ringaskiddy is the primary location for the relocation of port activities from the upper harbour in Tivoli which is currently underway. Following this relocation, the port activities at Ringaskiddy will be the most important in Cork harbour.

The Port of Cork is identified in *National Ports Policy* (NPP) (2013) as a Port of National Significance (Tier 1) and is proposed for inclusion as one of 3 ports, including Dublin and Shannon/Foynes, in the state in the TEN-T (European Union's Trans European Network – Transport). For inclusion in the core network, ports must enjoy significant volumes of freight and/or passenger traffic, have a high level of international connectivity and, by 2030, be connected to the core European rail and road network.

The Port of Cork's proposes to expand its facilities in Ringaskiddy so that port centred operations and logistics can become more efficient through the accommodation of larger ships and so that port traffic can directly access the National road network without passing through the city centre. The planned expansion of port facilities at Ringaskiddy will release dockland areas close to the city for planned redevelopment in line with proposals set out in the City Council's Development and Local Area Plans.

In June 2015, An Bord Pleanála (ABP) granted planning permission (subject to conditions) to the Port of Cork's proposal to upgrade their facilities at Ringaskiddy. This port upgrade project includes enhancements of the port container berths and multi-purpose berth at Ringaskiddy East, deepwater berth extension at Ringaskiddy West, road and access improvements and the development of an amenity area at Paddy's Point. The full implementation of the port upgrade, i.e. Phase 3 is conditioned on the completion of the upgrade of the N28. The proposed road project is a vital support for the Port of Cork's redevelopment, which in itself will create economic growth through the expansion and rationalisation of the port facilities.

1.3.3.3 Tourism

The proposed M28 Road Project will support the potential for increased tourism in the area. Current tourism plans include the restoration of the Irish Steel site and the remediation plans for the East Tip site on Haulbowline Island. These sites could facilitate a potential Naval or Maritime Museum to create an area of tourism interest around the theme of naval heritage currently being considered for the wider harbour area.

There is also significant potential for leisure and tourism attractions on Spike Island which was formerly a prison up to the 1960's and historically housed convicts scheduled for deportation to Australia during the 18th century. Spike Island redevelopment as "Fortress Spike" has been completed and is open to the public, with access by boat from Cobh. Other tourism potential sites include the historical and heritage importance of the town of Cobh, as a point of departure for the diaspora during the mid-19th century and the more recent provision by Port of Cork of the only dedicated cruise liner berth in Ireland capable of accommodating the largest of cruise liners.

These tourist developments will combine to make this area of Cork Harbour a key tourist attraction for the future, which could significantly increase travel demand on the N28 and which would be significantly boosted by the Proposed M28 Road Project.

1.3.3.4 Cost Benefit Analysis

In line with the requirements of the Department of Public Enterprise and Reform (DEPER) relating to any significant public capital project and in accordance with TII Project Management Guidelines (PMGs) a cost-benefit analysis (CBA) has been undertaken on the Proposed M28 Road Project. This cost-benefit analysis provides for the calculation, over an assessment period of 30 years, of the present value of both costs and benefits of a development. The benefit to cost ratio, (BCR) is an expression of the economic value of a project. Positive results are when the BCRs are >1, i.e., the value of the benefits exceed the value of the costs. A summary of the CBA results for the proposed Road Project for Low, Medium and High growth scenarios (refer to **Table 1.4**) are presented in **Table 1.1**. The user benefits calculated by TUBA are the value of the savings in travel time and vehicle operating costs that result from the project, based on comparing the Do-Scheme and Do-Minimum results from the traffic model.

Table 1.1: Cost-Benefit Results

Transport User Benefit Appraisal (TUBA)	**M28 Cork to Ringaskiddy Project**		
Growth Scenario	**Low**	**Medium**	**High**
Benefits €m			
TOTAL Present Value Benefits (PVB)	**200.11**	**615.117**	**785.963**
Costs €m			
Operating Cost (Maintenance)	5.169		
Investment Cost	167.262		
TOTAL Present Value Costs (PVC)	**172.431**		
Comparison			
Benefit to Cost Ratio (BCR)	*1.16*	*3.57*	*4.56*

The results show that the Proposed M28 Road Project is economically viable, offering an excellent return on the investment, illustrated by very positive Benefit to Cost Ratios (BCR), particularly for the medium and high growth scenarios (note, low growth scenario assumes negligible growth at the port in Ringaskiddy).

1.3.3.5 Economic Benefits

Road projects have beneficial economic impacts that are not fully captured by the transport cost assessment included in the CBA. The CBA assesses the road user cost of time benefits and investment costs arising from the provision and use of the road over its assessment period. The benefit of indirect benefits, so called externalities include impacts on competition in the economy, agglomeration or clustering of economic activity, FDI into Ireland, improved labour supply, and urban regeneration, etc. These benefits are additional to those quantified in the CBA.

1.3.3.6 Cork Region Economic Impacts

The proposed M28 Road Project is the most important transportation project for the Southern Region after the Dunkettle Interchange Improvement Scheme. The delivery of the Proposed M28 Road Project has direct consequences for the growth and development of Cork City, the economic development of the Cork region, the direct development of the Port of Cork and of the Strategic Employment Area located at Ringaskiddy. The delivery is very important to the economic development of the Southern Region.

The economic effects of the project will indirectly benefit Cork City through increased economic activity and it will enable the transition of port activities from the City Quays at the Dockland's and from Tivoli, to Ringaskiddy, which will release brown field development sites of significant scale within the city, the development of which will become the driving force for the growth of the economy of the Cork City region in the future.

To summarise the proposed M28 Road Project is critically important infrastructure for the future development of the Cork Region.

1.3.4 Safety

A significant number of potential road safety deficits have been identified with the existing road alignment, outlined as follows:-

- A significant amount of weaving occurs over a short distance on the N28, between the on-ramps from Rochestown Road and the Bloomfield Interchange with the N40 ring road (both directions);
- The build-up of a significant queue of traffic on the Rochestown Road off–ramp during the evening peak which can extend from the roundabout on Rochestown Road along the ramp back onto the N28 carriageway as far as the Bloomfield Interchange and potentially back onto the N40;
- The roundabout on the Rochestown Road at the off-ramp prioritises outbound traffic on the Rochestown Road coming from Douglas, which during the evening peak results in restricting access onto the Rochestown Road for traffic from the off-ramp contributing to the build-up of the queue on the ramp;
- The build-up of a traffic queue during the evening peak on Rochestown Road between the Clarke's Hill junction and the above mentioned roundabout because of congestion at the Clarke's Hill junction. This congestion is due to the restriction of right turning outbound traffic on the Rochestown Road arising from the absence of a right turn lane and/or signal control at the junction;

- Lack of overtaking opportunities along a significant proportion of the existing N28 route, due to the presence of long sections of continuous centreline markings arising from very poor existing alignment, proliferation of junctions and other deficiencies;
- There are a large number of direct accesses to properties and farms, including a sub-standard southbound off slip to Mount Oval estate and a number of concealed entrances, many of which have restricted visibility;
- No right turn permitted into the Board of Works Road for vehicles travelling southbound on the N28 and no right turn permitted from the Board of Works Road onto the N28;
- There are a number of different cross sections on the existing N28 between Bloomfield and Ringaskiddy including dual carriageway, climbing lanes, single carriageway with hard shoulders and single carriageway without hard shoulders;
- The combination of substandard vertical and horizontal alignments provides limited forward visibility and inadequate braking or stopping distance along sections of the route;
- A fuel station is located to the north of Shannonpark Roundabout, where truck parking is available. A significant number of uncontrolled turning movements occur here which are potential sources of collisions;
- The N28 is the main road through Shanbally and Ringaskiddy villages and the mix of pedestrians and high traffic volumes are a potential source of accidents and risk; and
- Collision clusters are noted at/adjacent to the Rochestown Road junction, at/adjacent to Shannonpark Roundabout and at Raffeen Bridge as indicated in **Figure 1.6** below.

1.3.4.1 Collision Information

Accident data for the five-year period between 2009 and 2013 was supplied by Cork County Council. The control data used for comparison purposes is the Road Safety Authority (RSA), Road Collision Facts, 2013.

The study area's geographical distribution of collisions between 2009 and 2013 are illustrated in the drawing provided in **Figure 1.6** and tabulated in **Table 1.2** below.

Table 1.2: Collisions 2009 to 2013

Collision Type/Year	2009	2010	2011	2012	2013	Total
Fatal	0	2	2	0	0	4
Serious Injury	1	0	0	0	0	1
Minor Injury	5	6	9	7	1	28
Total	6	8	11	7	1	33

Source: RSA and CCC (most up to date data available as of April 2017).

There were a total of 33 collisions recorded along the 11.9km section of the N28 from Bloomfield Interchange to Ringaskiddy from An Garda Síochána CT68 files and the RSA National Database. The 33 collisions comprised 4 fatal, 1 serious injury and 28 minor injury collisions. **Figure 1.6** illustrates the collision data (2009 to 2013) along the existing N28 corridor.

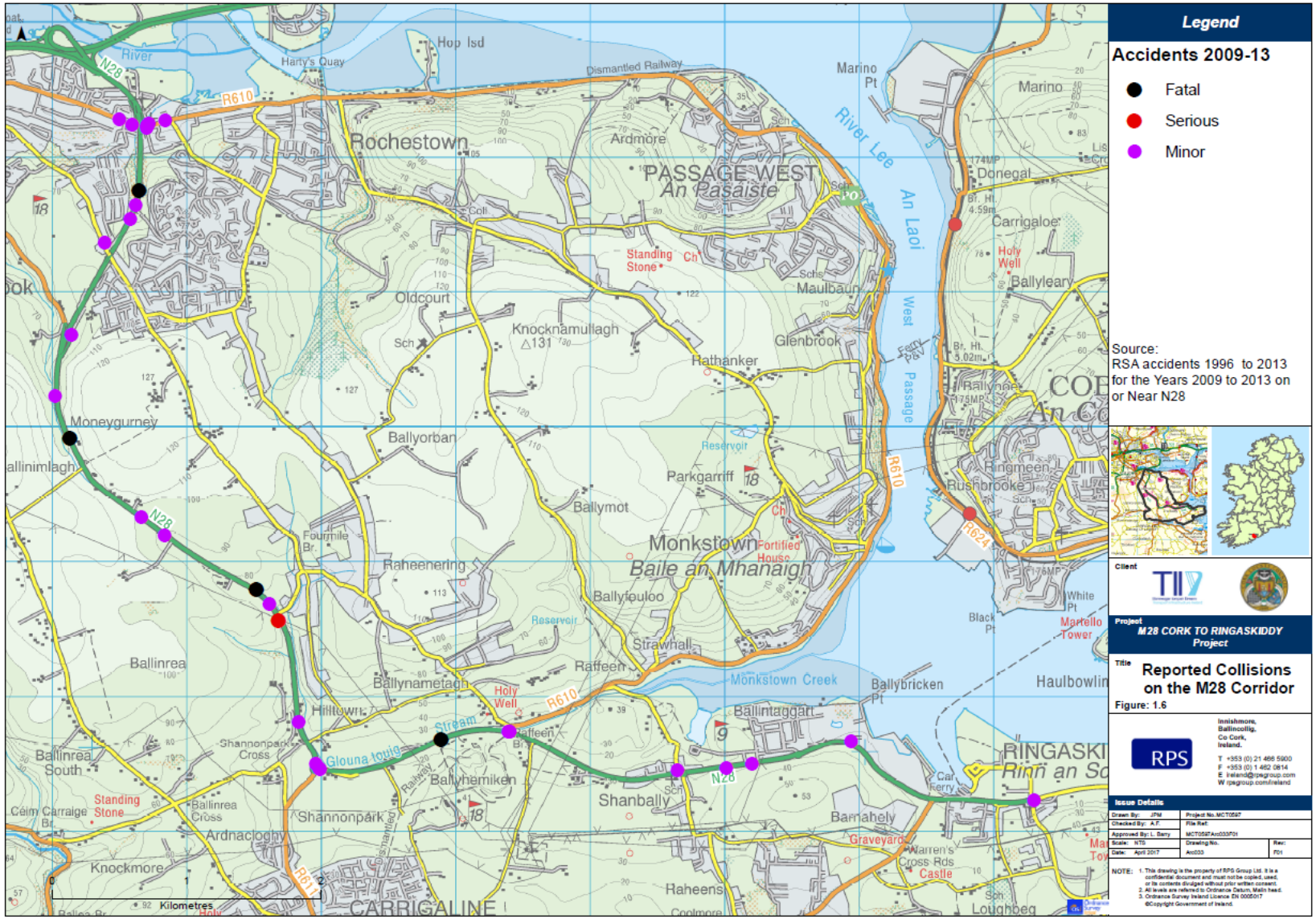
Collision clusters are noted at/adjacent to the Rochestown Road junction, at/adjacent to Shannonpark Roundabout and at Raffeen Bridge.

The N28 has a high record of fatal accidents in recent years, relating to the combination of heavy traffic flows, a significant proportion of HGVs and a road of poor quality in places.

It is possible to quantify improvements in safety performance of a proposed improvement of a route corridor in statistical and monetary terms. This is achieved by applying statistical accident rates and accident economic costs for different road types to the predicted amount of travel over time to calculate a predicted savings. Extrapolated over a 30-year period, using date from the Traffic model, it is estimated that the proposed road project will save 370 collisions, including 8 fatalities, giving a Present Value of Accident Savings of € 19.7m.

It should be noted that statistically, roads designed to motorway standards have the lowest accident rates per vehicle kilometre travelled. In comparison to rural single carriageway roads, motorways are statistically 4 times safer for the equivalent vehicle kilometres travelled (*Project Appraisal Guidelines for National Roads Unit 6.11 – National Parameters Values Sheet*).

Figure 1.6: Reported Collisions on the N28 Corridor



1.3.5 Inadequacies of the Existing Route

1.3.5.1 Overview of Existing N28

The N28 is the main route from Cork to Ringaskiddy and extends from the junction with the N40 South Ring Road at Bloomfield Interchange through Carr's Hill and Shannonpark Roundabout to Ringaskiddy. The N28 consists of 12km of single lane carriageway with a short section of dual carriageway immediately south of Bloomfield Interchange. The route ends at the village of Ringaskiddy and provides access to the Port of Cork facilities at Ringaskiddy harbour. The N28 ends at the L2545, which continues to Haulbowline Island.

The condition of the existing carriageway is such that significant improvements will be required to provide users with a route that satisfies today's standards for ride quality, safety and comfort. The horizontal and vertical geometry is sub-standard, the cross-section varies along its length, and junction types and layouts also vary.

1.3.5.2 Deficiencies on the Existing N28

The deficiencies associated with the existing N28 route are summarised as follows:-

- Single carriageway section between Rochestown and Shannonpark is subject to traffic volumes in excess of the capacity of the road. This section of the route is also characterised by the local topography with some climbing lanes having very high gradients;
- Weaving movements between different traffic streams result in accident risk and loss of capacity between Bloomfield and Rochestown Road;
- Sub-standard diverge at Mount Oval and merge at Maryborough Hill;
- South of Carr's Hill, frequent ribbon development and local road accesses;
- Non-standard road design in terms of horizontal and vertical alignment and narrow road widths;
- Frequent delays and collisions;
- Lack of overtaking opportunities;
- Capacity of Shannonpark roundabout is exceeded, particularly in peak hours;
- Route causes significant noise and severance in the villages of Shanbally and Ringaskiddy;
- Multi-functional corridor catering for all transportation demand including strategic port related traffic (with high HGV content), commuting to/from the strategic employment areas in Ringaskiddy, commuting to/from the dormitory town of Carrigaline, local traffic movements and agriculture related traffic movements. In addition the corridor has to cater for pedestrian, cyclist and public transport demand;
- Traffic calming and urban speed limits in the village of Shanbally causes delay and reduces the capacity of the route; and
- Capacity limitations of the existing route constrain sustainable growth in the Strategic Employment Area and restrict the full development of the Port of Cork facilities at Ringaskiddy, which are consented by ABP but that are constrained as a condition of the planning consent due to the capacity of the existing N28.

1.3.5.3 Benefits of the Proposed M28 Road Project

The Proposed M28 Road Project will mitigate the existing deficiencies on the existing N28 by:-

- Eliminating the need for traffic to weave between lanes over a very short distance where the northbound Rochestown Road traffic merges with the northbound N28 traffic, which then weaves in order to travel east or west on the N40;
- Providing road capacity to cater for demand and provision for future growth;
- Closing of the sub-standard merge at Maryborough Hill and replacing it with a compliant merge lane at Carr's Hill Interchange. A 2-way link road is proposed to connect the two locations;
- Upgrading the existing sub-standard diverge at Mount Oval to motorway standard;
- Providing a consistent design in terms of road cross-section, horizontal and vertical alignment in accordance with modern standards, which will improve both capacity and safety performance;
- Providing modern interchanges with the local road network to enhance the overall capacity of the network;
- Separating strategic and local traffic streams;
- Removal of through traffic from the villages of Shanbally and Ringaskiddy; and
- Facilitating improved public transport and other sustainable modes on the existing N28.

1.3.6 Existing Traffic Demand

1.3.6.1 Road Capacity and Level of Service

Traffic counts for this study were undertaken in April 2014. Data from the TII permanent counter at N28 Carr's Hill was used to convert these measured figures into estimated Annual Average Daily Traffic (AADT), contained in **Table 1.3.**

Typically, for national roads in Ireland a Level of Service (LOS) D[2] is the targeted minimum level of service to be achieved. In **Table 1.3**, the indicative capacities are those given for various road types which generally result in a LOS D.

[2] Level of Service (LOS) for a road is typically defined in the US Highway Capacity Manual as a quality measure describing operational conditions within a traffic stream. This is generally in terms of such measures as speed and travel time, freedom to manoeuvre, traffic interruptions and comfort and convenience. Six LOS are defined for various situations, LOS A to LOS F, where A represents the best operation conditions and F representing the worst.

Table 1.3: Traffic on Existing N28 – Flow to Capacity Ratios

Location	Annual Average Daily Traffic (AADT) Estimated from 2014 Counts	No. of Lanes	Type of Carriageway	Carriageway Width	AADT Capacity +	Ratio of Flow to Capacity (RFC)
N28 North of Rochestown Road Junction (dual carriageway section)	46,400	6	-	22.0	-	-
N28 South of Rochestown Road Junction	25,300	3	Type 3 Dual	11.1	14,000	**1.81**
N28 North of Shannonpark Roundabout	26,200	2	Type 1 Single	8.9	11,600	**2.26**
R611 South of Shannonpark Roundabout	20,900	2	Type 1 Single	8.0	11,600	**1.80**
N28 East of Shannonpark Roundabout	13,100	2	Type 1 Single	7.6	11,600	**1.13**
N28 East of Shanbally	8,900	2	Type 2 Single	6.9	8,600	**1.03**
N28 East of R613 Junction (Ringaskiddy Village)	6,700	2	Type 2 Single	8.6	8,600	0.78
+ taken from NRA DMRB TA 9/12 – Indicative Capacity at LOS D						

Table 1.3 tabulates indicative capacities for the various sections of the N28 based on guidance from NRA TD 9/12 of the NRA *Design Manual for Roads and Bridges* (DMRB). The Ratio of Flow to Capacity (RFC) compares the actual (or predicted) traffic flow with the theoretical traffic flow capacity. RFC values greater than 1 indicate situations where the capacity of the road is exceeded by the actual (or predicted) traffic flow. The analysis illustrated in **Table 1.3** shows that the capacity of the existing N28 is exceeded for LOS D and there is little or no capacity for future growth.

In particular, the existing capacity of the section of the N28 north of Carrigaline and Shannonpark Roundabout is significantly exceeded by the volume of the existing traffic. The low level of service actually achieved on this section of the route is manifested by the frequent delays and significant levels of congestion usually experienced by drivers, particularly during week-day peak hours which typically extend for approximately 2.5 hours in both the am and pm periods. Frequent delays are also experienced at Shannonpark Roundabout, Carr's Hill and at Bloomfield Interchange/Rochestown Road. Refer to **Plate 1.1** which would be a typical feature during peak hour traffic on the southbound approach to Shannonpark Roundabout.

The risk of accidents increases as level of service decreases. Also, vehicles seeking to access the N28 from side roads will find fewer opportunities to turn onto the carriageway and merge safely with the traffic stream and may through frustration take unnecessary risks.

East of Shannonpark, traffic demand is primarily driven by access to and from the existing pharmaceutical plants in Shanbally, Ringaskiddy and Loughbeg, where very significant employment is provided. Traffic to and from the port at Ringaskiddy is also significant. Other traffic generators include Irish Naval College/UCC Beaufort Laboratory and Haulbowline. Refer to **Figure 1.2** for illustration of the facilities present in the locality. Over this section, the route is typically at capacity for the particular type of road present.

Plate 1.1: Congestion on the N28 (2014)

1.3.6.2 Average Journey Times/Speeds

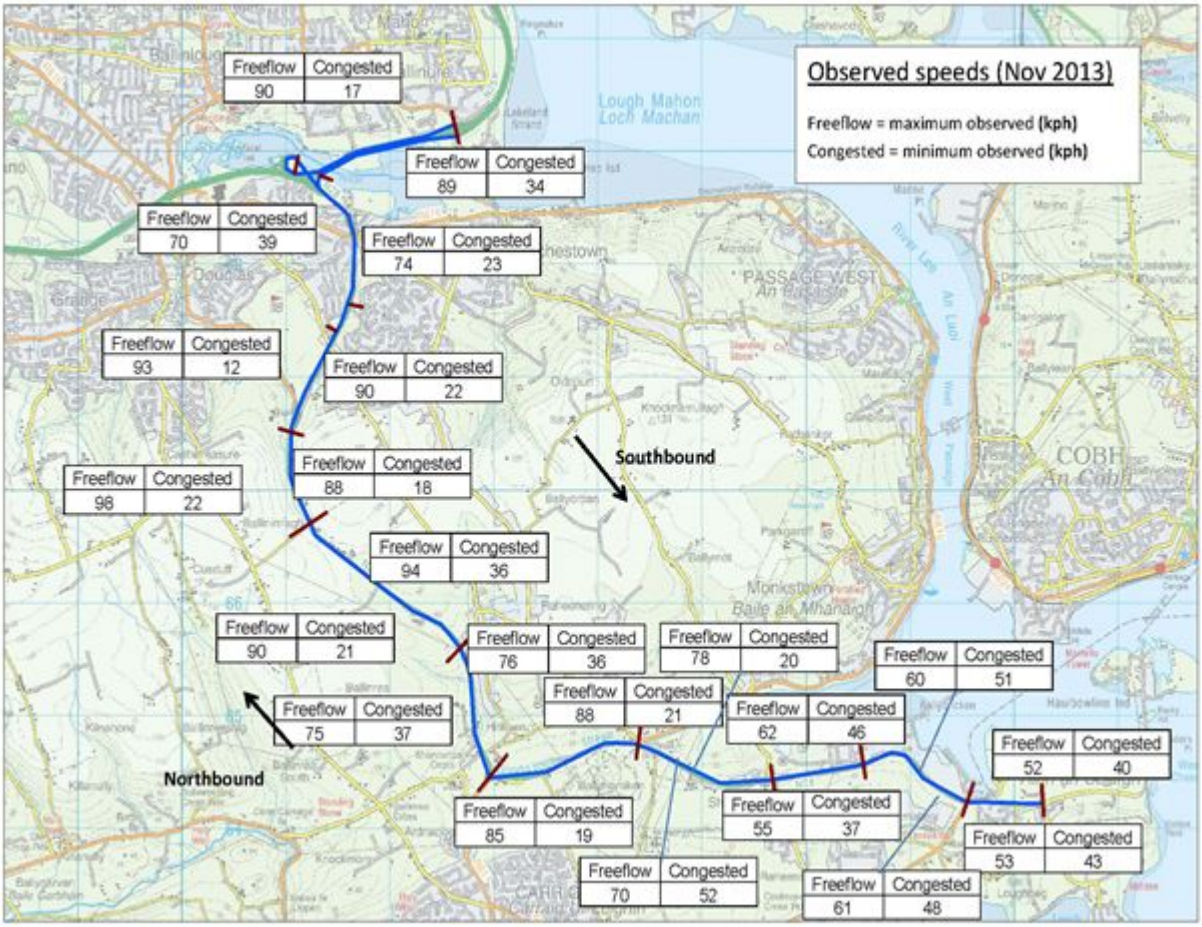
Figure 1.7 illustrates the measured traffic speeds based on a number of journey time surveys carried out in both congested peak hours and relatively free flow in off-peak periods. The map illustrates very clearly the existing peak hour travel problems experienced in the area.

Compared to the free flow condition, the peak hour travel speeds drop significantly. This is clearly illustrated to be the case on the N40 either side of the N28 and on the N28 between Shannonpark and Bloomfield, where northbound AM peak travel speeds can drop from around 90kph off-peak to around 20kph or less. Similarly the southbound PM peak hour in this location shows again that off-peak average speeds drop from around 90kph to 20kph or less. This is a very significant drop in average travel speed and is entirely consistent with the low level of service that the existing road provides in the peak hours.

East of Shannonpark, the observed average travel speeds also show significant reduction in the peak hours. This is not as dramatic as for the northern section of the route, but nonetheless it is significant confirming that the route is at or close to its capacity under current traffic conditions.

The peak hour reductions in eastbound travel speed towards Shanbally and westbound towards Shannonpark confirms the particular problem of peak hour delays that occur in these locations.

Figure 1.7: Observed Speeds



1.3.7 Predicted Traffic Demand

1.3.7.1 Forecast Growth

If no additional capacity is provided, then journey times for N28 traffic will increase significantly in the future (particularly during peak hours) as traffic demand continues to grow.

Forecast future levels of traffic are based on TII traffic growth projections from the National Traffic Model, and levels of port-related traffic from the published EIS for the development of the Port of Cork at Ringaskiddy. In accordance with standard forecasting methods, three growth scenarios are used – Low, Medium and High. **Table 1.4** shows the growth in demand for highway travel over the study area.

Table 1.4: Forecast Growth in Travel Demand (Relative to Base Year 2014)

Growth Scenario	2020	2035	2050
LOW	7.3%	17.7%	22.0%
MEDIUM	9.9%	26.0%	34.7%
HIGH	11.2%	29.8%	42.2%

1.3.7.2 Predicted Road Capacity and Level of Service

Without the proposed road project in place, the traffic model forecasts that with increasing congestion along the N28, an increased proportion of peak hour drivers will seek alternative routes involving minor roads unsuitable for heavy traffic, and an increasing proportion of drivers will not complete their journey in the modelled hour. Thus the observable traffic on the road will grow by less than the demand.

Table 1.5: Forecast Do-Minimum Traffic Levels at Design Year, 2035 – Flow to Capacity Ratios

Location	AADT Estimated from 2014 Counts	No. of Lanes	Type of Carriageway	Carriageway Width	AADT Capacity +	RFC
N28 North of Rochestown Road Junction (dual carriageway section)	60,560	6	-	22.0	-	-
N28 South of Rochestown Road junction	23,970	3	Type 3 Dual	11.1	14,000	**1.71**
N28 North of Shannonpark Roundabout	30,430	2	Type 1 Single	8.9	11,600	**2.62**
R611 South of Shannonpark Roundabout	20,350	2	Type 1 Single	8.0	11,600	**1.75**
N28 East of Shannonpark Roundabout	17,990	2	Type 1 Single	7.6	11,600	**1.55**
N28 East of Shanbally	10,860	2	Type 2 Single	6.9	8,600	**1.26**
N28 East of R613 Junction (Ringaskiddy village)	9,040	2	Type 2 Single	8.6	8,600	**1.05**

+ taken from NRA DMRB TA 9/12 – Indicative Capacity at LOS D

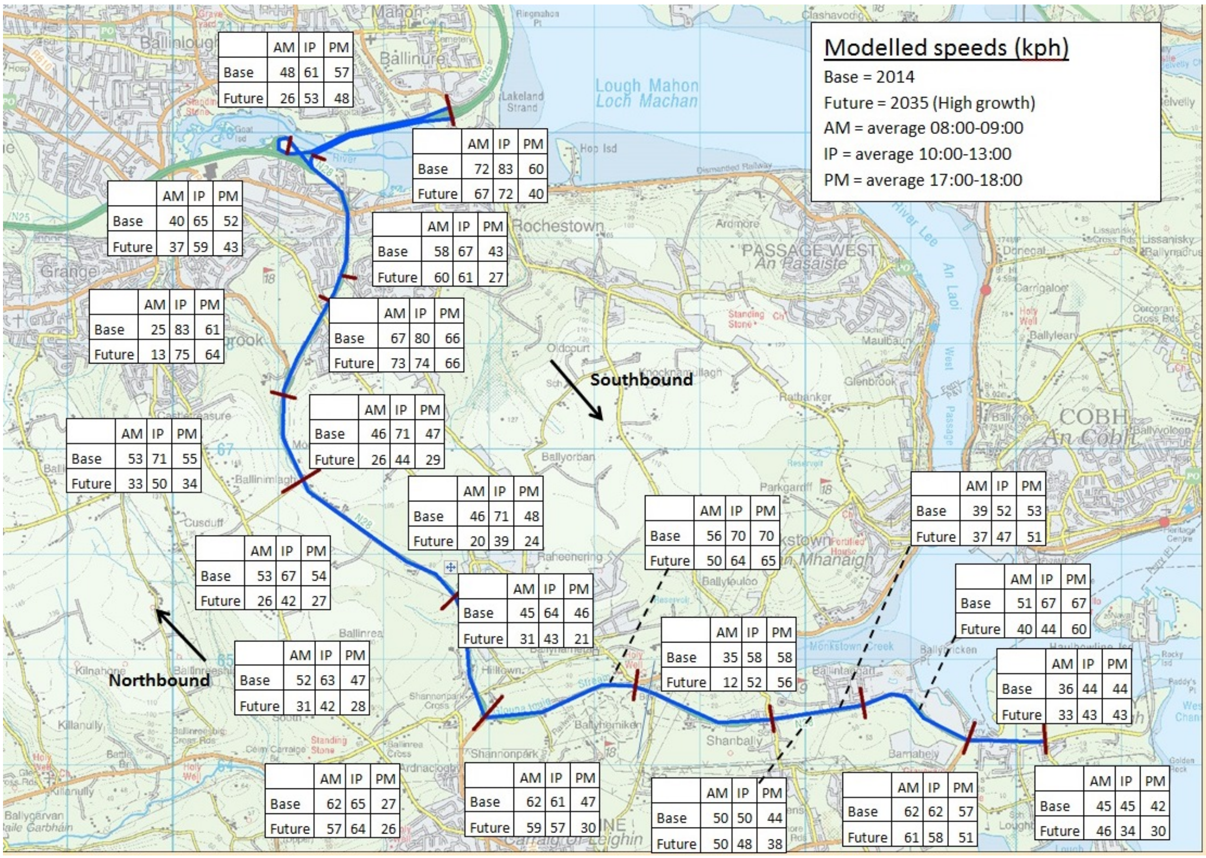
Table 1.5 tabulates indicative capacities for the various sections of the N28 based on guidance from NRA TD 9/12 of the NRA DMRB. The RFC compares the actual (or predicted) traffic flow with the theoretical traffic flow capacity. RFC values greater than 1 indicate situations where the capacity of the road is exceeded by the actual (or predicted) traffic flow. The analysis illustrated in **Table 1.5** shows that the capacity of the existing N28 will continue to be exceeded into the future and the already poor level of service will continue to decrease as traffic volumes increase over time.

1.3.7.3 Predicted Average Journey Times/Speeds

Figure 1.8 illustrates modelled traffic speeds for peak and interpeak hours, for base and future years without the proposed road project in place.

For many combinations of location, direction and time period, future speeds are slightly lower, reflecting the general increase of around 30% in the traffic along the route. Generally, where there is least congestion, the change in average speeds is smallest, as traffic volumes increase over time.

Figure 1.8: Modelled Speeds Base (2014) Vs Do Minimum (2035) High Growth



Particularly congested locations include:-

- Shanbally Roundabout (eastbound/southbound in the AM peak);
- Shannonpark Roundabout (both directions in the PM peak);
- Shannonpark Roundabout to Carr's Hill Interchange (both directions in both peaks); and
- Maryborough/Mount Oval (northbound in AM peak, southbound in PM peak).

Comparison between the Base Year (2014) and the Design Year (2035) indicate that existing conditions will continue to deteriorate with average travel speeds decreasing significantly as traffic demand continues to grow over time.

1.3.8 Do Minimum – Continuing with the existing situation

Sections 1.3.6 and **1.3.7** above describe the Do Minimum, i.e. existing and future situation without the proposed road project in place. Traffic growth will exacerbate the existing situation with congestion and delays getting worse. In **Chapter 5: Traffic and Transport** of this EIS, the traffic benefits of the proposed road project are described in detail and demonstrate the improvements that it will bring to the existing situation.

1.3.9 Environmental Benefits

The direct environmental benefits include:-

- Increased road network capacity and improved travel conditions for both local and strategic traffic;
- Improved road safety;
- Reduced traffic congestion by removing existing constraints;
- Improved road drainage;
- Overall a net decrease in the impact of road traffic noise on properties after the construction of the road project;
- Reduced community severance at Shanbally and Ringaskiddy villages; and
- Improved travelling environment on the existing N28.

1.3.10 Accessibility and Social Inclusion

It will significantly improve accessibility and social inclusion primarily relating to access to employment centres on the Ringaskiddy peninsula for non-car-owners and safer access for vulnerable road users including pedestrians and cyclists, particularly among the school children from the local communities. High levels of traffic on the existing N28 tend to deter vulnerable road users, with Shannonpark Roundabout being particularly difficult to navigate and unfriendly to cyclists and pedestrians.

It will remove significant traffic volumes from the existing N28. This reduction in traffic offers opportunities to improve facilities for alternative travel modes along the existing road for commuters, non-motorway users, the local community and other vulnerable road users. This will strongly support sustainable transport initiatives on the existing N28 corridor. Cork County Council are seeking to promote alternative travel modes among employee commuters on the Ringaskiddy Peninsula by implementing high quality pedestrian, cycle and bus priority routes and increased public transport within the study area.

The project has the potential to facilitate significantly improved bus services to the local area, including Carrigaline and Douglas. Public transport serving Carrigaline is currently by means of scheduled bus services. Express bus services to/from Carrigaline and Cork City in particular, facilitated by the motorway would be a significant improvement in public transport services leading to significant public transport mode shift in the area.

1.3.11 Summary

The generation of traffic as a result of the proposed road project is likely to be modest although there will be some minor increases due to the reduction in journey times between Cork and Ringaskiddy which will make the trip more attractive.

Key benefits are that it:-

- Supports European TEN-T Policy, National Ports Policy and other National, Regional and local policies as fully outlined in **Chapter 2: Planning and Policy Context**;

- Reduces peak hour congestion and travel delays on the N28 Corridor at an investment cost that offers value for money as illustrated by highly positive BCRs;
- Provides a high quality road for strategic port traffic and other users with capacity to cater for future demand to support growth of the Strategic Employment Areas, Port of Cork, IMERC and tourism potential and improves the competitiveness and efficiency of the economy both locally in the Ringaskiddy Peninsula and nationally;
- Improves the N28 route to modern design standards including the removal of bottlenecks, provision of safe overtaking, weaving lanes and appropriate dedicated road width;
- Improves transport infrastructure for local traffic and non-motorised road users by removing traffic from the existing N28;
- Improves safety along the existing roads and at junctions/accesses;
- Improves safety by separating local traffic movements from strategic traffic;
- Facilitates the use of the existing N28 for sustainable transport modes including cycling and walking (and potential creation of a green-route);
- Overall reduces environmental and socio economic impacts (including noise and air) on the local residents and communities along the existing N28;
- Facilitates sustainable transport, i.e., local Greenway initiatives and removing traffic from the existing N28;
- Provides a dedicated rest area for commercial vehicles at Ringaskiddy;
- Improves access to both the local and national network which will improve accessibility to work, education and other activities; and
- Improves overall emergency response in the Ringaskiddy area (Seveso Report, RPS 2017).

1.4 NEED FOR A SERVICE AREA

The travelling experience of road users is being transformed as a consequence of the scale of the present national roads programme. On completion of the M28 Cork to Ringaskiddy Road Project, it will be possible to travel on dual carriageway or dual carriageway motorway from the M1 Belfast to M50 Dublin and on to the M28 Ringaskiddy, a distance of over 430km.

With the upgrade of the N28, the proposed road project will by-pass the current fuel station situated on Carr's Hill. From Cork to Ringaskiddy there will be no direct fuelling area on the M28. Locating a terminus service area within the port will give users of the port and core network the comfort of knowing that there vehicle will be safe while waiting to board the ferry, a waiting area before collecting cargo or before setting off on their journey. It will provide users with rest facilities as well as fuel, toilet & food facilities.

Key policy and planning documents relating to service areas on the core national road network are obtained in the "Trans-European Transport Network"; Regulation No 1315/2013, "TII (NRA) Service Area Policy" and the "Spatial Planning and National Roads" guidelines.

The key objectives of the Trans-European Transport Network is to strengthen the social, economic and territorial cohesion of the European Union and contribute to the creation of a single European transport area which is efficient and sustainable; increases the benefits for its users and supports inclusive growth. Priorities for transport infrastructure requirements are as follows:-

- Improvement and promotion of road safety;

- Use of Intelligent Transport Systems (ITS), in particular multimodal information and traffic management systems and integrated communication and payment systems;
- Introduction of new technologies and innovation for the promotion of low carbon transport,
- The mitigation of congestion on existing roads; and
- Provision of appropriate parking space for commercial users offering an appropriate level of safety and security

In addition, Transport Infrastructure Ireland/National Roads Authority has published the "NRA Service Area Policy" which sets out the basis on which on- line service areas will be provided to meet the needs of road users on the National Road network in Ireland. The Authorities policy for the M28 Cork to Ringaskiddy Road Project is as follows:-

> *"A Type 1 Service Area is proposed for the M28 from Cork to Ringaskiddy. Cork County Council, in consultation with the Authority, will include consideration of the appropriate location of this service area as part of the scheme planning, currently underway."*

The Spatial Planning and National Roads provide guidelines to planning authorities on the siting of on-line and off-line motorway service areas. The service area must provide rest, fuel, toilets and food facilities. The guidelines state that a service area should avoid the attraction of short, local trips, avoid a class of traffic that is inconsistent with the primary intended role and cater for long distance, inter-urban and inter-regional traffic.

1.4.1 Non-Statutory EIA Scoping

An informal non-statutory EIA Scoping Report was prepared to avail of the opportunity for consultation prior to the publication of the EIS. The scoping consultation process commenced on 17th February 2015 and responses were requested by 16th March 2015 (4 weeks from date of issue). A Health Study Scoping Statement was issued to key stakeholders (including the HSE and EPA) in 2017.

Additionally, ongoing scoping has been applied proactively throughout the EIS compilation process by the design team and the various specialist sub-consultants. A copy of the EIS Scoping Report and a copy of the Health Study Scoping Statement are contained within **Appendix 1B**. Further detail on non-statutory consultation is provided in **Chapter 6: Non-Statutory Consultation**.

1.5 STRUCTURE AND SCOPE OF THE ENVIRONMENTAL IMPACT STATEMENT

The EIS has been prepared pursuant to Section 50(2) and Section 50(3) of the Roads Act, 1993, as amended.

The content has been informed by the Scoping Report and Health Study Scoping Statement prepared for the Proposed M28 Road Project (refer to **Section 1.4.1** above).

A Non-Technical Summary (NTS) has also been produced to summarise the main details of the project in non-technical language and is available as a separate report. This is contained in **Volume 1** of the EIS.

The details of the EIA are contained within the EIS in **Volume 2**. The EIS is divided into sections i.e. Human Environment, Natural Environment and Material Assets. There is potential for interactions and/or cumulative impacts between two or more environmental topics in each of these sections. The potential for likely significant effects from these interactions has been taken into account in **Chapter 18: Interaction and Inter-relationship of Impacts** and where relevant complimentary mitigation measures have been proposed (**Chapter 19: Summary of Mitigation Measures**).

The NIS, which addresses potential impacts to European Sites for the purposes of Article 6 of the Habitats Directive, is contained within **Volume 3.** The Health Study prepared for the project is included within **Appendix 1C** in **Volume 4** and referred to in **Chapter 7: Socio Economic & Community, Chapter 13: Air and Climatic Factors** and **Chapter 14: Noise and Vibration.** Appendices to the EIS are also contained in **Volume 4.**

Relevant drawings and figures are contained within **Volume 5** of the EIS. **Table 1.6** below summarises the structure of the EIS.

Table 1.6: Structure of the Environmental Impact Statement

Volume	Part
Volume 1: Non-Technical Summary	Non-Technical Summary
Volume 2: Main Report	Chapter 1: Introduction and Need for the Proposed Road Development
	Chapter 2: Planning & Policy Context
	Chapter 3: Description of Proposed Road Development
	Chapter 4: Outline of Alternatives
	Chapter 5: Traffic and Transportation
	Chapter 6: Non-Statutory Consultation
	Chapter 7: Socio-Economic & Community
	Chapter 8: Agricultural Land Uses
	Chapter 9: Hydrology & Drainage
	Chapter 10: Aquatic Ecology
	Chapter 11: Soils, Geology & Hydrogeology
	Chapter 12: Terrestrial Ecology
	Chapter 13: Air and Climatic Factors
	Chapter 14: Noise and Vibration
	Chapter 15: Cultural Heritage (including Archaeology and Architectural Heritage)
	Chapter 16: Landscape and Visual
	Chapter 17: Material Assets
	Chapter 18: Interaction and Inter-relationships of Impacts
	Chapter 19: Summary of Mitigation Measures
Volume 3	Natura Impact Statement
Volume 4	Appendices & Health Study
Volume 5	Drawings and Figures

The EIS has been prepared having regard to the following guidelines:-

- *Draft Advice notes on Current Practice* (EPA, 2015);
- *Draft Guidelines on Information to be contained in Environmental Impact Statements* (EPA, 2015);
- *Environmental Assessment and Construction Guidelines* (NRA, 2010);
- *Environmental Impact Assessment of National Road Schemes - A Practical Guide* (NRA, 2008); and
- Various NRA Guidelines for relevant specialist areas (treatment of bats, landscape, ecology noise), etc.

The assessment of impacts, the prediction of environmental effects and the proposed mitigation measures are based on the design[3] of the proposal as detailed in **Chapter 3: Description of the Proposed Road Development** of this EIS.

The impact assessment compares the quality of the receiving environment for the Do-Nothing Scenario (the environment as it would be in the future should the proposed road not be developed) and for the Do-Something (Proposed M28 Road Project).

The opening year is taken as 2020 and the design year is taken as 2035 as detailed in **Chapter 5: Traffic and Transportation**. The environmental assessment of the Do-Nothing and Do-Something Scenarios is documented in chapters **7** to **18** of this EIS.

This EIS is compiled by consultants RPS, together with independent specialist consultants (**Table 1.7**).

Table 1.7: Specialist Inputs

Specialist Input	Sub Consultant	Input
Aquatic Ecology Surveys **(Chapter 10)**	Dixon Brosnan Environmental Consultants	Fish Stock Assessment
Ecology Surveys (**Chapter 12**)	Tom Gittings, Ecological Consultant and Glás Ecology Tony Nagle Karen Banks and Aardwolf Consulting Cilian Roden	Winter Bird Surveys Peregrine Falcon Survey Bats Wetland Survey
Archaeology Surveys (**Chapter 15**)	Courtney Deery Heritage Consultancy	Archaeology and Cultural Heritage

1.6 NON -STATUTORY CONSULTATION

Statutory and non-statutory bodies, as well as interest groups and members of the public have been consulted through all stages of the progression of the project and is summarised in **Chapter 6: Non-Statutory Consultation** of this EIS.

[3] Design means a design to satisfy the requirements of Phase 3 NRA Project Management Guidelines.

2 PLANNING AND POLICY CONTEXT

This chapter reviews the proposed road project in the context of European and national transport policy and with national, regional and local planning policy.

In the context of the policies set out below, the proposed road project is of both international and national significance as well as a very important infrastructure project in the regional and local development context.

Transport Policy

- Infrastructure - TEN-T - Connecting Europe, 2014.
- North Sea-Mediterranean Second Work Plan of the European Coordinator, December 2016.
- TEN-T Network Regulations, 2013.
- National Ports Policy, 2013.
- Department of Transport: Statement of Strategy, 2016 - 2019.
- Investing in our Transport Future: A Strategic Investment Framework for Land Transport, 2015.
- Spatial Planning and National Roads: Guidelines for Planning Authorities, 2012.
- Smarter Travel, A New Transport Policy for Ireland, 2009 - 2020.
- NRA Service Area Policy, 2014.

Planning Policy

- National Development Plan, 2007 - 2013.
- Building on Recovery: Infrastructure and Capital Investment, 2016 - 2021.
- National Spatial Strategy, 2002 - 2020.
- Towards a National Planning Framework: Ireland 2040 Our Plan - Issues and Choices, DHPCLG February 2017.
- Our Sustainable Future: A Framework for Sustainable Development, 2020.
- Regional Planning Guidelines for the South West Region, 2010 - 2022.
- Cork Area Strategic Plan (CASP): Strategy of Additional Economic and Population Growth - Update 2008.
- Cork County Development Plan, 2009 - 2015.
- Cork County Development Plan, 2014 - 2020.
- Cork City Development Plan 2015 - 2021.
- Carrigaline Electoral Area Local Area Plan, 2011 (as amended).
- Draft Carrigaline - Ballincollig Municipal District Local Area Plan, 2016.

2.1 TRANSPORT POLICY

2.1.1 Infrastructure - TEN-T - Connecting Europe, 2014

As of January 2014, the European Union has a transport infrastructure policy entitled 'Infrastructure - TEN-T - Connecting Europe' which refers to the Trans European Network that connects the continent between east and west, north and south. This policy aims to close the gaps between member states' transport networks, and act as the economic life-blood of the Single Market.

The core network corridors were introduced by the European Commission to facilitate the coordinated implementation of the TEN-T dimensions requirements. Core network corridors bring together public and private resources and concentrate EU support from the Connecting Europe Facility (CEF) funding instrument. CEF Transport focuses particularly on removing bottlenecks, building missing cross-border connections and promoting modal integration and interoperability.

Nine core network corridors are identified in the annex to the CEF Regulations which includes a list of projects pre-identified for possible EU funding during the period 2014-2020, based on their added value for TEN-T development and their maturity status.

Ireland has one core network corridor crossing its country which comprises of the North Sea Mediterranean Corridor. Refer to **Figure 1.5** in **Chapter 1: Introduction and Need for the Proposed Road Development** and **Figure 2.1.**

The North Sea-Mediterranean Corridor stretches from Ireland and the north of UK through the Netherlands, Belgium and Luxembourg to the Mediterranean Sea in the south of France. This multimodal corridor, incorporates inland waterways in Benelux and France, aims not only at offering better multimodal services between the North Sea ports, the Maas, Rhine, Scheldt, Seine, Saone and Rhone river basins and the ports of Fos-sur-Mer and Marseille, but also better at interconnecting the British Isles with continental Europe.

The EU invited Member States to propose projects to avail of EU funding to improve European transport connections. This forms the largest ever single amount of EU funding earmarked for transport infrastructure. The funding is to be concentrated along the nine major transport corridors which, taken together, will form a core transport network.

The funding will be attributed to the most competitive projects and focused on nine major transport corridors in Europe.

Ireland has been successful in its bid to win funding for the Port of Cork Ringaskiddy Redevelopment as part of the North Sea Mediterranean Core Network Corridor. It will receive EU funds but must be co-financed by member states. The EU Commission states as follows in relation to the Port of Cork's Ringaskiddy Redevelopment:

> *Cork is an identified core port located on the North Sea-Mediterranean Core Network Corridor. The Action will expand and develop the State owned deep water port facility at Ringaskiddy in order to make its operations more competitive, efficient, sustainable and responsive to current and projected growth in trade.*

To that end it will remove the bottlenecks identified in the Corridor work plan, relocate the existing container terminal at Tivoli to Ringaskiddy, build a new 'fit for purpose' terminal at Ringaskiddy, handle projected growth in trade, facilitate access of larger vessels to the deep water port, reduce the port's carbon footprint, connect Ringaskiddy to its hinterland and improve the region's overall competitiveness.

A work plan has been drawn up for each corridor. The latest work plans were initially approved in June 2015 and establish the basis for member state action until 2030.

2.1.2 North Sea Mediterranean Second Work Plan of the European Coordinator, December 2016

The Work Plan for the North Sea-Mediterranean Corridor, produced by the European Commission, notes under the section *Road Standard* – that core links are required to be either motorways or express roads. In the North-Sea Mediterranean Corridor, virtually all of the core links comply with this standard, but there are certain last mile connections to seaports, including Zeebrugge and Cork, where current road standards are not adequate for the level of traffic. This Work Plan recognises the need to upgrade the current access route to Ringaskiddy.

In Ireland, road connections inland are paramount, allowing the heavy goods traffic generated by the ports to directly reach the motorway (core and comprehensive) network in the country. This particular aspect and its relevance to Ireland is also recognised in the work plan.

The North Sea Mediterranean Work Plan also states that *'further work is likely to be required in the United Kingdom and Ireland for secure parking areas for Heavy Good Vehicles with, for example, security fencing and CCTV.'*(p.8), this recognises the need for service areas on core network, particularly targeting the needs of HGV drivers.

The Work Plan states that '*In Ireland, where rail currently plays a minor role in freight transport, and where there are no commercial waterways, road pr*ojects are essential for maintaining accessibility to and from seaports.' (p.24)

The Work Plan states that Seaports are required to offer rail connections by 2030 unless physical constraints prevent such connection. (p.9)

In Ireland, road connections inland are paramount, allowing the heavy goods traffic generated by the ports to bypass the immediate urban areas in order to reach the motorway network. The proposed M28 Road Project and Service Area will deal with a number of the issues raised within the Work Plan including provision of a core link motorway / express road to the Port of Cork (in Ringaskiddy), secure parking for heavy goods vehicles.

In European terms, the efficient functioning of the North Sea Mediterranean Corridor is vital to the functioning of the Single Market and European trade. For the core maritime port of Cork it is effectively the last mile connection that is missing. The provision of the M28 Cork to Ringaskiddy Project will complete high quality core network connectivity for the port in line with European requirements.

2.1.3 TEN-T Network Regulations

2.1.3.1 Regulation 1315/2013

The TEN-T network is being developed through a dual-layer structure consisting of a comprehensive network and a core network, these two layers being the highest level of infrastructure planning within the European Union. Roads forming part of the TEN-T network are to be high quality roads, designed and built for motor traffic.

Article 41(2)g of **REGULATION (EU) No 1315/2013** in Chapter III which refers to the Core Network states that Marine Ports of the core network shall be connected with the railway and road transportation infrastructure of the TEN-T by 31st December 2030. This is the target date set in the Regulations for delivery of the core network. Therefore this would indicate that the core marine ports are envisaged to be connected to the core transport network by 2030. Relevant sections from Chapters II and III, including Articles 17 and 39, are quoted below in italics.

Article 17 Infrastructure Components

3. High-quality roads shall be specially designed and built for motor traffic, and shall be either motorways, express roads or conventional strategic roads.

(a) A motorway is a road specially designed and built for motor traffic, which does not serve properties bordering on it and which:

(i) is provided, except at special points or temporarily, with separate carriageways for the two directions of traffic, separated from each other by a dividing strip not intended for traffic or, exceptionally, by other means;

(ii) does not cross at grade with any road, railway or tramway track, bicycle path or footpath; and

(iii) is specially sign-posted as a motorway.

(b) An express road is a road designed for motor traffic, which is accessible primarily from interchanges or controlled junctions and which:

(i) prohibits stopping and parking on the running carriageway; and

(ii) does not cross at grade with any railway or tramway track.

(c) A conventional strategic road is a road which is not a motorway or express road but which is still a high-quality road as referred to in paragraphs 1 and 2.

Article 39 Infrastructure Requirements

2. The infrastructure of the core network shall meet all the requirements set out in Chapter II. In addition, the following requirements shall be met by the infrastructure of the core network, without prejudice to paragraph 3:

(a) for road transport infrastructure:

- *the requirements under points (a) or (b) of Article 17(3);*
- *the development of rest areas on motorways approximately every 100 km in line with the needs of society, of the market and of the environment, in order inter alia to provide appropriate parking space for commercial road users with an appropriate level of safety and security;*
- *availability of alternative clean fuels.*

Figure 2.1: Comprehensive and Core Network: Roads, Ports, Rail Road Terminals and Airports (Republic of Ireland) -Source DTTAS

2.1.3.2 Main International Traffic Arteries

In the EIA Directive (85/337/EEC) 'express road' means a road that complies with the definition in the European Agreement on Main International Traffic Arteries of 15 November 1975. The Economic Commission for Europe - Inland Transport Committee documented the consolidated text of the *European Agreement on Main International Traffic Arteries* (AGR) in March 2008. Included in this document are the conditions to which the Main International Traffic Arteries should conform. According to this document:-

> *"Motorway" means a road specially designed and built for motor traffic, which does not serve properties bordering on it, and which:*
>
> *(i) Is provided, except at special points or temporarily, with separate carriageways for the two directions of traffic, separated from each other by a dividing strip not intended for traffic or, exceptionally, by other means;*
>
> *(ii) Does not cross at level with any road, railway or tramway track, or footpath; and*
>
> *(iii) Is specially sign-posted as a motorway*

and

> 'an express road is a road reserved for motor traffic, accessible only from interchanges or controlled junctions only, and which:
>
> (i) Prohibits stopping and parking on the running carriageway(s); and
>
> (ii) Does not cross at level with any railway or tramway track, or footpath.

2.1.3.3 Irish Legislation – Roads Act

The Roads Act 1993, revised in 2015 defines a 'motorway' as:-

a) a public road or proposed public road specified to be a motorway in a motorway scheme approved under section 49, or

b) a national road or a proposed road development for the construction of a national road declared to be a motorway under section 8 of the Roads Act 2007.

Particular requirements for motorways are included in the Act:-

- No rights to access a motorway from adjacent lands or to access adjacent lands from a motorway.
- The Minister may prescribe certain classes of vehicles from using a motorway. In Ireland this translates to restrictions on Learner Drivers, pedestrians, cyclists and other generally slower moving vehicles including agricultural vehicles. Such prescriptions may be applied to motorways generally, particular motorways or particular parts of particular motorways.

- The Minister may also prescribe conditions in relation to the use of motorways generally, particular motorways or particular parts of particular motorways by vehicles or specified classes of vehicles (including conditions specifying the periods of use of motorways by specified classes of vehicles) and different conditions may be prescribed in relation to different motorways or different classes of vehicles.
- Pedestrians and pedal cyclists shall not use a motorway.
- Persons in charge of or having control over, animals shall not permit them to be on a motorway.
- Stopping is not permitted on motorways except in an emergency situation.

Motorway status as per the Roads Act meets the EU requirements for Core network.

2.1.3.4 Protected Roads

The Roads Act 1993 also provides for the making of national roads into protected roads.

A protected road scheme approved by the Minister may provide for the prohibition, closure, stopping up, removal, alteration, diversion or restriction of any specified or all means of direct access to the protected road from specified land or from specified land used for a specified purpose or to such land from the protected road.

A protected road scheme may prohibit or restrict the use of the protected road or a particular part thereof by:-

(i) specified types of traffic,
(ii) specified classes of vehicles,

but shall not prohibit or restrict such use:-

(i) by ambulances or fire brigade vehicles,
(ii) by vehicles used by members of An Garda Síochána or the Defence Forces in the performance of their duties as such members,
(iii) for the purpose of maintaining such protected road.

Protected Roads as per the Roads Act will require the additional requirement of 'Urban Clearway' status in order to achieve the EU requirements for Core network.

2.1.3.5 Service Area

The TEN-T policy highlights the need for parking-rest areas along the European road transport network. These areas must be adapted to the needs of modern logistics in terms of capacity and must provide for a safe and secure environment with adequate rest facilities for drivers and their cargo.

2.1.4 National Ports Policy, DTTAS 2013

Irish ports play a crucial, yet often overlooked role in facilitating economic growth and prosperity. As an island nation Ireland depends on the quality and efficiency of its port services to a great extent.

The National Ports Policy was published by the DTTAS in 2013. This policy document confirms that Cork's maritime port is part of the identified core network which could receive financing from the EU's 'Connecting Europe Facility' (CEF) as part of the TEN-T network.

Section 2.4 refers to the TEN-T network It states that:-

> *The proposed revision of the European Union's Trans European Network - Transport (TEN-T) consists of a comprehensive transport network, within which there is a core network of high priority. The core network connects the major European urban areas and includes the major European transport corridors, bottlenecks and multimodal hubs. The comprehensive network includes an extensive and dense network of railways, roads, inland waterways, ports, airports and freight terminals.*
>
> *The revised TEN-T programme will open up possibilities for TEN-T ports to avail of the funding facilities to be put in place through the Connecting Europe Facility, including the proposed Project Bonds. The European Commission made its proposals in October 2011. The proposals are still at a relatively early stage in the European legislative process and it will be 2013, at the earliest, before the final package is adopted.*
>
> *For inclusion in the core network, ports must enjoy significant volumes of freight and/or passenger traffic, have a high level of international connectivity and, by 2030, be connected to the core European rail and road network.*

Section 2.5 of the Ports Policy document refers to Ports of National Significance (Tier 1) and outlines that the criteria used by the European Commission are broadly similar to those used in identifying the Ports of National Significance (Tier 1). These are the ports that:-

- *are responsible for at least 15% to 20% of overall tonnage through Irish ports, and*
- *have clear potential to lead the development of future port capacity in the medium and long term, when and as required.*

Three ports are proposed for inclusion in the TEN-T core network including Dublin, Cork and Shannon Foynes. These ports are also identified in National Ports Policy as Ports of National Significance (Tier 1).

The continued commercial development of these three Ports of National Significance (Tier 1) is a key objective of National Ports Policy. (p. 24)

Section 4.4 of this policy document refers to Hinterland Connections and states that '*Efficient hinterland connections are critically important to any port's ability to facilitate large volumes of traffic. The European Commission's Communication on a European Ports Policy, published in 2007, highlights the importance of reliable and sustainable hinterland connections as part of an integrated transport chain.*

It further states that 'Such connections will also be an important feature of the revised TEN-T proposals. All TEN-T core ports must be connected to both the TEN-T core road and rail networks.' (p. 45).

The European Commission's related '*Connecting Ireland*' document[1] states that:-

> *Ireland has 1 Core Network Corridor crossing its country:* ***The North Sea-Mediterranean Corridor*** *stretches from Belfast and the Irish ports of Cork and Dublin, as well as from the northern UK ports Glasgow and Edinburgh through Belgium, with a branch from Amsterdam and Rotterdam, via Luxembourg to Strasbourg and Basel and via Lyon to the southern French ports of Fos/Marseille. It covers rail, road, airports, ports, RRT's and the Dutch-Belgian inland waterway system as well as the Rhône River.*

This Connecting Ireland document also confirms that Cork's maritime port is part of the identified core network which could therefore receive financing from the EU's *'Connecting Europe Facility'* (CEF).

2.1.5 Department of Transport: Statement of Strategy, 2016 - 2019

This strategy sets out objectives and actions which are designed to support continuing economic recovery, fiscal consolidation, job creation and social development. It notes that the maritime sector is a critical gateway for the movement of goods between Ireland and its trading partners. Recent trends point towards a steady growth of freight tonnage in line with the wider performance of the economy. Seaborne freight is currently estimated to account for 84% of Ireland's total trade by volume and 62% in value terms. The strategy includes an action for appropriate public spending and investment in efficient, sustainable, integrated and accessible land transport networks and services.

In regards to maritime, the strategy includes a high level goal to ensure the safety and competitiveness of maritime transport services.

The strategy includes an overarching objective to develop and implement the national ports and shipping policy in order to facilitate a competitive and effective market for maritime transport services. The strategy supports the implementation of the National Ports Policy.

2.1.6 Strategic Framework Investment in Land Transport, DTTAS 2015

The *Strategic Framework on Investment in Land Transport* (SFILT) sets out an evidence based assessment of transport trends in Ireland. It assesses demand for transport based on population and transport demand linking to the economy of the country. It considers modal choice in terms of commuter travel and the movement of goods.

[1] http://ec.europa.eu/transport/themes/infrastructure/doc/ten-t-country-fiches/ie_en.pdf

It notes integration of seaports and airports with land transport modes is an important aspect in ensuring the availability of competitive and efficient transport services that meet the needs of users. Catering for the needs of Ireland's main exporting sectors should be a key driver of investment decisions. The economy supports a very diverse range of manufacturing and services sectors, each with different transport needs.

The framework establishes investment in land transport as a high level priority. It notes that the development of transport infrastructure results in increased trade, enhanced competitiveness, increased productivity, labour mobility and attractiveness for Foreign Direct Investment. It further identifies land transport policy as playing a central role in supporting important government economic development objectives and in the main exporting sectors nationally. For example, the performance of road sea and air freight is central to the competitiveness of our national manufacturing sector.

SFILT sets three high level priorities for transport investment which are outlined as follows:-

- Maintenance of steady state maintenance and renewal of the transport system;
- Reduction of urban congestion by providing viable alternatives to car travel;
- Maximise the value of the road network through targeted investments that:
    - Enhance the efficiency of the existing network, particularly through the increased use of ITS applications;
    - Improve connections to key seaports and airports and poorly served regions and complete missing links;
    - Support identified national and regional spatial planning priorities;
    - Provide access for large-scale employment proposals; and
    - Address critical safety issues.

Within this context, the proposed road project is compliant with the policies of the SFILT as it particularly provides access to a key seaport and to a large scale employment zone. The proposed road project also facilitates the reduction in urban congestion by removing specific bottlenecks on the existing N28 and by facilitating the provision of alternative sustainable travel modes, as described in **Section 1.2.2** of this EIS.

2.1.7 Spatial Planning and National Roads: Guidelines for Planning Authorities, DoECLG 2012

The Department of the Environment, Community and Local Government (DoECLG) Spatial Planning and National Roads: Guidelines for Planning Authorities were issued under Section 28 of the Planning and Development Act, 2000 (as amended) and relevant authorities are obliged to have regard to them in the performance of their duties under the Planning Acts.

According to these Guidelines, the primary purpose of the national road network is to provide strategic transport links between the main centres of population and employment, including key international gateways such as the main ports and airports and to provide access between all regions.

Section 1.4 of the Spatial Planning and National Roads Guidelines defines strategic traffic, in the context of national roads as primarily comprising of major inter-urban and inter-regional traffic, whether HGV, car, public transport, bus services or other public service vehicles, which contribute to socio-economic development, the transportation of goods and products, especially traffic to and from main ports and airports, both freight and passenger related.

These guidelines have been developed by following a number of key principles and aim to facilitate a well-informed, integrated and consistent approach that affords maximum support for the goal of achieving and maintaining a safe and efficient network of national roads in the broader context of sustainable development strategies, thereby facilitating continued economic growth and development throughout the country. Key principles include:-

- Land use and transportation policies are highly interdependent. This is described as being vital in minimising the need to travel;
- Proper planning is central to ensuring road safety. Therefore, from a road safety perspective, planning authorities, the NRA, road authorities and the Road Safety Authority must guard against a proliferation of roadside developments accessing national roads;
- Development should be plan-led. Accordingly, in preparing development and local area plans, planning authorities must assess the trip generation aspects of any land use zoning objectives and how such trip generation is to be catered for, promoting the use of sustainable modes, while protecting the strategic function of the national roads network.
- Development management is key to plan management and as such development should achieve high standards in relation to traffic management and design quality; and
- Planning Authorities and the National Roads Authority and other public transport providers must work closely together in the course of preparing plans and assessing planning applications to ensure that future development is guided to suitable locations.

The guidelines indicate that TII adopts a 20 year design horizon as the basis for capacity design requirements in order to optimise the economic return on the investment and take account of local authority supplied estimates regarding future population and development patterns, local trends and the aims of achieving compact, sustainable urban development. In planning future new routes, the guidelines state that the TII (NRA) will work with planning authorities in basing new design on robust and reasonable assumptions with regard to future development and the extent to which, if any, traffic generated by such development should be appropriately catered for on the national road network. Development objectives, including the zoning of land, must not compromise the route selection process, particularly in circumstances where road scheme planning is underway and potential route corridor upgrades have been identified and brought to the attention of the planning authority.

Implementation of the guidelines will ensure that the state's considerable investment in national roads is harnessed in a manner that is sustainable in economic, social and environmental terms.

The Spatial Planning and National Roads also provide guidelines to planning authorities on the siting of on-line and off-line motorway service areas. The service area must provide rest, fuel, toilets and food facilities. The guidelines state that a service area should avoid the attraction of short, local trips, avoid a class of traffic that is inconsistent with the primary intended role and cater for long distance, inter-urban and inter-regional traffic.

2.1.8 Smarter Travel: A Sustainable Transport Future, A New Transport Policy for Ireland, DTTAS 2009 – 2020

The Department of Transport, Tourism and Sport published Smarter Travel, A New Transport Policy for Ireland in 2009. This policy document sets key goals, targets and actions in achieving sustainable transport to be achieved by 2020.

Action 12 comprises a broad list of actions to be taken to deliver a more effective public transport system. The proposed motorway can be used by public transport particularly in facilitating express type routes in delivering this action.

Action 13 sets performance targets for public transport in urban areas. The provision of a high quality motorway link available for use by public transport will assist in delivering this action in the motorway catchment area.

Action 14 relates to rural bus services and/or a "local transport bus". The M28 project provides a high quality corridor potentially for use by these types of services. There will also be an opportunity for use of the existing N28 for rural type bus services and for potential commuting services to neighbouring Carrigaline once reclassified.

Action 15 seeks to develop a strong cycling culture in Ireland. The proposed motorway will not be available to cyclists, however, it will provide for cycling by facilitating the reclassification of the existing N28 to local road status and removal of much of the traffic from this road. Crossing will also be facilitated at relevant points so that the motorway does not act as a barrier to cycling. The M28 project facilitates the Cork Harbour Greenway by way of a connection at Carrigaline.

Action 16 refers to the creation of a culture of walking in Ireland. The proposed motorway, while it will not be available for use by pedestrians will, similarly to cycling, facilitate walking by virtue of the reduction of HGVs and congestion on the exiting N28 and particularly within the villages of Shanbally and Ringaskiddy. Pedestrian connectivity at Rochestown Road and at Maryborough Hill will be improved as part of the road project also.

Action 23 seeks to ensure improved road priority for walking and cycling access to key public transport interchanges and ports. The M28 project has the potential to improve linkages to Europe, facilitate the provision of a greenway link on the existing N28 road linking the ferryport at Ringaskiddy to the Cork Harbour Greenway at Raffeen.

Action 29 refers to Ports Policy and its impact on maximising efficiency in the movement of goods. One of the Strategic Objectives of the M28 Motorway project is to ensure compliance with National Ports Policy and the associated efficient movement of goods. The proposed project is an integral part of the achievement of Action 29.

Action 30 relates to 'road safety and emissions' and states that *'The €18 billion investment in roads as part of Transport 21 will remove bottlenecks, ease congestion and pressure in towns and villages and provide the necessary infrastructural links to support the National Spatial Strategy.'* The proposed project will help to achieve this action.

Chapter 3 of the document sets out the government vision and high level targets, among those listed and which will also be achieved by the M28 project include:-

- The present levels of traffic congestion and travel times will be significantly reduced;
- The transport system will enhance Ireland's economic competitiveness; and
- Health risks and the incidents of accidents and fatalities will be reduced.

Among the key goals which form the basis of the policy, the Government aims to improve economic competitiveness through maximising the efficiency of the transport system and alleviating congestion and infrastructural bottlenecks.

Chapter 4 of the strategy notes that '*the efficient movement of goods is vital to our competitiveness and economic welfare. 65% of our GDP is based on the export of goods and services and that, at present, 95% of all goods are moved by road and over 30% of transport greenhouse gas emissions are from the freight sector*'. With this in mind, one of the stated actions in the policy is to set a target aimed at reducing the environmental impact of freight transport while at the same time improving efficiency in the movement of goods and promoting economic competitiveness.

The proposed road project, provides much improved access to the port in Ringaskiddy and the efficient movement of goods, alleviates congestion in the area, makes the existing N28 available as a potential cycle route to the port, increases road safety by the provision of a modern high quality road and generally increases transport efficiency. As such, it is consistent with the policy actions outlined in *'Smarter Travel, A New Transport Policy for Ireland, 2009 - 2020'*.

2.1.9 National Roads Authority Service Area Policy, TII 2014

The National Roads Authority (now Transport Infrastructure Ireland (TII)) published the "*NRA Service Area Policy*" in August 2014, which sets out the basis on which on- line service areas will be provided to meet the needs of road users on the national road network in Ireland. The TII's policy for the M28 Cork to Ringaskiddy Road Project is as follows:

> *'A Type 1 Service Area is proposed for the N28 from Cork to Ringaskiddy. Cork County Council, in consultation with the Authority, will include consideration of the appropriate location of this service area as part of the scheme planning, currently underway.'*

2.2 PLANNING POLICY

2.2.1 National Development Plan, 2007 - 2013

The National Development Plan 2007-2013 identified the national need to upgrade the N28 road, in order to improve accessibility and connectivity between the port at Ringaskiddy and the national roads network. The National Development Plan 2007-2013 specifically mentioned the upgrading of N28 road access to the port at Ringaskiddy and its associated industrial zone as being a key development and investment priority for the Cork Gateway. In the period since, there has been significant development in Ringaskiddy and Carrigaline, including the expansion of the pharmaceutical industry within this area and the development of IMERC. Planning permission has also been obtained for the expansion of the port at Ringaskiddy which will allow for the relocation of

the port. Significant growth has also taken place in the residential sections within the Carrigaline and Rochestown areas. Therefore, the need for the M28 has become even more critical within the intervening period since the initiation of this policy at a national level. The M28 Road Project will facilitate the reduction of transport costs through shorter journey times and is considered to be vital in order to improve competitiveness in the production and export of goods.

2.2.2 Building on Recovery: Infrastructure and Capital Investment, DPER 2016-2021

The National Capital Investment Programme published by the Department of Public Expenditure and Reform (DPER) sets out the Government's framework for infrastructure investment going forward and continues on from its predecessor entitled *Infrastructure and Capital investment 2012-2016: Medium Exchequer Framework* which among one of its priorities was *'Targeting the improvement of specific road segments where there is a clear economic justification…*'

The predecessor document also expressed the belief that '*economic recovery in Ireland will be enterprise-driven and export-led*'. Section 3.2 of the 2012-2016 document states '*The National Road Network… is a crucial component of the economy's export potential and carries goods to airports and ports for onwards delivery to global markets'*.

This framework for the period 2016-2021 makes provisions for the proposed road development. It notes a number of schemes, targeted at removing bottlenecks, will also commence subject to planning permission. The M28 Cork to Ringaskiddy Project is listed amongst these schemes.

The framework recognises the economic importance of the countries ports and airports.

It also acknowledges that the Government is committed to the further development of the Irish Maritime Energy Resource Cluster (IMERC) in Cork, which supports jobs and urban renewal and regeneration in the area.

As such, the proposed road project, which will serve the industries in Ringaskiddy including the Port of Cork, has a clear economic justification and is therefore consistent with the '*Infrastructure and Capital Investment 2012 - 2016*' and '*Building on Recovery: Infrastructure and Capital Investment 2016 - 2021*'.

2.2.3 National Spatial Strategy for Ireland, DoELG 2002-2020

The Department of the Environment and Local Government published the National Spatial Strategy for Ireland (NSS) in 2002. The NSS seeks to achieve a spatial balance by developing the growth potential of areas. The NSS proposes that the national spatial structure be supported by a national transport framework, providing an improved network of roads and public transport services, enhancing access and connections throughout the country. This framework will be internationally connected through key points such as airports and ports with links to Northern Ireland, the UK, EU and the broader global economy.

The National Spatial Strategy identifies Strategic Radial Corridors as part of a National Transport Framework to support balanced regional development. The NSS identifies a Strategic Radial Corridor between Cork and Dublin and recognises Cork as an International access point via air and sea. The Strategy acknowledges that for Ireland to be globally competitive it needs effective communications to sea ports and associated shipping services.

2.2.4 Towards a National Planning Framework: Ireland 2040 Our Plan - Issues and Choices, DHPCLG February 2017

A new 20 year National Planning Framework (NPF) is being prepared for Ireland which will replace the NSS. As part of this process the Department of Housing, Planning, Community and Local Government (DHPCLG) have prepared an 'Issues and Choices' paper which provides an overview of some of the main national planning issues that affect Ireland and invited submissions in order to inform the draft National Planning Framework which is due to be published in Q4 of 2017.

Cork County and City Council have prepared a joint submission to the NPF entitled "*Cork 2050 Realising the Full Potential (March 2017)".* This document sets out various strategies for the comprehensive and evidence based approach to the future development of Cork. The Transport Strategy recognises the need for the M28 to connect Ringaskiddy Port to the N40 as being of National importance.

The NPF will be a statement of the Government's objectives for Ireland's spatial development and it will form the top tier of Ireland's planning policy hierarchy. It will build on the strengths of the former NSS while at the same time addressing newer challenges in relation to the need for greater emphasis on environmental matters such as climate change and sustainability, as informed by European Union legislative requirements that have been introduced since the NSS was published.

The NPF Issues and Choices Paper acknowledges Ireland's position as an island nation on the western periphery of Europe[2]. It notes that National Ports Policy has resulted in tiering Ireland's ports and that as a result transport infrastructure has and is developing well in Ireland's three 'Tier 1' ports. The paper states that *'Dublin, Cork and Shannon Foynes development plans, with related road and rail infrastructure upgrades, provide evidence of the progress being made.'*(Section 4.5.14) It further notes that *positive trends have been reported across a number of key sectors such as seafood exports, shipping and tourism in marine and coastal areas. The total volume of traffic moving through Irish ports recorded a 7 percent increase in 2015, the highest level recorded since the beginning of the economic crisis.* (Section 4.5.13). This further highlights the need for the proposed M28 Road Project.

One of the potential themes identified for the NPF is to deal with identifying infrastructural priorities. It acknowledges that the co-ordination of infrastructure and the wider economic and community development strategies are essential to positioning strategic locations as drivers of wider regional development. It states that reference will be made to sectoral investment strategies including, for example, the SFILT and the National Ports Policy.

[2] Section 4.5.1

2.2.5 Our Sustainable Future: A Framework for Sustainable Development, DoECLG 2012 - 2020

Our Sustainable Future sets out a medium to long-term framework for advancing sustainable development and the green economy in Ireland which was prepared by the Ireland Department of the Environment, Community and Local Government.

Section 2.6 of the document is concerned with sustainable transport and states that '*sustainable transport is central to national efforts to combat climate change, air pollution and other negative environmental and social impacts'* and notes that increasing congestion and lengthened journey times are the main pollution problems associated with transport in Ireland. Section 2.6 of the document also sets out that action is being taken on delivering ambitious goals for 2020, which include:-

> *'Improving the planning system so that future population and employment growth will have to predominantly take place in sustainable compact urban areas or rural areas which discourage dispersed development and long commuting; Reducing car travel, and particularly work related commuting by car by encouraging modal shift to walking, cycling, and public transport, where possible*'.

The proposed road supports the policy of enhancing the sustainability of transport in Ireland as it:-

- Will reduce congestion and journey times along the N28 route.
- Improves access and transport efficiency to the Ringaskiddy area for all users, particularly for key industry and employment transport.
- Will remove traffic from the existing N28, thereby facilitating the use of the existing N28 for sustainable transport models including cyclists and pedestrians for people living, working and studying in the area (See **Figure 1.4 in Volume 5** of this EIS which provides an overview of how the M28 project ties in with existing and proposed sustainable travel within the area).

2.2.6 Regional Planning Guidelines for the South West Region 2010 – 2022

The Regional Planning Guidelines (RPGs) for the South West Region 2010 – 2022 support development of strategic roads including the N28 which serves the Port of Cork facilities at Ringaskiddy and Ringaskiddy as a strategic employment location. It specifically mentions:-

- The N28 servicing the major industrial developments at Ringaskiddy as a major piece of road infrastructures required to be delivered. (Section 1.3.26).
- *'The Port of Cork is a key element of the regional economy and infrastructure and offers a wide range of shipping services to worldwide destinations. … The rail network serving Cork does not provide an adequate means of collection/distribution of freight to the region and so* ***future port facilities need to be well served by the road network.'*** (emphasis added) (Section 1.3.33).
- Significant employment growth is envisaged at Ringaskiddy as a principal location for new industrial employment. The Plan notes that Ringaskiddy will continue to act as a strategic employment location and should see primarily industrial employment growth based on the relocation of port activity from Docklands(p. 34)

- One of the key principles underpinning the regional vision statement is the need to '*Deliver an integrated and cost effective transportation and infrastructure system …throughout the region in a sustainable manner*'. (Section 2.1.2).
- *'Recent studies undertaken by the Port of Cork regarding the potential of rail/road services for port activities have indicated that, with the exception of a limited need for niche cargos in appropriate locations, the existing rail network from Cork Harbour does not adequately support the collection/distribution of freight to/and from the port. The predominant existing and likely future* ***mode of freight transport for port activities is by road***.' (emphasis added) (Section 5.5.10).
- Cork Harbour is described as being important for economic and environmental reasons. As the largest port in Ireland outside of Dublin, it makes a strong contribution to the overall economic wellbeing of the South West Region, particularly in the manufacturing, commercial, industrial and tourism sectors. (Section 5.5.6)
- Cork Harbour is described as being of both national and regional significance as it contains the regional significant pharmachem industries at Ringaskiddy. (Section 3.3.12)

The proposed road project will help facilitate the relocation of the Port of Cork to Ringaskiddy which has recently been approved by An Bord Pleanála as it will increase road capacity to cater for the ports expansion of facilities in line with the RPGs. It will also service existing industries and future expansion of industry and employment within the area which is identified by the RPGs as being of both national and regional significance.

A detailed review of the proposed M28 Road Project in relation to these guidelines is provided in **Appendix 2A** in **Volume 4** of this EIS.

2.2.7 Cork Area Strategic Plan (CASP): Strategy of Additional Economic and Population Growth Update, 2008

The N28 is identified as a Major Transport Infrastructure Proposal and is described as the Port Access Route to improve access to the proposed new port facilities including a container terminal at Ringaskiddy (Exec Summary).

The Strategy acknowledges that the Port of Cork is heavily reliant on HGVs and is thus strategically reliant on the provision of a high quality national road network noting the particular importance of the implementation of the N28 (P.117).

The CASP update considers the N28 Ringaskiddy Port Access Route '*to be critical and essential to the growth and development of the CASP region and the achievement of the CASP goals'* (p. 117).

The M28 project is listed as a CASP infrastructure priority in line with NDP policy (p.148).

Significant employment growth is envisaged at Ringaskiddy as a principal location for new industrial employment. The Plan notes that Ringaskiddy will continue to act as a strategic employment location and should see industrial employment growth based on the relocation of port activity from Docklands (p. 34).

In referring to Ringaskiddy as a Strategic Employment Area the Plan notes that the development of Ringaskiddy will require the provision of a high quality green route (p. 50). The proposed project will reduce traffic levels on the existing N28, thereby facilitating an opportunity for sustainable transport models including cyclists and pedestrians and potentially opening up the opportunity to develop this route as a green route.

A detailed review of the proposed M28 Road Project in relation to CASP is provided in **Appendix 2A** in **Volume 4** of this EIS.

2.2.8 Cork County Development Plan 2009-2015

The Cork County Development Plan (CDP) 2009-2015 has been superseded by the Cork CDP 2014-2020. However, this earlier plan actively supported development of the road infrastructure and wider national and regional proposals.

Policy INF 3-3 specifically provided support for the TII (NRA's) targets for the road network, which included the M28 Cork to Ringaskiddy Project.

2.2.9 Cork County Development Plan 2014-2020

The Cork County Development Plan 2014 - 2020 (hereafter referred to as the CDP) is the key planning policy document for the Cork County area in which the project is located. There is strong and wide ranging support in the CDP for the upgrade of the N28 to ensure expansion of Port facilities at Ringaskiddy.

Ringaskiddy peninsula is identified as one of four 'strategic employment centres' in the county and a principal location within the employment hierarchy. (Table 6.1) The CDP acknowledges that '*In employment terms, the Cork region has a number of employment locations that have underpinned Cork's economic success. These include, for example; the port related, pharmaceutical and associated industries at Ringaskiddy;' (*Section: 6.2.2)

The CDP states that *'Cork Harbour is the most significant port in the state, outside Dublin, and has an important role in the continuing success of the marine – leisure, recreation and tourism sectors in the South West Region'.* (Section 4.9.2) CDP Objective EE 6-2 which refers to Cork Harbour provides '*Support of the upgrade of the N28 to accommodate the expansion of Ringaskiddy Port.'*

The proposed road project is identified in the CDP as critical infrastructure required for the following:-

- At project stage of the Shannon Park Masterplan which makes provision for a significant expansion of housing to the north of Carrigaline (Table 15.1).
- To be in place on commencement of development of the Ports primary location for future port development and port uses displaced from Cork City Centre development areas (e.g. Docklands) Large scale technology based manufacturing e.g. (pharmaceutical Research and employment linkages with National Maritime College of Ireland (Table 15.1).
- Short term objective required to serve Cork Gateway/County Metropolitan Cork Strategic Planning Area (Table 15.2).

Objective TM 3-1 of the CDP which relates to the National Road Network seeks the following:-

a) *Support of the National Roads Authority in the implementation of the N28 (Cork – Ringaskiddy) as a major project which is critical to the delivery of Planned Development.*
b) *Support and provide for improvements to the national road network, including reserving corridors for proposed routes, free of inappropriate Development, so as not to compromise future road schemes.*
f) *Consider the most up to date guidance in relation to the provision of Service and Rest Areas on the National Road Network (Section 2.8 of the Department of the Environment Community Heritage and Local Government 'Spatial Planning and National Roads Guidelines' (2012) and 'NRA Service Area Policy' (August 2014).*
g) *Cooperate with the National Roads Authority to identify the need for Service areas and/or rest areas for motorists along the national road network and to assist in the implementation of suitable proposals for provision, subject to normal planning considerations.*
h) *Ensure that in the design of new development adjoining or near National Roads, account is taken of the need to include measures that will serve to protect the development from the adverse effects of traffic noise for the design life of the development.*

CDP Objective TM 5-2 which refers to Cork and Other Ports provides general support for appropriate road transport capacity to facilitate strategic port facilities at Ringaskiddy, the relocation of the port to Ringaskiddy and support the ports role in facilitating industry, defence, trade, marine leisure and other economic sectors. This objective supports the need for the M28 Road Project.

CDP Objective TM 6-1 which relates to Water Based Transport seeks to ensure appropriate access (road and rail) to Cork Port, recognising its role in the provision of maritime transport, both passenger and freight which supports the need for the M28 Road Project.

The 'Preferred Route Selected - N28' is identified in Figure 10.2 and in Volume 4 of the CDP Map Browser as a route protection corridor. According to the CDP the Council, in consultation with the National Roads Authority, will protect proposed national road route corridors where the route selection process has been completed/approved and where preferred route corridors have been identified. Objective TM 3-1 as outlined above provides protection to such routes. The N28 route protection corridor within the CDP is based on the historic route which was prepared in 2008. This route has since changed and is reflected in the draft Ballincollig – Carrigaline Municipal District Local Area Plan 2016.

A detailed review of the proposed road project in relation to this plan is provided in **Appendix 2A** in **Volume 4** of this EIS.

2.2.10 Cork City Development Plan 2015 – 2021

The Cork City Development Plan (hereafter referred to as the City Plan) places increased emphasis on the renewal and development of the City Centre as the employment, social and cultural heart of the city and the region. In doing so it supports the gradual expansion of the City Centre eastwards through the creation of sustainable neighbourhoods into the Docklands area (including Tivoli) which is currently occupied by the Port of Cork.

Section 13.94 of the City Plan which identifies the *'The relocation of the Port and SEVESO site'* as a critical step that needs to be undertaken to facilitate and encourage the redevelopment of Docklands.

The City Plan identifies the 'N28 Cork Ringaskiddy route upgrading' as one of the '*key strategic road priorities for the city'* (Section 5.30). Furthermore, the *'N28 Cork Ringaskiddy route upgrading'* is identified as a strategic road infrastructure objective of the City Plan under Objective 5.18.

The City Plan identifies the redevelopment of the North and South Docks as a major new mixed use quarter and as the most significant sustainable development opportunity for the City Region. The overall strategy for Docklands is set out in Chapter 13 and the *South Docks Local Area Plan 2008 – 2018* (SDLAP) contains the detailed planning strategy for the South Docks area. The City Plan states that the *'delivery of Docklands development is critical to the city achieving its population and employment targets and to the implementation of the CASP update strategy as a whole'* (Section 2.2.3).

Section 13.79 of the City Plan acknowledges the importance of the development of the South Docks and its dependence on the relocation of the Port of Cork. It states: '*With appropriate investment, the South Docks area is capable of supporting a large residential and working population, however the achievement of this will be dependent on the relocation of the Port of Cork.'*

The City Plan intends to prepare a new Local Area Plan for the redevelopment of the Tivoli Docklands area as a new residential quarter with complementary employment uses. Section 2.27 of the City Plan states that the '*planned relocation of the Port of Cork container operations from Tivoli creates the potential to consider the future development of this area for alternative more intensive uses'.* It states that '*it will be important to ensure that the mix of uses and timing of development of Tivoli does not take away from the potential of the City Centre and North and South Docklands for economic development and employment generating uses.'* A Local Area Plan will be prepared in co-operation with key stakeholders including the Port of Cork to determine the appropriate mix of uses, access and extent and timing of development. The City Plan states that *'The timing of the preparation of a local area plan will be linked to the need to prepare for the relocation and to facilitate lands becoming available for redevelopment.'* (Section 2.27).

Therefore, it is clear that the relocation of the Port from Cork is critical in achieving the City's housing and employment targets. The M28 will provide a key piece of infrastructure to facilitate the relocation of Port of Cork to Ringaskiddy.

2.2.11 Carrigaline Electoral Area Local Area Plan 2011 (As Amended)

The Carrigaline Electoral Area Local Area Plan (LAP) 2011 (as amended in 2015 – 2nd Edition) provides wide ranging support for the M28 Road Project as follows:-

- Section 4.3.3 of the Plan acknowledges that '*The N28 is a critical piece of infrastructure which needs to be upgraded. The current road is a sub-standard single-carriageway. Failure to upgrade the N28 to dual carriageway will have severe competitive and economic implications for both the Metropolitan Cork area and the region as a whole*.'
- '*The upgrading of the N28 is essential to the future development of the Carrigaline Electoral Area*.' (p.16).

- The improved road will have a greater capacity particularly for freight vehicles making journeys to and from the port and this will substantially improve the standard of the existing N28. …. It is critical that the N28 project be finalised as quickly as possible in order to bring certainty and assurance of commitment to existing and future investment in the Ringaskiddy area. This planned upgrade represents an important catalyst for the economic development of Cork and the South-West region. (Section: 4.2.19 and 2.2.55).
- Section 4.1.2 of the plan acknowledges that '*There are advanced proposals to upgrade the N28 to motorway standards*.'

The proposed alignment of the N28 at the time of preparation of this plan is set out in the Carrigaline zoning map on page 31 and under Objective U-02 in the Ringaskiddy map on page 74. The reservation corridor identified within the LAP was based on the proposed road alignment at the time of preparation of this plan. The proposed M28 road alignment has been updated since then and it identified in the draft Ballincollig – Carrigaline MDLAP 2016 which is due for adoption by August 2017.

A detailed review of the proposed road project in relation to this plan is provided in **Appendix 2A** in **Volume 4** of this EIS.

The LAP also refers to the proposed upgrade as being of 'motorway standard'.

2.2.12 Draft Ballincollig Carrigaline Municipal District Local Area Plan November 2016

Cork County Council recently published the draft Ballincollig-Carrigaline Municipal District Local Area Plan which will replace the Carrigaline Electoral Area LAP 2011 on adoption in August 2017.

The draft LAP supports the proposed road development as an important catalyst for the economic development of Cork and the South West region. It further states that it '*is critical that the M28 project be finalised as quickly as possible in order to bring certainty and assurance of commitment to existing and future investment in the Ringaskiddy area.'* (Section 3.7.37).

The draft LAP proposes to facilitate the proposed road development and protect the route corridor from inappropriate development and provides an indicative alignment of the roadway within the Ringaskiddy area. (Objective RY - GO - 04).

A detailed review of the proposed road project in relation to this consultation document including the proposed changes to the LAP is provided in **Appendix 2A** in Volume 4 of this EIS.

2.3 CONCLUSION

In terms of national transport policy, the proposed road project will form part of the core network under the 'Trans European Network-Transport (TEN-T)'. The upgrading of national primary route forms a major component of upgrading the transport network to ports of national significance (Tier 1) as defined under Section 2.5 the 'National Ports Policy'. The 'Department of Transport's Statement of Strategy' further includes an overarching policy to support the National Port's Policy which is in line with the proposed road project.

The M28 is in line with the 'Strategic Investment Framework for Land Transport' which establishes investment in land transport as a high level priority and the need to support exporting sectors including port facilities.

The proposed road project provides a strategic transport link between one of the main ports in the country providing access to all regions which is outlined as a key principle of the 'Spatial Planning and National Roads Guidelines'.

The proposed road project in providing much improved access to the Port of Cork in Ringaskiddy will open up access to a key seaport and to a large scale employment zone. The proposed road project will facilitate a reduction in urban congestion by removing specific bottlenecks on the existing N28.

The reclassification of the existing N28 will facilitate the introduction of a specific N28 Sustainable Travel Strategy. As a result this will open up opportunities to promote and support multi modal travel including a mobility management approach to new developments in the area. This will also include the provision of enhanced public transport and the provision of improved active mode facilities including increased walking and cycling within the area. This approach is consistent with the policies actions outlined in 'Smarter Travel, A New Transport Policy for Ireland, 2009 - 2020' and will have the effect of future proofing the proposed M28 Road Project.

The proposed road development has been fully supported within national, regional and local level planning policy documents for a number of years.

Specifically, at the national level, it has been included in the National Development Plan (NDP) 2007-2013, which states that *'over the period of the plan key development and investment priorities for Cork and its wider environs included the need for the upgrading of the N28 road access to Ringaskiddy Port and its associated industrial zone.'*

The NDP framework including the 'Infrastructure and Capital Investment programmes from 2012-2016 and 2016-2021 also make provision for the upgrading of the N28 in order to improve accessibility and connectivity between the Port and the national road network. In line with the 'National Spatial Strategy', the road project will provide an effective means of communications to sea ports and associated shipping services supporting Ireland to be globally competitive.

At the regional level, the South West Regional Planning Guidelines in 2010 identified that 'integral to both the expansion of the Port of Cork and the planned redevelopment of the City Docklands is the relocation of port activities and related uses from the City Docklands and Tivoli to new sustainable locations in the harbour', supported by improved transport networks.

The CASP Update 2008 identifies the upgrading of the N28 road access to Ringaskiddy Port and its associated industrial zone as key development priorities for the Cork Gateway as identified in the NDP 2007-2013. The plan proposes that the upgrading of the N28 be included in Tranche 2 (2008-2013) of the plans phasing as it is critical and essential to the growth and development of the CASP region and the achievement of the CASP goals. The plan also supports the creation of an Integrated Transport System which would include the development of an integrated rapid transit network including the upgrade of the N28.

The CASP update highlights the fact that the Port of Cork and Cork Airport are two major economic factors in the CASP region and their efficient operation at a strategic level is based on their accessibility and connectivity with the wider region, primarily though not exclusively by the national roads network. The Port of Cork relies heavily on HGV traffic to deliver and distribute goods by the national roads network and is thus strategically reliant on the provision of a high quality national road network in the CASP area. The proposed M28 Road Project will help improve connectivity for distribution of goods and make the area more attractive to investors.

The Cork CDP 2014-2020 supports development of the road infrastructure and wider national and regional proposals. Policy TM 3-1 specifically supports the TII/NRAs targets for the road network which includes the N28 as a project critical to the delivery of planned development within the County.

Figure 2.2: Route Protection Corridors in Cork County

The Cork City Development Plan identifies the redevelopment of the North and South Docklands within the City as the most significant sustainable development opportunity for the City Region and is critical to the City in achieving its population and employment targets. The achievement of this objective is dependent on the relocation of the Port of Cork to Ringaskiddy and the delivery of the M28 Road Project.

At the local level, the Carrigaline Electoral Area Local Area Plan 2015 (LAP) recognises the importance of the N28 National Primary route linking Ringaskiddy to Cork City and onwards to the wider region and its existing problems with traffic congestion and public transport connectivity.

The Carrigaline Electoral Area LAP 2011 mentions the proposals in the NDP and CASP to improve the existing N28 between the Bloomfield interchange with the N40 South Ring Road and Ringaskiddy. It states that the improved road will have a greater capacity particularly for freight vehicles making journeys to and from the port and this will substantially improve the standard of the roadway.

The Carrigaline Electoral Area LAP 2011 states that '*it is critical that the N28 project be finalised as quickly as possible in order to bring certainty and assurance of commitment to existing and future investment in the Ringaskiddy area'*.

In the Draft Ballincollig-Carrigaline Local Area Plan 2016, a revised route corridor which is in line with current proposals has been identified in objective RY-U-02. Further support for the proposed road project is detailed in Section 3.7.37 of the Draft Local Area Plan.

3. DESCRIPTION OF THE PROPOSED ROAD DEVELOPMENT

3.1 OVERVIEW

The proposed M28 Road Project will consist of the construction, operation and maintenance of 10.9 kilometres of dual carriageway motorway from the N40 Bloomfield Interchange to Barnahely, 1.5 kilometres of single carriageway protected[1] road from Barnahely to the eastern side of Ringaskiddy and a Service Area at the Port of Cork Facility at Ringaskiddy together with ancillary and consequential works.

An overview is shown on **Figure 3.1** comprising;

- 10.9km of mainline motorway from Bloomfield to Barnahely;
- 1.5km of mainline single carriageway protected road from Barnahely to east of Ringaskiddy;
- 4.8km of new and realigned regional and local roads;
- 2.2km of accommodation works tracks;
- 1 full grade-separated interchange at Carr's Hill with associated roundabouts, slip roads and widening of the existing underbridge at Carr's Hill;
- 3 partial grade-separated interchanges at Bloomfield/Rochestown Road, Shannonpark and Shanbally, with associated roundabouts and slip roads, including 2 new underbridges, existing bridge at Rochestown retained as part of the scheme;
- 3 at-grade roundabouts at Barnahely, Loughbeg and eastern Port of Cork entrance;
- Provision of a M28 to N40 westbound link road and improvement of the westbound merge from the M28 to the N40;
- Removal of the existing sub-standard northbound on-ramp at Maryborough Hill;
- Upgrading of the existing sub-standard off-ramp to Mount Oval;
- 4 new road underbridges to allow the proposed M28 to pass over existing roads;
- 1 underbridge widening at Carr's Hill;
- 2 shared use pedestrian and cyclist underpasses, one at Carr's Hill and one at Old Post Office Road;
- Demolition of the existing Maryborough Hill overbridge and construction of a replacement overbridge at the same location. This overbridge will take Maryborough Hill over the widened M28 below;
- Various other structures including large retaining walls and stream culverts;
- Traffic signalised control to be implemented at key junctions on Rochestown Road, including the replacement of the Rochestown Road roundabout with a signalised junction, signalising of the merge to the M28 and signalising of the Clarke's Hill junction;
- Local road improvements and parallel access roads, etc.;
- Accommodation works and farm accesses as required;
- Provision for footpaths and cycle facilities;
- Relocation of high voltage electricity pylons at Shanbally;
- Drainage system, including attenuated outfalls, watercourse culverts and realignments; and
- Landscaping and environmental mitigation measures.

[1]No access points other than designated junctions will be permitted to this road.

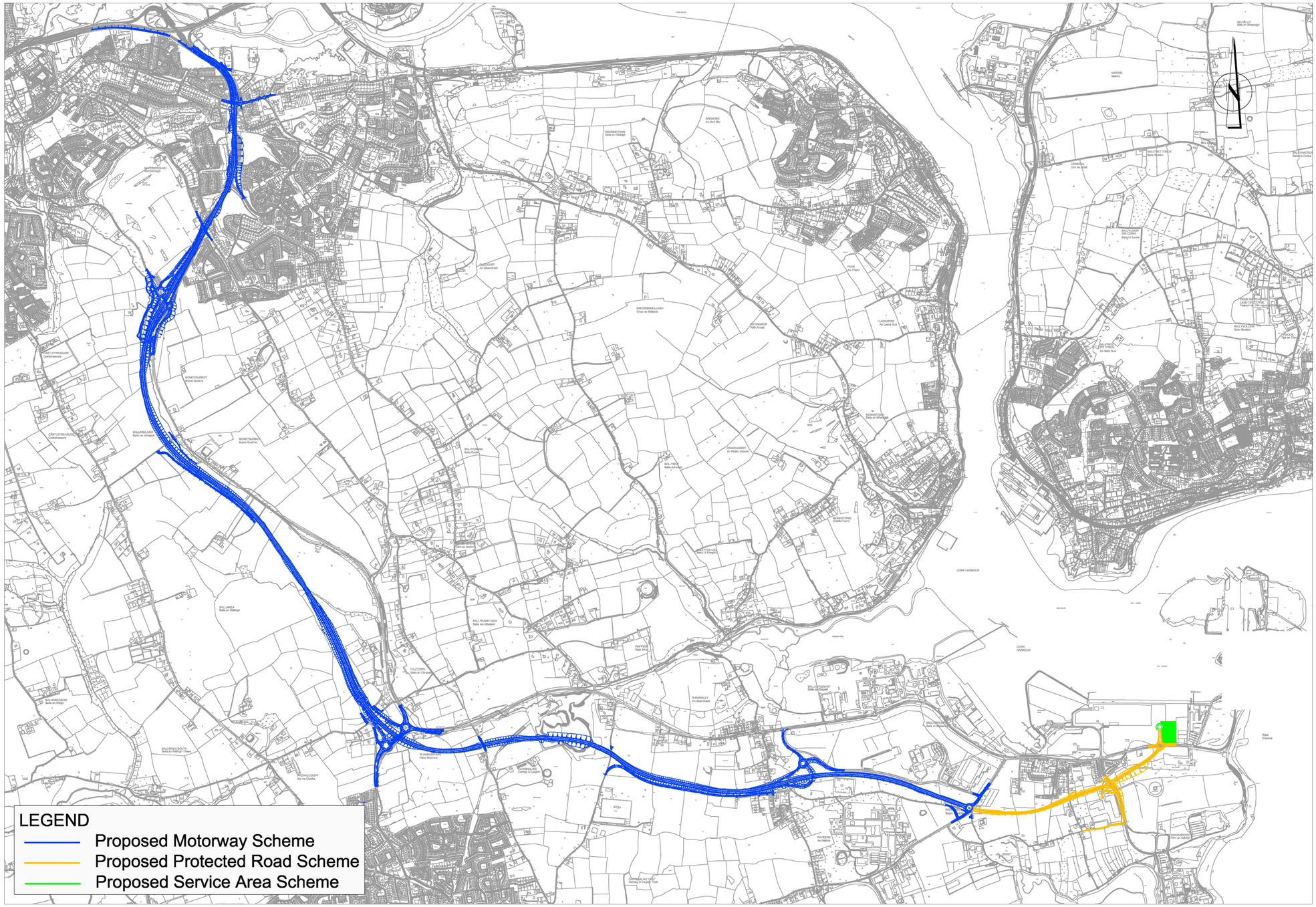
A Service Area for commercial vehicles including amenity building, fuel facilities, parking etc. within the Port of Cork lands at Ringaskiddy will also be provided. The service area is contained on a site which is approximately 1.77ha. The Service Area (SA) shall comprise 45 HGVs (including Coach) spaces and includes a 500m^2 facility building with a HGV only forecourt (refer to **Section 3.9** below).

The carriageway types for the proposed M28 Road Project are shown in **Table 3.1** below. The design of all carriageways has been undertaken in compliance with the NRA Design Manual for Roads and Bridges (NRA DMRB).

Table 3.1: Carriageway Design Criteria for the Proposed M28 Road Project

Road Type	Carriageway Width	Central Reserve	Verge Widths	Design Speed Km/h
Standard Dual-Carriageway Motorway (D2M)	2 x 7.00m	2.6m with concrete barrier	Minimum 2m, Typically 3m	100
Type 1 Single Carriageway Protected Road (S2)	1 x 7.30m	N/A	Minimum 3m, Typically 4m where required for footway	100
Type 2 Single Carriageway (S2)	1 x 7.00m	N/A	Typically 5m where required for cycleway	As appropriate

Figure 3.1: Overview of Proposed M28 Road Project



3.2 DESCRIPTION OF THE PROPOSED ROUTE

3.2.1 Overview of the Mainline M28

As outlined in **Chapter 2: Planning and Policy Context**, the route is a TEN-T core route which will comprise a motorway between Bloomfield Interchange and the roundabout at Barnahely. From Barnahely to the eastern side of Ringaskiddy, a single carriageway with protected road status as per the Roads Act is proposed. There will be a Service Area thereafter.

An overview is depicted on **Figure 3.1**. A full set of the mainline road drawings are included in **Volume 5** (Road Layout (GA Series) and Plan and Profile (GE Series))**.** The following description is an outline of the principal features of the works.

The route commences at Bloomfield Interchange, where the existing N28 meets the N40, South Ring Road. This Interchange allows N28 northbound traffic to access the N40, east towards the Jack Lynch Tunnel and west towards Cork City and environs, West Cork and County Kerry. It also facilitates access to the N28 southbound towards Ringaskiddy for all vehicles from the N40. In addition the Bloomfield Interchange is also used by N40 traffic for access to and from the R610 Rochestown Road and vice versa.

Northbound traffic on the M28 and from Rochestown Road will be streamlined by the provision of a dedicated M28 to N40 westbound link road and by dedicating one lane each on the Rochestown Road on-ramp to westbound and eastbound traffic. This arrangement will considerably reduce the current weaving problems for northbound traffic negotiating the Bloomfield Interchange. For traffic travelling from the N40 to the N28 and Rochestown Road, the road layout will be similar to the existing situation but with improved signage and road markings to minimise potential conflicts. It is proposed to retain the 60kph speed limit on this section as far as Ch. 600 approximately (i.e., from Bloomfield to just beyond the Rochestown Road).

It is proposed that the first 2km approximately (Bloomfield to Carr's Hill) of mainline motorway will be achieved primarily by on-line widening of the existing N28 carriageway. Within this 2km section, structures including new retaining walls and new bridges will be necessary to fit the proposed road layout broadly within the corridor of the existing road. The retaining walls will allow the various slip-roads and mainline widening to be facilitated while minimising additional landtake. The exceptions to this include widening on the east side of the existing road south of the Bloomfield interchange as far as the proposed off-ramp to Rochestown Road, widening on the northbound side from Maryborough Hill to Rochestown Road and widening on the east side to facilitate the upgraded Mount Oval slip road and motorway widening as far as Maryborough Hill. Additional landtake will be required in these locations.

Rochestown Road will be widened to accommodate a right turning lane to Clarke's Hill and improved pedestrian facilities. The sub-standard slip road at Maryborough Hill will be closed. The sub-standard off-ramp to Mount Oval will be improved to comply with design standards. The existing Maryborough Hill Overbridge will be demolished and replaced with a new bridge at the same location to accommodate the proposed widened mainline below. The proposed link road between Maryborough Hill and Carr's Hill will be provided between the boundary of Douglas Golf Club and the proposed M28, though additional lands will be required on the south side of the golf club. A number of retaining walls of various heights are proposed throughout this section to minimise impacts to adjacent residential estates and Douglas Golf Club.

From Carr's Hill to Barnahely Roundabout, approximately 8.9km, the scheme will comprise a new offline motorway. The existing Carr's Hill Underbridge will be widened to accommodate the new M28 mainline. A full interchange is proposed in this location.

South of the existing underbridge at Carr's Hill the proposed mainline veers off-line into agricultural land on the western side of the existing N28 on an embankment to cross the L6465 Board of Works Road at Chainage 3,350m. A new bridge will be constructed at this location to allow the Board of Works Road to pass under the M28 mainline.

The mainline will then continue to run to the west of the existing N28 passing through agricultural land and sweeping in a south easterly direction as it passes Hilltown. At this point the mainline deviates further from the existing road and passes through a significant cutting before crossing on an embankment over the R611 Carrigaline Road, where an underbridge is proposed. A partial grade separated interchange will be provided at Shannonpark with north facing slip roads to facilitate access to and from Carrigaline.

As the route passes through Shannonpark, the mainline passes to the south west of the existing Shannonpark Roundabout and continues in an easterly direction towards Shanbally and the Ringaskiddy Peninsula. The alignment undulates before rising on an uphill gradient to an embankment, where the mainline crosses over the existing Ballyhemiken Road (Rock Road), where an underbridge is proposed. The alignment then veers towards and passes through the southern part of Raffeen Quarry avoiding impacting upon the Fernhill Golf & Country Club. A substantial fill will be required within the quarry, which is anticipated to be a source of road construction materials.

After passing through the quarry the alignment will continue in an easterly direction, following existing ground levels as it passes through an area constrained by existing services in the vicinity of the L6472 Raffeen Road. It is proposed to close this road with alternative access being provided through a new parallel link road on the southern side of the proposed M28, which extends from the L6472 to the L2492 at Shanbally.

Beyond the Raffeen Road the mainline will continue to progress in an easterly direction on an embankment towards the proposed partial interchange at Shanbally. At Shanbally, the mainline follows a route through a corridor between Marian Terrace to the north and Coolmore Close to the south. The existing local road, L2492 linking these two housing estates will be maintained as the motorway will be raised onto an underbridge at this location to take the motorway over the road. The existing road network at Shanbally will be substantially unaltered.

The partial interchange at Shanbally will be facilitated by an underbridge and a roundabout located to the north of the mainline. The existing private road access to the Janssen complex will be designated a public road and linked to the existing N28. The private road to Janssen will be realigned to the east to link to the existing road.

The alignment then sweeps to the north of the ESB sub-station beyond Shanbally Interchange, and continues east in a designated corridor adjacent to a recently developed industrial complex (Janssen) towards Barnahely. Between Shanbally and Barnahely the road will run through a shallow cutting to the proposed at-grade roundabout located on the R613 at Barnahely.

The proposed motorway will finish at the Barnahely Roundabout. The scheme will then continue eastwards as a Type 1 single carriageway (Protected Road status) towards the L6517 Loughbeg Road and the eastern side of Ringaskiddy Village. From the Barnahely Roundabout, the mainline will veer towards an existing undeveloped services corridor to the south of Ringaskiddy village. At the services corridor, the alignment will follow a route between existing pylons and poles, towards the Loughbeg Road, L6517. The vertical alignment along this corridor is predominantly at grade with the exception of two sections on embankment including where the mainline crosses over Old Post Office Road.

Old Post Office Road will be closed to vehicular traffic and a new underpass will be provided at local road level to maintain pedestrian and cyclist access to Ringaskiddy Lower Harbour National School which is located to the south of the mainline.

At Loughbeg Road, an at-grade roundabout is proposed. From Loughbeg Road the alignment will continue in an easterly direction towards the existing local road L2545 on the east side of Ringaskiddy village. In this area the alignment is substantially in cut due to the presence of a locally prominent hill. An at-grade roundabout (Ringaskiddy Roundabout) will be constructed where the new mainline meets the existing local road. This roundabout will provide access to the proposed service area, the eastern entrance to the port and Haulbowline Island via the L2545.

3.3 DECLASSIFIED N28 – ALL PURPOSE ROAD

3.3.1 Declassified N28 - All-Purpose Road

At Carr's Hill the proposed motorway will diverge from the existing N28. At this location, the existing N28 will be realigned through the proposed Carr's Hill Interchange to connect to the existing R609 via the motorway interchange.

The existing N28 carriageway from Carr's Hill to Ringaskiddy village will be retained as a local access road for local traffic. This road will be reclassified to become an all-purpose Regional or Local road. Together with the R609, the route will provide the primary route in the area for Non-Motorway Users (NMUs).

The newly declassified all-purpose road, shown in green on **Figure 3.2,** will serve the surrounding communities and numerous individual properties and industries that adjoin the existing N28, separating local and strategic traffic while providing opportunity to access the motorway via the interchanges located at Carr's Hill, Shannonpark, Shanbally and the at-grade roundabouts at Barnahely, Loughbeg and Ringaskiddy.

This reclassified all-purpose road will also provide an alternative route for NMUs. Non-motorway users are classified as pedestrians, cyclists, equestrians, learner drivers and certain classes of motorised vehicles which are not permitted on motorways. The routes shown in **Figure 3.2** indicate that alternative routes exist, particularly for motorised NMUs. This is not to imply that the routes shown are recommended for use by vulnerable road users, such as cyclists and pedestrians as they exist, but rather to identify the future potential for such routes. Routes proposed for use by vulnerable road users will require further development and upgrade.

It is noted that motorised NMUs, e.g., learner drivers cannot access the N40 at Bloomfield interchange and vice versa. The only access to the area will be via the Douglas Road, South Douglas Road or eastbound on the N40 from Kinsale Road Interchange (access via the Douglas slip roads). To access to and from the N40 east will entail the making of U-turn manoeuvres via the Kinsale Road Interchange.

Throughout the design iteration, the interfaces with the existing road network include provision for cyclists and pedestrians (see **Section 3.7** below) to facilitate sustainable transport in the wider area.

3.3.2 Proposed Existing Road Treatment

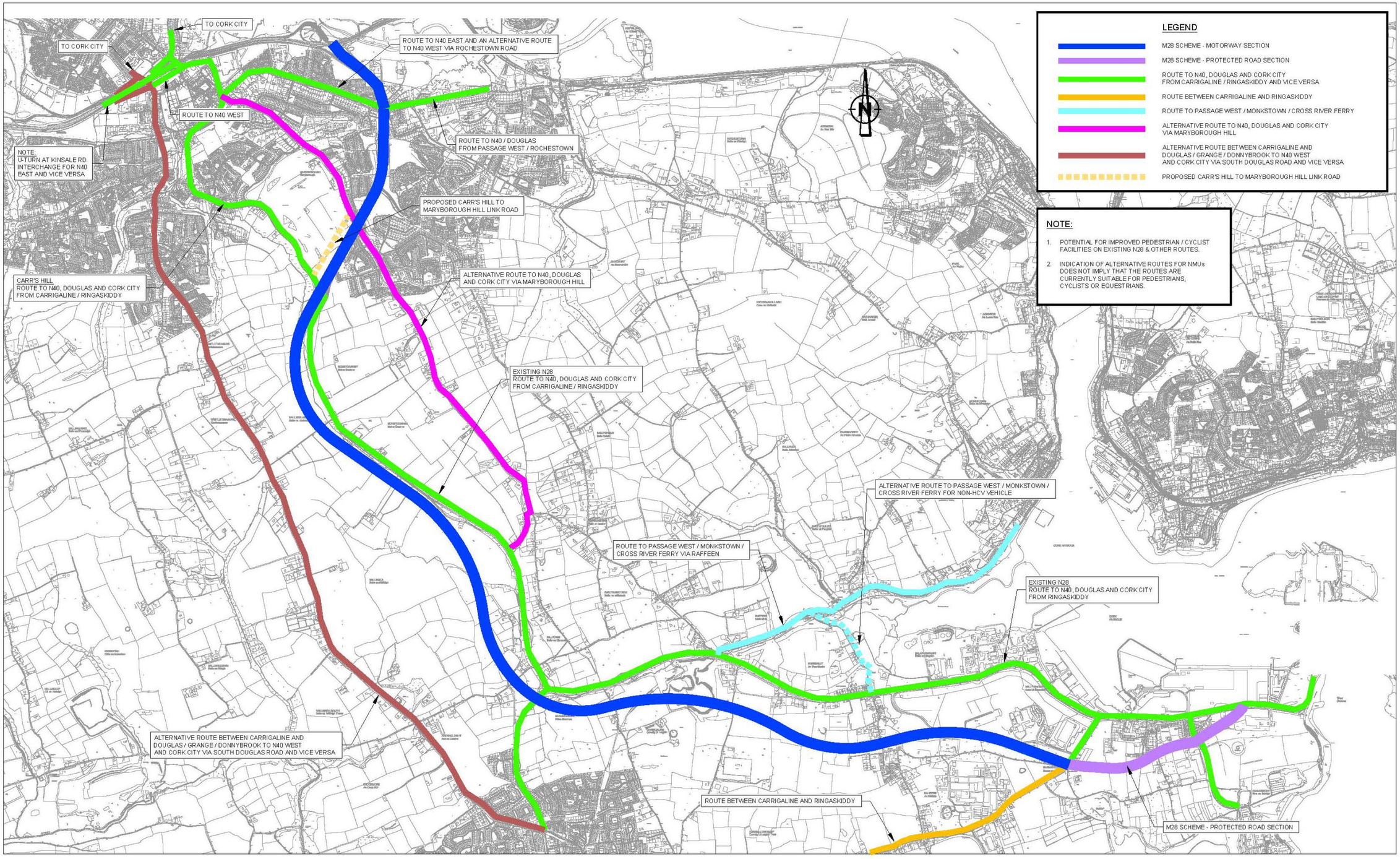
The existing N28 road will be substantially maintained in its current state with some local upgrades. A local realignment is proposed at Carr's Hill as part of the interchange design – Carr's Hill South Link Road. This realignment will extend from the proposed Carr's Hill East Roundabout for a distance of approximately 350m before tying back into the exiting N28.

A short section (c. 120m) of the existing N28 as it approaches the Shannonpark Roundabout from the north will be upgraded – proposed Shannonpark North Link Road. In addition a section (c. 250m) of the existing N28 from the Shannonpark Roundabout towards Ringaskiddy will be upgraded – proposed Shannonpark South Link Road.

The existing IDA access road currently forms a junction with the N28 approximately 150m east of the roundabout at Shanbally village. This is currently a private road/junction and it is proposed that a section of this will be designated a new public road with a priority junction at the N28. This proposed Shanbally North Link Road will be approximately 270m in length and will form one arm of the proposed Shanbally Roundabout.

A 330m section of the existing Local Road (known locally as Tower Road) will be upgraded between its junctions with Loughbeg Road and Old Post Office Road. This road is currently subject to local flooding, has a poor surface and a cross-section that does not allow cars to pass. The upgrading of this road will provide a high quality alternative route for vehicles travelling to/from the Ringaskiddy Lower Harbour National School in-lieu of Old Post Office Road which will be closed to vehicular traffic. Pedestrians and cyclists can remain on Old Post Office Road.

Figure 3.2: Non Motorway User Routes



3.4 SIDE ROADS – REGIONAL AND LOCAL ROADS

There will be realignment of numerous side roads. All side roads are designed as non-national roads with design speeds and cross-sections appropriate to the related existing roads. Layout drawings (GA Series) and Plan and Profile (GE Series) of all regional and side roads are contained in **Volume 5** (SR and SL Series).

3.4.1 Existing R610, Rochestown Road

The existing Rochestown Road is to be reconfigured from the existing junction with Rochestown Rise to a location, some 70m east of the junction with Clarke's Hill. The existing cross-section is being widened to accommodate a right-turn lane at Clarke's Hill and 3 sets of linked traffic signals are being provided. Linked traffic signalisation is to be provided at Clarke's Hill junction, a reconfigured St Patrick's roundabout and at the proposed M28 merge junction.

The existing underbridge structure S1, which currently takes the N28 mainline over the R610 will be retained. A new structure, S2, will be provided to carry northbound M28 traffic to the N40 westbound. This structure will be located to the west of the existing underbridge and will carry a single lane of traffic.

It is proposed to relocate the existing on-ramp which enables traffic from the Rochestown Road to merge with the N28 northbound. The new on-ramp will be situated approximately 20m east of its current location, and will have 2 lanes, i.e., westbound or eastbound to the N40. Road markings and signage will be provided, which will encourage drivers to get into the correct lane promptly.

As noted above, the proposed development includes the provision of a right-turn lane at the existing junction of Rochestown Road and Clarke's Hill. This additional capacity will reduce peak hour delays at the junction. Currently, a vehicle making this right-turn relies on a gap in the westbound traffic stream. When there is no gap the vehicle making the right-turn, will sit in the eastbound lane and block traffic continuing eastwards to Passage. The provision of the right-turn lane allied to the signalised junction control will increase overall traffic throughput.

It is proposed that 3 sets of linked traffic signals will be provided along Rochestown Road as follows:-

- Proposed repositioned on-ramp from Rochestown Road to M28 northbound;
- Proposed reconfigured junction where M28 off-ramp meets Rochestown Road (currently a roundabout junction); and
- Junction of Rochestown Road and Clarke's Hill.

It is also proposed that improved footpaths and pedestrian crossings will be provided at each of the signalised junctions. An additional pedestrian crossing is also proposed on the east side of the reconfigured traffic signal controlled St. Patrick's roundabout junction.

3.4.2 Maryborough Hill

The existing northbound on-ramp to the N28 from Maryborough Hill will be closed. In addition, the existing Maryborough Hill overbridge will be demolished and replaced with a new bridge at the same location, Structure S3. Refer to Drawing Nos. BR0303 and BR0304. This new bridge will have a cross-section that consists of the following:-

- 2m wide footpath.
- 1.5m wide on-road cycle lane.
- 3.5m wide traffic lane.
- 3.0m wide ghost island/right-turn lane.
- 3.5m wide traffic lane.
- 2.0m wide verge/hard strip (future footpath).

The design speed shall remain as per the existing road. A proposed right-turn lane will be provided on the eastbound approach to the new bridge to facilitate vehicles wishing to turn right from Maryborough Hill into the proposed Maryborough to Carr's Hill link road (refer to **Section 3.4.4** below).

3.4.3 Existing N28/R609 at Carr's Hill

To accommodate local traffic the grade-separated interchange at Carr's Hill links the existing N28 and the R609 through the interchange, via the proposed Carr's Hill Central Link Road and associated roundabouts. Realignment of the N28 and R609 will be to a design speed of 60kph through the interchange with a cross-section of 2 x 3.5m wide lanes with 2 x 0.5m hard strips.

The Carr's Hill South Link Road tie-in to the existing N28 will have a design speed of 85kph to generally align with the standard of the existing N28. The realigned roads provide for access from the south (via the existing N28) and from the west side of Douglas (via the R609) to the M28 and vice versa.

The realigned local roads pass under the mainline at the location of the existing Carr's Hill underbridge, S4 which is proposed to be widened as part of the scheme.

The realignment of the existing N28 and the R609 Douglas Link Road, the Carr's Hill Central Link Road and the Carr's Hill South Link Road are illustrated in the SR series of drawings in **Volume 5** (SR0002 (Plan Layout) and SR0003 (Vertical Alignments)).

3.4.4 Maryborough Hill to Carr's Hill - Link Road

The proposed Maryborough Hill to Carr's Hill link road will connect Carr's Hill Interchange with Maryborough Hill on the western side of the M28 mainline. This link will replace the existing sub-standard on-ramp to the M28 northbound. This link road has a design speed of 70kph and a cross-section of 2 x 3.5m wide lanes with 2 x 0.5m hard strips and its alignment is illustrated on the GE and GA series of drawings in **Volume 5**.

The road links to a proposed roundabout on the R609 at the western side of the Carr's Hill Interchange and provides access to the M28 from Douglas (east and west) and vice versa.

3.4.5 L6465 Board of Works Road

The L6465 Board of Works Road shall remain as per the existing road. The mainline will cross over the existing road on an underbridge, S5. The underbridge will be wide enough to accommodate 2 x 2m wide footpaths and 2 x 3.5m wide traffic lanes to allow for future upgrade of the L6465.

3.4.6 Existing N28 at Shannonpark

The existing N28 at the proposed Shannonpark interchange is to be maintained substantially as currently configured. Where realigned sections of the N28 tie back into the existing road (N28), cross-sections similar to the current road are proposed, except where additional widening is required to facilitate footways and cycle tracks locally.

At the northern tie-in, the existing road consists of a single lane southbound and a single lane northbound. The proposed cross-section at the northern tie-in consists of a 7.0m carriageway (2 x 3.5m lanes) with a 0.5m hard strip on each side. In addition, a combined footway/cycleway is proposed on the eastern side and a cycle lane on the western side.

At the tie-in on the eastern side of Shannonpark Roundabout the existing N28 consists of two carriageway lanes and a hatched out central area which facilitates right-turn pockets for existing dwellings on the south side of the road and for an existing right-turn lane for access to L2490 Rock Road. The proposed cross-section includes for a 10m carriageway (2 x 3.5m lanes + 3m hatched area) to tie-in with the existing road. A westbound hard shoulder and an eastbound hard strip are also provided to match the existing road. The existing access to the dwellings on the south side of the road is to be closed and an alternative access relocated further from the Shannonpark Roundabout is proposed.

Between the proposed Shannonpark South Roundabout and the existing Shannonpark Roundabout the existing R611 is partly utilised as part of the Shannonpark Interchange to take traffic from one side of the M28 to the other. To meet demand, 2 lanes of traffic southbound (to Carrigaline) are necessary with a single lane northbound to Shannonpark roundabout. The cross-section consists of 3 x 3.5m wide lanes with a combined footway/cycleway on the southern side of the road between the two roundabouts.

At the tie-in to the existing R611 on the southern side of the Interchange the cross-section consists of a single lane of traffic in each direction, a footpath on the western side and a combined footway/cycleway on the eastern side of the road. This cross-section widens to 2 southbound and 2 northbound lanes closer to the proposed Shannonpark South Roundabout.

3.5 SUMMARY OF STRUCTURES REQUIRED

Nine bridges and two pedestrian/cyclist underpasses are proposed. These bridges comprise six underbridges, one overbridge, the widening of Carr's Hill Underbridge and the upgrading of the existing Rochestown Road Underbridge. The existing Maryborough Hill overbridge will be demolished and rebuilt at the same location over the M28 realignment. A summary of the proposed bridges/underpasses is provided in **Table 3.2** and drawings are included in **Volume 5** (BR-Series).

Table 3.2: Structures along Proposed M28 Road Project

Structure No.	BR Series Ref	Name	Chainage	Comment
S1	BR0101	Existing Rochestown Road Underbridge	0+550	Existing concrete bridge to be upgraded by replacing deck waterproofing system, bridge deck surfacing, new median barrier and reinstatement of carriageway markings to suit the realigned M28.
S2	BR0201	Rochestown Link Road Underbridge	0+550	New underbridge to carry the proposed northbound M28 to N40 westbound link road over the existing R610 Rochestown Road.
S3	BR0303 & BR0304	Maryborough Hill Overbridge	1+560	Existing structure to be demolished and replaced with a new overbridge at the same location, to facilitate the widened M28 underneath and widened Maryborough Hill above.
S4	BR0401	Carr's Hill Underbridge	2+190	Existing bridge to be widened to facilitate the increased cross-section of proposed M28. The span arrangement is 12.7m + 14.5m + 12.8m.
S4a	BR0401a	Carr's Hill Underpass (Cyclists/pedestrians)	2+550	New shared use cyclist/pedestrian underpass to link the existing N28 to the R609, under the proposed M28 mainline.
S5	BR0501	Board of Works Underbridge	3+350	New underbridge to carry the proposed M28 over the existing Board of Works Road (L6465).
S5a	BR0501a	Board of Works Underpass (Stock)	3+670	New underpass to facilitate the movement of livestock from one side of the mainline to the other.
S6	BR0698	Shannonpark Underbridge	6+260	New underbridge as part of Shannonpark Interchange to carry the proposed M28 realignment over the widened R611 Carrigaline Road.
S7	BR0701	Rock Road Underbridge	6+940	New underbridge to carry the proposed M28 realignment over the existing L6472 Local Road (Rock Road or Ballyhemiken Road).
S8a	BR802	Shanbally West Underbridge	9+230	New underbridge to carry the M28 mainline over the existing L2492 Local Road at Shanbally.
S8b	BR0803	Shanbally East Underbridge (Shanbally Interchange)	9+550	New underbridge as part of Shanbally Interchange to facilitate a single lane westbound merge to the M28.
S9	n/a	**NOT USED**	n/a	N/a
S10a	BR1001a	Old Post Office Road Underpass (Cyclists/ pedestrians)	11+660	New shared use cyclist/pedestrian underpass at Old Post Office Road, under the proposed mainline.
S10b	BR1001b	Stock underpass	11+765	New underpass to facilitate the movement of livestock from one side of the mainline to the other.

The semi-urban nature and the proposed on-line widening of parts of the existing N28 mean that several large retaining walls will be required. Fifteen retaining walls (RW) are proposed and a summary of the proposed retaining walls is provided in **Table 3.3** below. The plan locations of these walls can be seen on the GA Series of drawings in **Volume 5**.

Table 3.3: Proposed Retaining Wall Structures along the M28 Road Project

Structure Ref. No.	Name	Approximate Mainline Ch.	Comment
RW1	Retaining wall at Rochestown Rd. (N40 Westbound Link)	Ch. 320 to Ch. 580	Retaining wall required to protect properties to west of proposed northbound M28 to N40 Westbound Link Road Diverge at Rochestown. Retained height varies from 0 to 9m. Wall length approximately 230m, either side of Structure S2.
RW2	Retaining walls at Rochestown Rd. (M28 Diverge)	Ch. 250 to Ch. 480	Retaining wall required to protect properties and accesses to the east of the proposed M28 mainline and southbound diverge to Rochestown Road. Retained height varies from 0 to 5.5m. Wall length approximately 230m.
RW3	Retaining wall at Rochestown Rd. (M28 Merge)	Ch. 320 to Ch. 580	Retaining wall required between west side of M28 northbound merge ramp, and northbound M28 to N40 Westbound Link Road. Retained height varies from 0 to 7.5m. Wall length approximately 230m, either side of Structure S2.
RW4	Retaining wall at Rochestown Rd. (M28 Merge and Mainline)	Ch. 275 to Ch. 530	Retaining wall required between east side of M28 northbound merge ramp and M28 Mainline. Ties into existing Rochestown Road bridge. Retained height varies from 0 to 6.5m. Wall length approximately 255m.
RW5	Retaining wall at Rochestown Rd. (M28 Mainline and Rochestown Diverge)	Ch. 410 to Ch. 530	Retaining wall required between M28 Mainline and west side of proposed southbound M28 Diverge to Rochestown Road. Ties into existing Rochestown Road bridge. Retained height varies from 0 to 3m. Wall length approximately 120m.
RW8	Mount Oval Retaining Wall	Ch. 200 to Ch. 300 (Mount Oval Diverge)	Retaining wall on eastern side of proposed Mount Oval diverge at top of cutting to maintain the existing footway. Retained height varies from 0.5m to 2.5m. Wall length approximately 100m.
RW9	Maryborough Heights Retaining Wall	Ch. 1,210 to Ch. 1,250	Retaining wall required along western side of mainline to reduce impact on adjacent properties in Maryborough Heights. Retained height approximately 3.5m. Wall length approximately 40m.
RW10	Retaining wall at Maryborough Hill Rd. – North West Corner	Ch. 1,520 to Ch. 1,550	Retaining wall on western side of mainline to maintain mainline widening within the existing road corridor. Ties in to proposed Structure S3. Retained height approximately 6m. Wall length approximately 30m.
RW11	Retaining wall at Maryborough Hill Rd. – North East Corner	Ch. 1,535 to Ch. 1,565	Retaining wall on eastern side of mainline to maintain mainline widening within the existing road corridor and protect existing private property. Ties in to proposed Structure S3. Retained height approximately 3.0m. Wall length approximately 30m.

Structure Ref. No.	Name	Approximate Mainline Ch.	Comment
RW11A	Retaining Wall on eastern side of M28	Ch. 1,570 to Ch. 2,120	Retaining wall on eastern side of the M28 mainline, adjacent to Maryborough Ridge housing estate, to maintain road widening within the existing road corridor. Ties in to Structure S3. Retained height approximately 3.5m. Wall length approximately 550m.
RW12	Retaining Wall on western side of M28	Ch. 1,560m to Ch. 1,800	Retaining wall on the western side of the M28 mainline to maintain road widening within the existing road corridor adjacent to Douglas Golf Club. Ties in to Structure S3. Retained height varies from 4.5m to 6m. Wall length approximately 240m.
RW15	Retaining Wall to accommodate ESBI Tower	Ch. 8,680 to Ch. 8,690	Retaining wall on the southern side of M28 mainline to accommodate future pylon for ESB. Retained height varies from 0 to 5m. Wall length approximately 20m.
RW17	Retaining wall to minimise impact on existing building at Shanbally	Ch. 9,260 to Ch. 9,305	Retaining wall to retain motorway embankment to avoid encroachment onto the existing building (Forrester's Hall). Retained height, maximum 5.2m and approximately 32m in length
RW18	Retaining wall to minimise impact on Grotto at Shanbally	Ch. 9,335 to Ch. 9,395	Retaining wall to retain motorway embankment to avoid encroachment onto the existing Grotto. Retained height, maximum 5.7m and approximately 65m in length.
RW16	Retaining Walls at Rochestown Road to minimise permanent land acquisition	Ch.0 to Ch. 57 on Clarkes Hill	Retaining wall forming new residential boundaries to existing dwellings on Rochestown Road and Clarke's Hill. Retained height approximately 1.0m. Wall length approximately 200m.

3.6 WATERCOURSE CROSSINGS AND DRAINAGE

The proposed road project involves the construction of a new surface water drainage system including new outfalls to existing watercourses or existing surface water drainage networks. Furthermore, it will cross a number of local watercourses, necessitating stream realignments, new culvert crossings and extensions to existing culverts.

The development of the proposed surface water drainage design has been carried out having regard to the requirements of Cork County Council, Environmental Protection Agency (EPA), Inland Fisheries Ireland (IFI) and National Parks & Wildlife Service (NPWS).

The proposed surface water drainage system has been designed in accordance with the relevant TII Drainage Design Publications, as listed in **Chapter 9: Hydrology and Drainage**.

There are three major objectives in the drainage of national roads:-

- The speedy removal of surface water to provide road safety;
- Provision of effective sub-surface drainage to maximise longevity of the pavement and its associated earthworks; and
- Minimisation of the impact of the runoff on the receiving environment.

The surface water drainage design incorporates the following aspects:-

- All drainage systems are accessible for inspection and maintenance;
- All impermeable and semi-impermeable surfaces are adequately drained;
- Drainage systems do not have an adverse impact on existing ecology, surface-water hydrology or groundwater hydrogeology;
- In the interest of pollution control and containment the road drainage shall be kept separate from other catchment drainage; and
- The road drainage causes no disruption in water supply to landowners/occupiers who obtain their water from wells, boreholes and the like.

A number of drainage collector systems will be available, subject to design requirements in accordance with TII Publication DN-DNG-03022 (Drainage Systems for National Roads). These collector systems include kerbs and gullies, combined kerb and drainage blocks, linear drainage channels, surface water channels, combined surface and groundwater filter drains, over the edge drainage and grassed surface water channels.

3.6.1 Design Requirements

The design of the proposed drainage collector systems will allow for the following:-

- Consideration of pollution and flood risk requirements;
- Determination of the design storm used in the design of the drainage elements;
- Calculation of the flows from the design storm within each drainage element;
- Establishment of the hydraulic adequacy of each drainage element;
- Determination of the location of outfalls or soakaways; and
- Determination of structural loading upon drainage conduits (where necessary).

Longitudinal carrier drains will be designed to accommodate a one-year storm in-bore without surcharge. The design will be checked against a five-year storm intensity to ensure that surcharge levels do not exceed the levels of chamber covers or channel depths. The rainfall intensities used in the design have been increased by 20% in order to allow for the future effects of climate change in the design.

3.6.2 Interceptor Ditches

Interceptor ditches and infiltration drains have been included to collect, control and dispose of runoff from adjoining land draining towards the proposed road. This provision reduces the amount of water that might otherwise run onto the road carriageway and thus maintains the integrity of the road construction and reduces the likelihood of localised flooding or ponding. Such ditches and drains will collect overland flow and outfall directly into existing watercourses separately from the road carriageway drainage system.

3.6.3 Discharge to Outfalls

Surface water runoff collected by the carriageway drainage system will be discharged to ground, into existing watercourses or existing surface water drainage networks adjacent to the proposed road. The steps taken to identify the locations of proposed outfalls/soakaways and to quantify the extent and impact of run-off from the carriageway are described in **Chapter 9: Hydrology and Drainage.**

The road pavement is much more responsive to rainfall and will generate run-off at a higher rate than the surrounding natural catchment. Generally, the peak discharge rate from the road drainage network is likely to occur before the peak flow rate in the receiving watercourse. Outfalls from the proposed drainage will be designed to manage this effect. Measures include attenuation of run-off rates, consideration of outfall invert levels and scour protection.

To minimise flood risk downstream of proposed outfalls, outfalls are designed to have 'no worsening' of flow rates up to and including the 1 in 100 year storm. Therefore the peak discharge rates for the critical 1 in 100 year storm duration are equal or less than the peak 1 in 100 year greenfield runoff rate for the critical storm duration. In addition, 20% is added to the critical 1 in 100 year storm rainfall intensity to account for climate change.

There are a total of 13 no. outfall locations from the new surface water drainage system. The outfalls will be provided with surface water attenuation infrastructure to reduce the potential for flooding. Depending on location, attenuation facilities will consist of attenuation ponds, tanks or swales. For further information, refer to **Chapter 9: Hydrology and Drainage** and **Volume 5** Drainage Design Drawings (DR001-DR007).

3.6.4 Control of Pollution and Flooding

The proposed surface water drainage design includes measures to minimise the risk of accidental spillage causing pollution and will provide for removal of suspended solids and other contaminants. Guidance on the assessment of pollution and flooding provided in TII Publication DN-DNG-03065 (Road Drainage and the Water Environment) has informed the design of the proposed surface water drainage system.

Carriageway drainage systems can prevent pollutants reaching the receiving water environment, e.g., gully pots can capture potentially contaminated sediments and can form a first defence in the event of an accidental spillage. However, high flow rates can cause re-suspension of sediments.

Bypass oil separators capture flows from rainfall events of up to 5mm/hour, which is about 10% of the typical peak rainfall intensity in Ireland. They rely on the greatest pollutant load being carried by the 'first flush' of a rainfall event. This is the initial flow of runoff following a rainfall event which is most likely to carry the highest pollution load from the carriageway.

Unlined ditches and grassed swales/channels have potential to control pollution, by allowing infiltration of runoff to ground. Where vegetation is present, this can also contribute to pollution control. Filter drains offer some protection as the filter media can absorb suspended solid pollutants and heavy hydrocarbons, reducing downstream pollution risk from routine runoff.

Attenuation ponds, where provided, will also treat run-off as well as attenuating flow rates. The ponds will increase the likelihood of settlement of suspended solids, adsorption of any potential remaining pollutants and will also act as a natural flow attenuation mechanism, while promoting ecology to some degree.

A variety of treatment systems such as swales and grassed channels, oil separators, filter drains, etc., have been incorporated in the proposed design. The potential treatment efficiency of each component varies and the proposed treatment has been selected depending on the expected pollutants within the road run-off and the potential for contamination of receiving waters.

The proposed measures and reasoning for their selection are outlined in more detail in **Chapter 9: Hydrology and Drainage**.

3.6.5 Existing Watercourses

The proposed road crosses several existing watercourses including the Glounatouig, the Donnybrook and the Woodbrook streams. The Glounatouig stream commences near Ch. 3,500 at Carr's Hill and flows in a southerly to easterly direction, generally following the route of the existing N28 before outfalling to Monkstown Creek/Cork Harbour coastal water body. The Donnybrook stream also commences at Carr's Hill and it flows northerly before turning to a westerly direction towards Douglas. The Woodbrook stream flows northerly from the Mount Oval area along the line of the existing N28 before discharging to the Lough Mahon transitional water body. These watercourses and their tributaries will require culverts or extensions to existing culverts to convey their flow under the proposed scheme at various locations. Realignments of both the Donnybrook and Woodbrook streams are also required to accommodate the proposed scheme.

Culverts and stream realignments are designed in accordance with the requirements of the Office of Public Works (OPW), the relevant TII Publications, and Inland Fisheries Ireland (IFI). Culverts are designed in accordance with Inland Fisheries Ireland's 'Guidelines for the protection of fisheries during construction works and adjacent to waters (2016)'. New culverts will also be designed to accommodate mammal passage where such need is identified (**Chapter 10: Aquatic Ecology**).

The OPW recommend a minimum culvert size of 900mm pipe to reduce the risk for blockage during high flows. At minimum, new culverts along the proposed road project will be designed to accommodate the following:

- The 1 in 100 year flood flow rate generated within the upstream catchment;
- An increase of 20% on the 1 in 100 year flood flow to allow for climate change effects; and
- The culvert must be capable to operating under the above conditions while maintaining a freeboard of at least 300 mm.

New culverts will be bottomless culverts to allow the maintenance of the natural stream bed and provide unrestricted fish passage. Where possible, existing culvert extensions will be placed a minimum of 500mm below the existing watercourse bed level. The stream diversions will maintain existing watercourse flow and capacity.

Further details of the proposed culverts and their locations are described in **Chapter 9: Hydrology and Drainage** and indicated on the drainage drawings (DR001-DR007) in **Volume 5**.

3.7 PROVISION FOR CYCLISTS AND PEDESTRIANS

Walking and cycling will not be permitted on the mainline as it is a dedicated TEN-T road and is classified as motorway/protected road. However, provision of the new route will result in the reclassification of the existing N28 road from Carr's Hill to Ringaskiddy as a local or regional road, which will be subject to significantly lower traffic volumes than is currently the case. This will provide an opportunity for the provision of improved walking and cycling along this route. This will be particularly beneficial to the villages of Shanbally and Ringaskiddy which are currently unattractive for walking and cycling due to the high traffic volume and associated high HGV content being catered for on the N28 through both villages.

To facilitate and enhance sustainable transport opportunities, the proposed road has been designed to include provision for pedestrian and cycle facilities on sections of the existing road network which cross the proposed road project. Footways and cycleways have been included to either match existing facilities or to facilitate future upgrades. This will provide sufficient road space to accommodate the expansion of sustainable modes of travel in the area.

Section 3.7.1 to **Section 3.7.10** describe and **Figure 1.4** in **Volume 5** illustrates how the proposed road has been designed to facilitate travel by walking or cycling.

3.7.1 Rochestown Road

The proposed road project provides a new footway on each side of the upgraded Rochestown Road. These footways are proposed to be 1.8m wide. Additional signal controlled pedestrian crossings are also proposed to significantly improve the pedestrian environment at this location.

3.7.2 Existing N28/R609/R611 at Carr's Hill and Shannonpark Interchanges

The proposed road interfaces with the existing N28 at the proposed Carr's Hill and Shannonpark Interchanges. The GE and GA series of drawings in **Volume 5** illustrate the cycle and pedestrian facilities proposed on the existing N28 at Carr's Hill and Shannonpark Interchanges. The specific provisions include for the following design considerations:-

- Provision of a segregated cycle/pedestrian route from the existing N28 to the R609 at Carr's Hill. This is a new link under the proposed M28 in a dedicated underpass, which then runs alongside the proposed stream diversion on the western side of the proposed road. This provision also has the potential to link the segregated cycle/pedestrian route being considered by Cork County Council along the R609.
- Off-Road One-way Cycle Tracks as per Figure 4.2 of NRA TD 300/14 (Rural Cycle Scheme Design) are proposed at some locations at Shannonpark Interchange. This provision consists of one-way cycle tracks on both sides of the carriageway, 2.0m wide, with a 2.0m separation distance from the running carriageway.
- Off-Road Shared Cycle and pedestrian facilities as per Figure 4.5 of NRA TD 300/14 are also proposed at Shannonpark where pedestrian facilities are required in addition to cycle facilities. This provision typically consists of a 3.0m wide shared surface with a separation distance from the running carriageway appropriate to the design speed of the road.

At the northern and southern ends of Shannonpark Interchange, the cycle tracks will link back to the existing road.

There are existing footpaths immediately in the vicinity of all approaches to the existing roundabout at Shannonpark. It is proposed to provide a new footpath along both sides of the R611 Carrigaline Link Road from the proposed Shannonpark South Roundabout to the tie-in with the existing R611. In addition a footway is to be provided on the eastern side of the link road between the Shannonpark North (existing) and South (proposed) roundabouts. Footpaths will be also provided along the proposed tie-ins to the existing N28 on either side of Shannonpark Roundabout. All footpaths are proposed to be 2.0m wide, except when combined with cycle facilities where the proposed combined width is 3.0m.

Verge widths and structural spans will be wide enough to accommodate future footways at Carr's Hill interchange.

3.7.3 Maryborough Hill Overbridge

There is an existing 1-way on-road cycle lane on the eastern side of Maryborough Hill. This cycle lane currently stops immediately before the northbound on-ramp to the existing N28. As this on-ramp is being removed and the overbridge is being demolished and rebuilt, it is proposed to extend the on-road cycle lane across the new bridge.

The replacement Maryborough Hill Overbridge will include a 2.0m footway on the northern side to tie-in to the existing footway. There are currently no footway facilities on the southern side of Maryborough Hill, but a 2.0m wide verge will be provided across the bridge, which can be converted to a footpath. There are plans, as part of the Maryborough Ridge development, to provide a new footpath on the southern side of the road from the main entrance to the estate (currently an unfinished roundabout) as far as the Maryborough Hill Overbridge.

3.7.4 Board of Works Road

The proposed underbridge crossing the Board of Works Road will be sufficiently wide to accommodate future footways.

3.7.5 Ballyhemiken (Rock Road) Road

This road is planned to form part of the future access to the proposed Shannonpark Masterplan development lands. To facilitate future upgrade of this road, the proposed underbridge and short realignment of this road will include additional widths to allow for the construction of a cycleway. This provision will form part of the planned Greenway link between Carrigaline, Monkstown and Passage West.

The proposed short road realignment will also include provision for footpaths on both sides, 2.0m wide.

3.7.6 Shanbally

The existing IDA access road at Shanbally is currently a private road and has footway facilities. It is proposed that a section of this road, between the existing N28 and the proposed Shanbally Roundabout will become a public road which will incorporate a 2.0m wide footpath on each side. In addition the realigned IDA Link Road between the proposed Shanbally Roundabout and its tie-in to the existing will have a 2.0m wide footpath on the northern side to match existing facilities.

A 2.0m wide footpath will also be provided along the southern side of the proposed L6472 Shanbally to Raffeen Link Road to connect the L2492 to the Hibernian AFC Club House and soccer pitch.

The existing road network at Shanbally remains substantially unaltered. Where the proposed motorway passes over Marian Terrace (L2492), the proposed underbridge will incorporate a footway on both sides. This will provide continuity of the existing footway on the east side of this road and provide for potential future upgrade to provide another footway on the west side.

3.7.7 R613 at Barnahely

It is anticipated that a future cycle route may be designated on the existing local road, L6472 which could access onto the R613 at Barnahely. To facilitate this, an additional 2.0m wide cycle lane provision is included in the design for cyclists to negotiate the proposed Barnahely Roundabout via uncontrolled crossing points. This additional width is continued along the eastern side of the realigned R613 North Link Road.

There is an existing footway on the eastern side of the R613 at Barnahely from Ringaskiddy to Coolmore Cross. It is proposed to reinstate this footway as part of the scheme along the proposed R613 South Link Road and the proposed R613 North Link Road. In addition, the proposed Janssen Biologics Access Spur will include a footpath on the northern side to tie-in with the existing. A provision for 2.0m wide footways is made at each of these locations.

3.7.8 Old Post Office Road

A combined footway/cycleway underpass will be provided where the route passes over the Old Post Office Road. This underpass will be maintained at existing road level to enhance its attractiveness for vulnerable users. This underpass maintains existing pedestrian/cyclist access to Ringaskiddy Lower Harbour National School.

3.7.9 Loughbeg Road

There is an existing footpath on the east side of the L6517 Loughbeg Road. The Loughbeg Road is to be lowered and realigned for a distance of 270m or so to the south of the proposed Loughbeg Roundabout. A new 2.0 wide footpath will be provided on the eastern side of the proposed realignment to match existing provisions. Uncontrolled pedestrian crossing facilities are proposed at the Loughbeg Roundabout.

3.7.10 L2545 to Haulbowline and Access to Proposed Services Area

The proposed road links to the L2545 Local Road with a future access roundabout to the Port and Service Area. At this location there is an existing footway on the northern side of the existing road.

It is proposed to include provision for 6.0m wide shared use cyclist/pedestrian facility on either side of the L2545 and for an uncontrolled pedestrian crossing to be provided at the proposed roundabout.

Footway provision is also included along the access route to the proposed Service Area.

3.8 RELOCATION OF PYLONS AT SHANBALLY

There are two overhead 110kV lines in the vicinity of the proposed Shanbally Interchange. Of the two, the single phase line is located slightly closer to Shanbally Village. A diversion of this line is required. It is proposed to remove two existing polesets and a tower, which will be replaced with a new poleset and two new towers. A diversion of the double circuit line is also required, which will result in the removal of four towers. In order to facilitate the diversion six new towers will be required. The line of the proposed diversion can be seen on Drawing No. **DG0210** in **Volume 5.**

3.9 SERVICE AREA

The requirements for the M28 Service Area broadly follow the criteria outlined in the Transport Infrastructure Ireland (TII) Design Manual for Roads and Bridges (DMRB) document DN-GEO-03028 'The Location and Layout of On-line Service Areas' (formerly referenced TA70/14). With reference to TII document DN-GEO-03028 the services in **Table 3.4** are deemed suitable for the Service Area at the Port of Cork lands:-

Table 3.4: M28 Service Area Facilities

DN-GEO-03028 Facilities / Services Recommended	Proposed M28 Port of Cork Service Area Facilities
Facilities	
Travel & Tourist Information Centre	Information Leaflets
Convenience Shop	Vending Machines
Fuelling	✓ (HGV only)
Restaurant Facilities	x
Toilet / Shower Facilities	✓
Baby Changing Room	x
Additional Toilet Facilities (Outside Access**)**	x
Back of House Facilities	x
Wi-Fi	✓
Electric Car Charger	x
Air / Water	✓
Parking	
Car	x

DN-GEO-03028 Facilities / Services Recommended	Proposed M28 Port of Cork Service Area Facilities
Coach	8
Motorcycle	x
HGV	37

The proposed Service Area is located within Port of Cork lands to the east of Ringaskiddy Village. The Service Area is contained on a site which is approximately 1.77ha. The Service Area (SA) shall comprise 45 HGV (including Coach) spaces and includes a 500m^2 facility building with a HGV only forecourt. Four fuel pump stations for HGVs and Coaches shall be constructed at the Service Area. The layout of the proposed Service Area is shown on **Figure 3.3.**

Access to the Service Area shall be from a new at-grade roundabout (Ringaskiddy Roundabout) on the existing local road, L2545, a 100m length of road and a second roundabout, located in lands currently owned by Port of Cork, refer to Drawing No. **GA0121** in **Volume 5**.

The site complies with TII policy (Service Area Policy, August 2014) for the provision of rest, fuel, toilet and food facilities for long distance road users. Its location inside the Port means it best complies with planning guidelines as it is the most unattractive site for short, local trips which avoids a class of traffic that is inconsistent with the primary intended role which is to cater for long distance, inter-urban and inter-regional traffic to and from the port at Ringaskiddy. Existing facilities within the port comprise of toilets, baby care, tourist information and telephones which are all located within the terminal building close to the ferry terminal.

Therefore, the principal functionality of the service area is to provide secure HGV/Coach parking and a facility and fuelling forecourt. The general road layout is designed to minimise vehicular conflicts.

The western section of the service shall be for HGV and Coach parking, the HGV fuelling area shall be located to the west with pedestrian connectivity to the facility building. The service area shall be secured with a high boundary wall or fencing to ensure that all HGV/Coaches and the goods they are hauling are safe and secure.

The TII document DN-GEO-03028 "*The Location and Layout of On-line Service Areas*" provides general guidance on the design of service areas. This document requires amenity buildings to offer a range of services. The following services for the M28 Service Area shall be provided with HGV users in mind:-

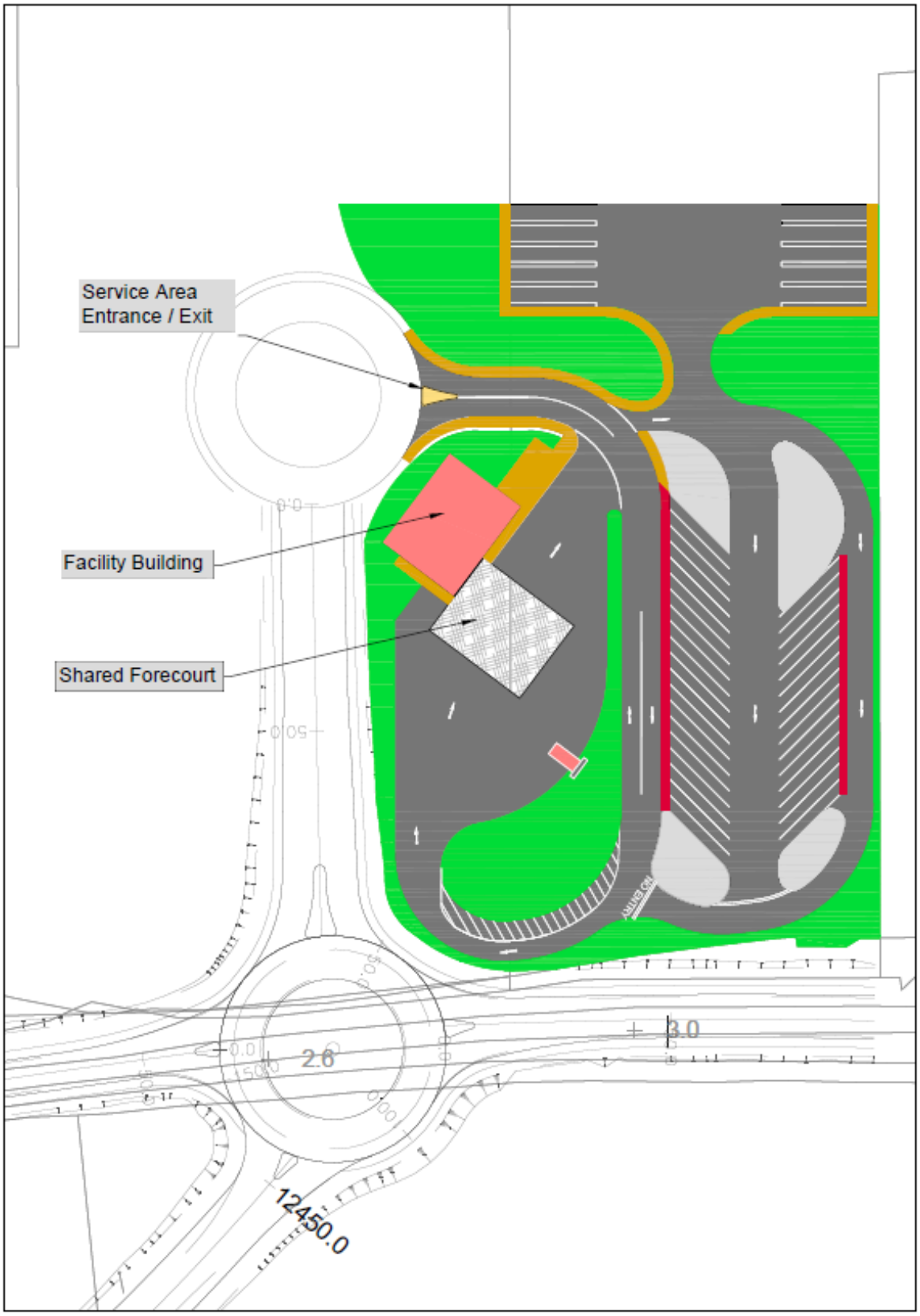
- General entrance and circulation area;
- Vending Services;
- Restaurant facilities;
- Toilet areas, including facilities for disabled users (a minimum of 3 cubicles for males, 5 cubicles for females, 1 cubicle for disabled users) and wash and shower facilities (a minimum of 1 self-contained washing cubicle to include lockable doors, wash hand basin, mirror, shaving point, bench and shower);
- Additional toilet facilities, accessible from the exterior of the building and to be available at all times when the amenity building is closed (a minimum of 1 cubicle for males, 1 cubicle for females, 1 cubicle for disabled users and a baby changing facility);

- Back of house facilities; and
- Wi-fi availability.

In addition, the facility building and western forecourt area shall be designed for future light vehicle (LV) needs as follows:-

- Restaurant/Café;
- Convenience Shop; and
- Separate Fuel Facilities (LV & HGV).

Figure 3.3: Service Area



3.10 BLASTING REQUIRED FOR THE ROAD

The locations of potential areas of blasting are:-

- Ch. 4,800 to 6,900; and
- Ch. 12,000 to 12,300 (Loughbeg to Ringaskiddy).

It is also anticipated that materials present at Raffeen Quarry will be used for construction under the existing planning permission.

The timing and scheduling of blasting activities for the road will be agreed with Cork County Council in advance of commencement on site.

3.11 PUBLIC LIGHTING

Public lighting will be provided in accordance with TII Publication DN-LHT-03038 *Design of Road Lighting for the Strategic Motorway and all Purpose Trunk Road Network*. The lighting will be provided by energy efficient light emitting diode lanterns (LED) providing a neutral white output with each one mounted on galvanised steel lighting columns/passively safe lighting columns (as appropriate to the location) up to maximum of 12m high above finished road level. All lanterns will be fully cut-off type to minimise light spill and ensure that light is concentrated on the road surface. The lighting will be designed to the appropriate Lighting Class in compliance with BS 5489-1 2013. All cables for the lighting installation will be ducted underground. The following paragraphs outline the various locations where public lighting will be required (refer to Drawing Nos. PL001 to PL005 in **Volume 5)**.

3.11.1 Bloomfield Interchange

The N40/N28 Bloomfield Interchange has existing public lighting to a point south of the existing R610 Rochestown Road Underbridge. It is proposed that public lighting will be reinstated as necessary throughout the reconfigured N40/M28 Bloomfield Interchange. If possible, existing public lighting columns will be retained and upgraded to LED. At a minimum, public lighting will be provided as follows:-

- Proposed northbound N40 West Diverge to a point where it ties into the existing;
- Proposed Rochestown Southbound Diverge Slip Road to a point where it ties into the existing;
- Proposed Rochestown Northbound Merge; and
- M28 Mainline through the interchange as far as Ch. 790m approx. (where existing public lighting finishes).

3.11.2 Rochestown Road

Rochestown Road is currently lit at night. It is proposed to reinstate public lighting on the realigned section of this road as may be required.

3.11.3 Maryborough Hill

Maryborough Hill is currently lit at night. It is proposed to reinstate public lighting on the realigned section of this road.

3.11.4 Carr's Hill Interchange

At Carr's Hill Interchange it is proposed to provide public lighting on each of the 2 roundabouts and along the link road between them. The approaches to each of these roundabouts will also be lit. At a minimum public lighting will be provided as follows:-

- Proposed Carr's Hill West and Carr's Hill South Roundabouts;
- Proposed Carr's Hill Central Link Road (incl. Carr's Hill Underbridge);
- Proposed Carr's Hill Northbound Diverge Slip Road (partially);
- Proposed Carr's Hill Northbound Merge Slip Road (partially);
- Proposed Carr's Hill Southbound Diverge Slip Road (partially);
- Proposed Carr's Hill Southbound Merge Slip Road (partially);
- Proposed Carr's Hill South Link Road (partially);
- R609 Carrigaline Road approach to proposed Carr's Hill West Roundabout;
- Proposed 2-way Maryborough Hill to Carr's Hill Link Road; and
- Proposed shared use cyclist/pedestrian route.

3.11.5 Shannonpark Interchange

At Shannonpark it is proposed that the existing Shannonpark roundabout will be retained to form part of the dumbbell interchange. The existing public lighting at this roundabout will be upgraded as will the public lighting on the existing approaches from the N28 (southbound and westbound). In addition public lighting will be provided on the new Shannonpark South Roundabout and the link road between the 2 roundabouts. Lighting is also proposed on the upgraded R611 Carrigaline Road, on the northbound merge to the new N28 (partially) and on the approach to the Shannonpark South Roundabout from the realigned Ballinrea Access Road.

At Shanbally Interchange, it is proposed that public lighting will be provided as follows:-

- Proposed Shanbally Roundabout;
- Proposed Shanbally Southbound Diverge Slip Road (partially);
- Proposed Shanbally Northbound Merge Slip Road (partially);
- Proposed IDA Link Road to a point where it ties into the existing; and
- Proposed Shanbally North Link Road from the existing N28 to the Shanbally Roundabout.

3.11.6 Barnahely Roundabout

Lighting will be provided to the at-grade roundabout at Barnahely on the R613 and on all 4 approaches. New public lighting to the proposed R613 North and South Link Roads will tie-in to the existing lighting on the R613 at the earliest possible opportunity**.**

3.11.7 Barnahely to Loughbeg

The full length of single-carriageway road between Barnahely and the L2545 local road tie-in, including the Loughbeg Roundabout will also be lit. This is due to the short distance between adjacent roundabout junctions. The proposed roundabout (Ringaskiddy Roundabout) on the L2545 local road tie-in will also be lit. In addition the L6517 local road approaches to the Loughbeg Roundabout and the L2545 local road approaches to the Ringaskiddy roundabout will also be lit.

3.12 CONSTRUCTION MANAGEMENT

3.12.1 Programme

The overall construction period for the proposed road is anticipated to be in the region of 30 – 36 months

Once appointed the main Contractor shall be required to provide a detailed programme prior to commencement of the works. This shall set out:-

- The overall programme of construction;
- Programming of the key elements and phases of construction;
- Programming of environmental mitigation and monitoring; and
- The duration of each element and phase.

The programme will be regularly updated to reflect any changes in programmed activities and shall provide the basis for notification to residents and local communities where sensitive activities would be likely to involve temporary disturbance to access or non-routine events such as blasting of rock or piling or temporary local road diversions.

The likely principal stages of works that will be employed during the construction of the proposed road project are outlined below. This section of this EIS outlines some general impacts and mitigation measures that will be employed during the construction stage. This section should be read in conjunction with **Chapter 19: Summary of Mitigation Measures** and **Section 3.13** below**.**

3.12.1.1 Pre Main Construction Works

It is anticipated that some works may be undertaken as part of an advance works contract prior to the main construction works commencing. Examples of such advance works contracts would include:-

- Archaeological surveys and testing in order to resolve archaeological issues;
- Fencing works;
- Site clearance and tree and hedgerow removal works;
- Ecological Surveys and mitigation;
- Utility and Drainage Diversions;
- Removal of any invasive species within the site;
- Surface water and groundwater quality monitoring; and
- Detailed ground investigation works.

During this stage the site boundary will be fenced off and site access points will be constructed to provide access for construction vehicles from the existing road network. This will involve some works adjacent to existing roads and may require temporary traffic diversions.

Before earthworks commence the Contractors must prepare the Environmental Operating Plan (EOP) which must set out the Contractors approach to managing environmental issues associated with the construction phase and provide a documented account to the implementation of the environmental commitments as set out in the EIS and NIS (refer to **Section 3.13** below) and any approval/consent as may be granted.

All on site drainage, erosion and sediment control measures for the construction works must be in place and functioning prior to the commencement of earthworks/site clearance.

3.12.1.2 Main Construction Works

The construction of the section of road between Bloomfield Interchange and Carr's Hill Interchange has the potential to cause significant disruption to the local population, particularly in relation to traffic as there is considerable work required on the existing local road network. In particular the following works are noted:-

- Online widening and road reconfiguration between Bloomfield and Rochestown Road,
- Relocation of the existing Rochestown Road on-ramp,
- Provision of the M28 to N40 westbound link road and upgrades merge with the N40,
- Upgrade to Rochestown Road,
- Online widening of the proposed mainline between Rochestown Road and Carr's Hill,
- Demolition and replacement of Maryborough Hill overbridge,
- Upgrade of Maryborough Hill,
- Construction of Carr's Hill to Maryborough Hill link road and tie-ins, and
- Construction of the Carr's Hill Interchange.

The proposed works at each of these locations will cause disruption to the travelling public in an environment where there is limited capacity with significant peak hour demand and delays occurring frequently. To mitigate this potential impact, the following will be required in terms of the proposed order and sequence that the works will be undertaken in this area:-

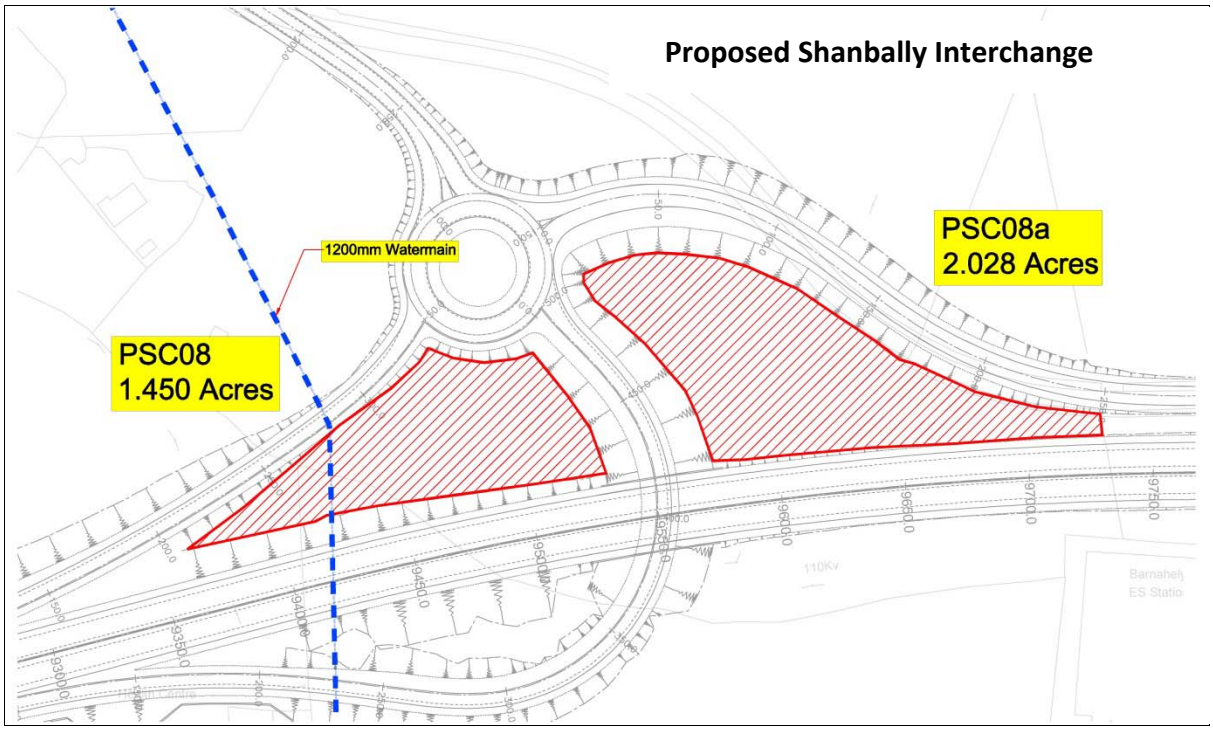
- The existing N28 will remain open to two-way traffic at all times, except for short term managed road closures for critical works, such as the proposed demolition of the Maryborough Hill overbridge. This will entail careful phasing and sequencing of the works along the N28 in order to maintain traffic flows.
- All traffic movements will be accommodated on the section of the works between Bloomfield Interchange and Rochestown Road. Phasing of the works will be carefully planned and sequenced to maintain traffic flows at all times.
- Local road closures will not be permitted, except for critical works. Any road closures permitted will be for limited periods, e.g., night-time or weekend.
- Works on the local road network at the northern end of the scheme will not coincide. This means that works, say on Rochestown Road will not coincide with works on Maryborough Hill or Carr's Hill and so on.
- Construction of the Carr's Hill Interchange with temporary tie-ins to the existing N28 will be constructed early in the construction programme and prior to works at Rochestown Road and/or Maryborough Hill to facilitate local access to the N28.
- A section of the proposed overbridge at Maryborough Hill will be constructed prior to demolition of the existing bridge in order that one-way traffic from the east can be maintained whilst the remainder of the proposed bridge is constructed.
- Prior to demolition of the existing bridge at Maryborough Hill, construction of the proposed link road between Maryborough Hill and Carr's Hill will occur. Construction access is proposed via Carr's Hill only.
- Prior to demolition of the existing bridge at Maryborough Hill, construction of the road widening works on the west side of Maryborough Hill will occur.
- Demolition of existing Maryborough Hill overbridge and opening of the partially constructed bridge to eastbound traffic one-way flow. A short-term N28 and Maryborough Hill road closure will be needed to facilitate this operation. A weekend possession is envisaged. The link road from Maryborough Hill to Carr's Hill will be open to traffic at this stage also.
- Existing merge to the N28 from Maryborough Hill to be closed only after the proposed bridge and realignment on Maryborough Hill and the proposed link road to Carr's Hill are fully completed and open to traffic.

Prior to the commencement of works the Contractor will be required to prepare and submit a detailed site specific traffic management plan to be agreed with Cork County Council and appropriate emergency services, i.e., An Garda Síochána, ambulance services and fire services. In the preparation of the temporary traffic management plan, the restrictions/requirements outlined above will be complied with to minimise disruption to local traffic flows. Off-peak and night working will be considered for works in critical locations. Any approval for night working will give consideration to the potential disruptive effects there may be on nearby residences and significant restrictions on noise and other adverse environmental emissions may be conditioned to any approval granted.

3.12.1.3 Site Compound and Offices

The project team have identified an area within the proposed project lands for the location of a temporary construction compound as illustrated on **Figure 3.4**.

Figure 3.4: Location of Construction Compound



The construction compound is likely to include stores, offices, welfare facilities, materials storage areas, material processing areas, plant storage and parking for site and staff vehicles. The site is anticipated to remain in place for the duration of the works. The compound will have appropriate levels of security. The Contractor will be required to manage parking and deliveries at the compound and other areas in such a manner as to ensure that there is no obstruction to traffic or sightlines during construction.

The site of the proposed compound has been selected to be set back from watercourses, ecological sensitive areas (as described in **Chapter 12**, **Figure 12.5**), areas of extreme vulnerability, and away from potential floodplain areas and areas containing invasive species. It has also been selected to ensure that it is accessible from roads that can cater for predicted volumes of site traffic and has connectivity to a main sewer for treatment of wastewater.

The following measures will apply to the detailed design of all temporary construction compounds in order to mitigate against potential for adverse impact on the aquatic environment:-

- Each temporary compound will have a dedicated Waste Storage Area for construction waste generated;
- In order to minimise any impact on surface water and groundwater from material spillage, all oils, solvents, paints and other potential contaminants used during construction will be stored within suitably designed bunded areas in accordance with Guidance Note for the Control of

Pollution (Oil Storage) (England) Regulations 2001 by the Department of Environment Food and Rural Affairs (DEFRA) in the UK;

- Oil and fuel storage tanks will be stored on designated areas of hardstanding, and these areas will be bunded to a volume of 110% of the capacity of the largest tank/container within the bunded area(s) (plus an allowance of 30mm for rainwater ingress); and
- Drainage from the office facilities will be connected to a foul sewer and surface water drain. Oil interceptors will be installed in the compound vehicle parking areas to control runoff. Pollution control measures will be implemented elsewhere in the compounds where required (for example, chemical storage areas).

Satellite offices are likely to be required during the construction phase. These temporary facilities will be located within the lands made available for the construction at suitable locations. These offices are likely to be served by temporary mobile sanitation units.

3.12.1.4 Stockpile Areas

It is envisaged that topsoil and/or acceptable material will be stockpiled during the course of the proposed road development.

The following restrictions will apply:-

- Topsoil stripping over large areas in advance of main excavation works will not be permitted. It will be restricted to the minimum required for efficient earthworks operations;
- Each construction area will be top-soiled as soon as practicable thus limiting both the amount and the length of time for which materials have to be stockpiled;
- Stockpiles will not be located within 10m of any watercourse or within 50m of a sensitive watercourse or water body;
- Runoff from a stockpile will be collected via a shallow toe drain, which will discharge to a settlement pond which will be designed to have a retention time of at least 5 hours. Sediment build-up will be removed at regular intervals by manual means only and will be disposed of at appropriately licensed facilities only; and
- Stockpiles of non-granular materials shall be limited in height to not more than 2m.

3.13 ENVIRONMENTAL MANAGEMENT DURING THE CONSTRUCTION PHASE

Construction impacts are generally of a short-term duration over the construction period and are often localised. The works will nonetheless be carried out in compliance with:-

- Mitigation measures for the construction phase as set out in this EIS, NIS and any Approval/Consent as may be granted.
- Construction industry guidelines (such as CIRIA C502 Environmental Good Practice on site).
- CIRIA Guidance - Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors (C532), (Masters- Williams et al (CIRIA, 2001)).
- Control of Water Pollution from Linear Construction Projects. Technical guidance (C648), CIRIA (E. Murnane, A. Heap and A. Swain. (CIRIA, 2006)).
- PPG 6 Working at Demolition and Construction Sites (Environment Agency, 2012).

- PPG 26 Safe Storage - Drums and Intermediate Bulk Containers (Environment Agency, 2012).
- PPG 7 Safe Storage –The Safe Operation of Refuelling Activities (Environment Agency, 2011b).
- BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*. And BS 5228-2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part2: Vibration* (together referred to as B.S. 5228).
- *Control of Dust from Construction and Demolition Activities (BRE 2003)*,
- NRA Environmental Construction Guidelines (various dates):-
  - Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Water (IFI, 2016);
  - Guidelines for the Treatment of Badgers prior to the Construction of a National Road Scheme;
  - Guidelines on Provisions for the Conservation of Bats during the Planning and Construction of Roads;
  - Best Practice Guidelines for the Treatment of Bats during the Construction of National Road Schemes;
  - Guidelines for the Crossing of Watercourses during the Construction of National Road Scheme;
  - Guidelines for the Testing and Mitigation of the Wetland Archaeological Heritage for National Road Schemes:
  - Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub prior to, during and post-construction of National Schemes;
  - Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes;
  - Guidelines on the Management of Noxious Weeds and non- native Plant Species on National Roads;
  - Guidelines for the Treatment of Noise and Vibration in National Road Schemes;
  - Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes;
  - Guidelines for the Treatment Otters Prior to the Construction of National Road Schemes;
  - Guidelines on the Implementation of Landscape Treatments on National Road Schemes in Ireland;
  - Guidelines for the Management of Waste from National Road Construction Projects; and
  - Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan.

This relevant guidance and best practice requirements will be further detailed in the Environmental Operating Plan (EOP), which will be prepared in accordance with "*Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan*" published by the NRA as part of an overall mitigation strategy and the implementation of conditions attached to any approval/consent as may be granted.

The EOP will assist in preventing, managing and/or minimising potential significant environmental effects during the construction phase. To achieve this, the EOP will:-

- Incorporate all Environmental Commitments/Mitigation measures set out in this EIS and any other conditions attached to approvals as may be granted by statutory bodies (i.e. NPWS).

- Incorporate any relevant conditions as may be imposed through the statutory approval of the proposed road development;
- Provide a method of documenting compliance with these Environmental Commitments/ Mitigation measures;
- List all relevant environmental legislation requirements and provide a method of documenting compliance with these requirements; and
- Outline methods by which construction works will be managed to avoid, reduce or remedy potential adverse impacts on the environment.

Details of the predicted impacts and mitigation measures associated with the construction phase are included within the relevant chapters (**7** to **17**) with the schedule of commitments presented in **Chapter 19**. The environmental measures detailed in the EIS and in such approval/consent as may be granted will be implemented as an integral part of the works.

3.13.1.1 Construction & Demolition Waste Management Plan

An outline Construction & Demolition (C&D) Waste Management Plan has been prepared (Refer to **Appendix 17A**) and it will be a requirement of the Contractor to update and maintain this Plan for the duration of the construction phase. The plan shall be incorporated into the EOP. The C&D Waste Management Plan will address the following aspects of the project:-

- Analysis of the waste arising/material surpluses;
- Specific waste management objectives for the project;
- Methods proposed for the prevention, reuse and recycling of wastes;
- Material handling procedures;
- Proposals for disposal of waste at appropriately licensed facilities only; and
- Proposals for education and a workforce and plan dissemination programme.

The C&D Waste Management plan will be organised systematically and the following individual headings must be included:-

- Description;
- Waste arising including proposals for minimisation/reuse/recycling;
- Estimated cost of waste management;
- Demolition Plan;
- Roles including training and responsibilities for C&D Waste;
- Record keeping procedures; and
- Waste auditing protocols.

3.13.1.2 Environmental Emergency Procedures/Contingency

Prior to commencing works, the Contractor shall prepare an Environmental Emergency Response Plan/Contingency Plan. The Plan will detail the procedures to be undertaken in the event of the release of any sediment into a watercourse, a serious spillage of chemical, fuel or hazardous wastes (e.g., Concrete), or other such risks that could lead to a pollution incident, including flood risks. The Plan will be updated regularly and will include a simplified Spill Response with the following as a minimum:-

- Instruction to stop work;
- Instruction to contain the spill;
- Details of spill clean-up material location;
- Name and contact details of responsible staff; and
- Measures particular to the location and the activity.

This Spill Response shall be displayed at several locations along the proposed road and at all sensitive locations.

3.13.1.3 Construction Traffic Plan

Issues pertinent to the preparation of a construction traffic management plan are detailed within **Chapter 5: Traffic and Transportation** of the EIS. Conditions to apply to the order and sequence of the construction of the works at the northern end of the project are set out in **Section 3.12.1.2** above. The Contractor will be required to submit a detailed site specific temporary traffic management plan (TTMP) to be agreed with Cork County Council and appropriate emergency services, i.e., An Garda Síochána, ambulance services and fire services. This will ensure that potential traffic disruption, road closures, restrictions and diversions are carried out safely and efficiently and to the satisfaction of the relevant stakeholders.

The study area is very sensitive to traffic delay and disruption during the peak hours. The preparation of the Construction Traffic Management Plan will include measures to ensure that construction related traffic is not going to contribute to the existing peak hour traffic congestion problems. There will be a requirement that construction related traffic will be restricted from entering the local road network during the AM (07.45-09.00) and PM (17.00-18.00) commuter peak periods. The local road network as referred to in this requirement would encompass the network as illustrated in **Figure 3.1**.

The order and sequence of the works will need to take account of the requirement to maintain existing traffic flows on existing roads and therefore in some locations it is likely to be necessary to construct temporary roads and/or to construct the permanent works in sections. Such a scenario is likely to apply to the proposed works to realign the Loughbeg Road (south). Also, the works between Bloomfield and Carr's Hill will also require the permanent works to be completed in sections so that existing traffic flows can be maintained.

However, the Contractor may choose to seek temporary road closures from the Local Road Authority (Cork County Council), which will be assessed and decided upon in accordance with their procedures and in accordance with requirements of the Roads Act 1993 and Road Regulations 1994. This may result in the temporary closure of some side roads during the construction period, which would require the traffic to be temporarily re-routed during the period of closure.

The planning, design, implementation and maintenance of all temporary diversions and localised re-routings, will be the responsibility of the Contractor, and will be undertaken in compliance with the requirements of the Cork County Council, Department of Transport's Traffic Management Guidelines (2012) and An Garda Síochána. The Contractor will employ methods to allow safe operation of all temporary diversions for both construction operatives and the public in accordance with Chapter 8 (Temporary Traffic Measures and Signs for Roadworks) of the Traffic Signs Manual.

3.13.2 Construction Phase Hours of Operation

Site working hours will vary throughout the duration of the construction period and will also depend on weather and seasons. The typical normal working hours for the project are described below in **Sections 3.13.2.1**. Working times outside these normal hours, including Sundays, are likely to be necessary in certain circumstances. Except for emergency works, any night-time and Sunday work will require specific permission from the Local Authority. Example of works that may be required outside the normal working hours include diversion of utilities, demolition of the bridge at Maryborough Hill or working on existing roads outside of peak traffic periods to avoid or minimise traffic congestion.

Acceptable construction noise levels, as outlined in **Chapter 14: Noise and Vibration** and summarised in **Table 3.5** below, will be adhered to throughout the duration of the construction of the project by the Contractor.

Table 3.5: Maximum Permissible Noise Levels at the Facade of Dwellings during Construction (NRA Guidelines, 2014)

Days and Times	$L_{Aeq(1hr)}$ dB	L_{AMax} dB
Monday to Friday 07:00 – 19:00	70	80
Monday to Friday 19:00 – 22:00	60	65
Saturday 08:00 – 16:30	65	75
Sunday and Bank Holidays 08:00 – 16:30	60	65

3.13.2.1 Construction Works Hours of Operation

Normal working times will be 07.00 to 20.00 hours Monday to Friday and 07.00 to 14.00 hours 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 Local Authority. This permission, if granted, can be withdrawn at any time should the working regulations be breached.

The northern end of the site is a sensitive residential area where significant civil engineering construction is required to be implemented. As noted in **Section 3.12.1.2** above, off-peak and night working will be considered for works in critical locations. Any approval for night working will give consideration to the potential disruptive effects there may be on nearby residences and significant restrictions on noise and other adverse environmental emissions may be conditioned to any approval granted.

For the purpose of this requirement, night is defined as 20.00 to 07.00 hours.

3.13.3 Employee Numbers

3.13.3.1 Construction Workers for the M28

It is envisaged that up to 400 people could be employed during the construction period of the M28, which is likely to be approximately 30 – 36 months.

3.13.3.2 Construction Workers for the Service Area

It is envisaged that up to 30 people could be employed during the construction period of the Service Area, which is likely to take approximately 15 months.

3.13.4 Accommodation

Requirements for local accommodation will depend on the Contractor and the level to which local labour is employed.

3.13.5 Resource Requirements

3.13.5.1 Earthworks

The project will require approximately 2.2 million m^3 of fill material. It is anticipated that approximately 1.15 million m^3 of reusable material will be excavated from the cuttings for the project. This means that there will be a deficit of material required to construct the road project, including the project requirements for higher quality rock material of the order of 1.05 million m^3.

At the Service Area site there will be approximately 22,300m^3 of excavated material that will need to be managed appropriately through disposal or recovery, as appropriate. At this stage, it is assumed that this material will not be suitable for reuse on site and will require transport off site. Disposal will be to appropriately licensed facilities only in accordance with the C&D Waste Management Plan to be prepared for the project. There will be a requirement for the import of materials for the construction of the green spaces and for use as engineering fill (i.e., to be used in the capping, subbase, backfill, etc.) of approximately 5,635m^3 and 14,435m^3 approximately.

It is anticipated that the majority of the material deficit will be obtained from Raffeen Quarry. The route of the proposed road passes through the southern part of the quarry. The quarry has planning permission to resume material extraction, obtained on 16th July 2008 under Reg. Ref. 06/10037 and PL. 04.225610. This planning permission is valid for a 30 year period.

The potential for cumulative impacts associated with the construction of the road and quarrying activity occurring simultaneously is addressed in the relevant specialist EIS chapters and within the NIS. The benefits of using material from the quarry from a sustainability perspective on air and climate are outlined in **Chapter 13: Air and Climatic Factors**.

It is anticipated that any fill material, which is sourced in the quarry, will be transported to its destination within the Lands Made Available (LMA) as the southern part of the quarry will be within the lands acquired for the schemes. Ramps are likely to be formed at appropriate locations, within the quarry boundary, to facilitate access for dump trucks etc. directly onto the LMA.

Haulage of material from the quarry will access the LMA and avoid using local roads where possible. Where the proposed route crosses an existing Regional or Local Road, 'crossing points' will be formed to ensure that construction vehicles can cross safely from one side to the other. These 'crossing points' will be within the LMA and priority will be given to vehicles on the public road network.

3.13.5.2 Concrete

Concrete will be required throughout the construction period, with demand being the greatest during the construction of structures. The construction of bridges, retaining walls and culverts may include the use of pre-cast units, cast in-situ concrete or a combination of the two.

It is estimated that bridge construction will require approximately 3,300m^3 of concrete and a further 2,000m^3 will be required for the construction of the various retaining walls.

Concrete will be sourced from local suppliers or batched on site.

3.13.5.3 Road Pavement Materials

Bituminous based and other road pavement materials will be required throughout the construction period. Demand will be greatest during the latter phases of construction. It is estimated that some 220,000 tonnes of bituminous based materials and 70,000m^3 of sub-base materials will be required.

Bituminous based and other road pavement materials will be sourced from local suppliers or batched on site.

3.14 OPERATION

3.14.1 Traffic

The predicted traffic flows for the various scenarios for the years 2020 (notional year of opening) and 2035 (design year), for the local road network affected by the proposed road are provided in **Chapter 5: Traffic and Transportation.** The Medium Growth scenario has been used for traffic impact predictions.

Predicted traffic flows have been used throughout the EIS to determine potential for environmental impacts. **Chapter 13: Air and Climatic Factors** and **Chapter 14: Noise and Vibration** have used the traffic forecasts for the High Growth scenarios in their prediction models.

3.14.2 Design Speed, Sight and Stopping Distance

The design speed for the various elements of the proposed road project is outlined in **Table 3.1 - Carriageway Design Criteria for the Proposed M28 Road Project** above. Stopping sight distances and other road design criteria for the proposed road are as set out in the NRA DMRB, Volume 6, Road Geometry.

3.14.3 Maintenance

Normal road maintenance procedures will be required for the proposed national and non-national routes.

3.14.4 Lights, Signalling and Signage

Public lighting will be provided on the approaches to all at-grade junctions along the proposed routes (refer to **Section 3.12** of this EIS). Public lighting will also be reinstated at all other routes where there is existing public lighting. The public lighting proposals are illustrated on drawings PL0001 to PL005 in **Volume 5**. **Section 12.7.2.5** of **Chapter 12: Terrestrial Ecology** sets out the lighting restrictions to be applied for the protection of bats.

Traffic signs, road markings and road studs will be provided in accordance with the Traffic Signs Manual, November 2010 (Department of Transport) and with TS-4 Guidelines, Certification Scheme and Specifications for the Construction of Traffic Signs (Department of Transport, Tourism and Sport). Regulatory and warning signs will comply with all statutory requirements. Signage for facilities must be in accordance with NRA policy documents.

3.14.5 Safety Measures

Police Observation Platforms on Motorways will be designed in accordance with TII publication DN GEO-03027**.** Garda observation platforms and lay-bys are located along the proposed mainline at the locations as shown in **Table 3.6**.

Emergency telephones will be provided on the M28 in accordance with NRA policy at an approximate spacing of 1.5km in accordance with UK DMRB TA 73.

Table 3.6: Garda Observation Platforms

Type	Approx. Mainline Chainage	Drawing Number
Garda Platform Type 1	1,150 Northbound	GA0103
Garda Platform Type 1	3,950 Southbound	GA0107
Garda Platform Type 1	5,025 Southbound	GA0109

Emergency Accesses are often provided on motorways and type 1 dual carriageways to provide access for emergency vehicles to the location of an incident on the network and to provide egress opportunities to other road users whose vehicles may become trapped when one or both carriageways are obstructed. Emergency Accesses are required to comply with TII Publication DN GEO-03031.

If the distance between junctions is less than 5km and the traffic flows are less than 50,000 AADT (Annual Average Daily Traffic), then normally Emergency Accesses are not required. Typically the proposed project would meet these criteria as for the most part the AADT is less than 50,000 and the distance between junctions is less than 5km.

A problem arises as a number of the junctions have access in one direction only (R610 Rochestown Road, Shannonpark and Shanbally). This means that certain sections of the motorway will have relatively long distances between access/egress points. This is particularly the case for northbound egress between Barnahely Roundabout and Carr's Hill interchange, i.e. no opportunity to egress from the route for a distance of approximately 8km. Similarly there is no opportunity for southbound access to the route between Carr's Hill and Barnahely, which could be a problem for emergency vehicles, e.g., Gardaí from Carrigaline.

Providing a number of Emergency Crossing Points (ECP) along the route will enable flexibility in the management of incidents along the route. This provision consists of designating locations where parts of the median barrier will be removable to allow for the contra-flow of traffic in the event of an emergency. The provision of emergency crossovers will be in compliance with TII Publication DN GEO-03031.

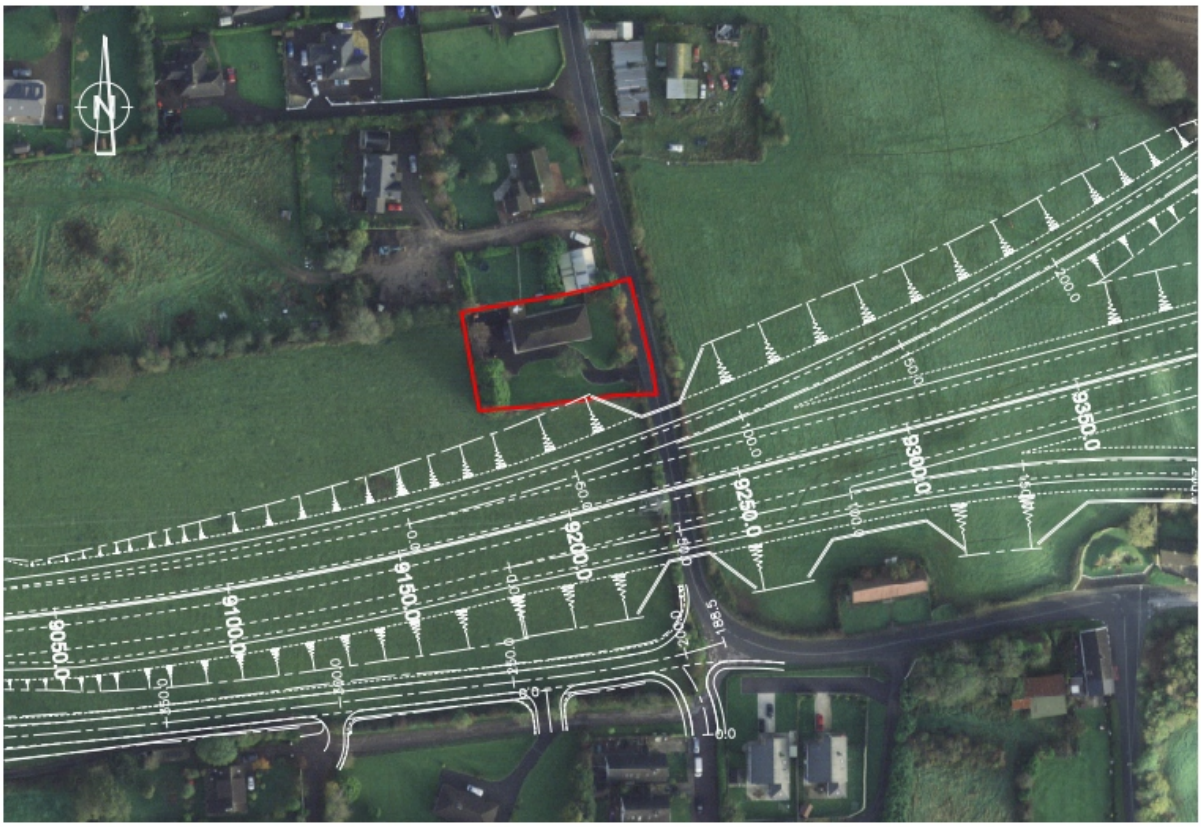
Vehicular restraints (safety barriers) will be provided along the proposed project in compliance with TII Publication DN-REQ-03034. This will typically include the provision of a concrete safety barrier system in the central reserve (median) of the M28 Mainline, in the verges where sections of the proposed road are on substantial embankments, on the approaches to bridges and at structural piers and other locations where safety hazards are identified.

3.15 LANDTAKE REQUIREMENTS

The proposed road project will involve a landtake of approximately 142ha. More information in relation to land acquisition can be found in **Chapter 7: Socio-Economic and Community** and **Chapter 8: Agricultural Land Uses.**

Three dwellings and a commercial premise will be acquired as part of the proposed road project. The dwellings are located at Maryborough Hill, Shannonpark and at Shanbally while the commercial premise is located at Shannonpark. Two of the dwellings are likely to be demolished and these are shown on **Figure 3.5**.

Figure 3.5: Dwellings to be Demolished



3.16 FUTURE DEVELOPMENT WITHIN THE STUDY AREA

The Cork County Development Plan 2014-2020 includes for strategically zoned lands within the study area. Typically, there are industrially zoned lands within the Ringaskiddy peninsula area and there are residentially zoned lands within the Douglas and Carrigaline areas. Completion of the proposed road project may act as a catalyst for further development in the area. All future developments will require planning consent in their own right and will be subject to the relevant statutory consents and conditions.

The proposed road project is directly linked to the expansion of the Port of Cork activities in Ringaskiddy port. Planning permission for this expansion has already been subject to EIA and has been granted, with Phase 3 of this development being dependent on the completion of the proposed road project.

Chapter 18 of the EIS and the NIS address the potential for cumulative impacts of permitted projects and projects currently within the planning system. **Table 18.4** of this EIS provides a summary table of all projects within the study area that were considered to assess the potential for cumulative impacts of the proposed M28 Road Project with other projects in the area.

3.17 SUSTAINABILITY AND DESIGN – PARTICULAR MEASURES

3.17.1 Climate Adaptation

The proposed road has been developed to ensure that it is resilient to future changes in the climate, particularly in relation to future risks of flooding. The potential impacts of flooding are addressed through consultation with the Catchment Flood Risk Assessment and Management (CFRAM) mapping for the area and design of the proposed drainage system to cater for climate change. Refer to **Section 3.6** of the EIS.

3.17.2 Designing to Include for Sustainable Transport

The proposed road has been designed to provide opportunities for the further development of sustainable modes of transport. Refer to **Sections 1.2.2, 3.7** and **5.9** of this EIS.

3.17.3 Design to Include Sustainable Drainage Systems

The drainage of the proposed carriageway has been designed in accordance with the NRA's Design Manual for Roads and Bridges (NRA DMRB). The drainage system has been designed to include solutions to control pollution and run-off and improve the existing situation on the on line section from Bloomfield to Carr's Hill. Refer to **Section 3.6** and **Chapter 9: Hydrology and Drainage** of this EIS.

3.17.4 Use of Aggregate from a Local Source at Raffeen Quarry

It is proposed to source material within the mainline works or from the quarry at Raffeen under its existing planning permission thereby minimising the transport element of any associated emissions from haulage of aggregate from off-site sources.

4 OUTLINE OF ALTERNATIVES

This chapter provides an outline of the main alternatives considered and the main reasons for choosing the preferred alternative, taking into account environmental considerations.

4.1 POLICY AND CONSTRAINTS

The identification of alternatives was carried out having regard to the environmental constraints and the principal policy objectives in relation to development of the proposed road project including the National Development Plan (NDP), National Spatial Strategy (NSS), National Ports Policy, the Trans-European Transport Network (TEN-T), Cork City and Cork County Council's "Cork 2050 Realising the Full Potential (March 2017) submission to the National Planning Framework and the Cork County Development Plan (CDP) 2014-2020 (Refer to **Chapter 2: Planning and Policy Context**).

4.1.1 Road Context and Policy

Based on EU policy, as outlined in **Chapter 2: Planning and Policy Context** and the requirements for motorway or "express roads" and service areas (outlined in **Chapter 1: Introduction and Need for the Proposed Road Development**), it is concluded that the N28:-

- Should be considered to be part of the TEN-T core road network;
- Should serve the Port facilities at Ringaskiddy;
- Should be not only designed for motor traffic but reserved for motor traffic. This includes for restrictions on non-motorised users;
- Should have no access to/from adjacent properties, with access only by grade-separated or controlled junctions;
- Should have no level crossings; and
- Should have particular designation with stopping and parking legally prohibited.

Based on the above parameters, the proposed road project comprises a motorway, protected road and Service Area under the Roads Acts.

The upgrade is supported by EU policy on the TEN-T network, National Ports Policy, national planning policy and Cork regional and local area planning as stated in **Chapter 2: Planning and Policy Context**.

As stated in **Chapter 1: Introduction and Need for the Proposed Road Development**, the key objectives of the project are thus defined under environment, safety, economy, accessibility and social inclusion and integration as:-

Environment Objective

- To facilitate a reduction in the traffic-related impact of the existing N28 on the human environment in the communities through which the road passes; and
- To minimise the impact of any improvement works on nearby environmentally-sensitive sites.

Safety Objective

- To improve road safety by reducing the number of road collisions and associated injuries/fatalities in the N28 corridor.

Economy Objective

- To facilitate strategic development at the Port of Cork facilities at Ringaskiddy by improving access for port-related traffic along the N28 corridor;
- To reduce peak hour congestion and travel delays in the N28 corridor, at an investment cost that offers good value for money; and
- To facilitate general economic development within the Cork Gateway and Ringaskiddy Strategic Employment Area by improving journey time reliability on the N28 corridor at an investment cost that offers good value for money.

Accessibility and Social Inclusion Objective

- To facilitate improved accessibility to the Ringaskiddy peninsula and associated employment opportunities for cyclists and other vulnerable road users; and
- To return to communities along the route such as Shanbally, easier and safer access to their local facilities by the removal of strategic and through traffic from their environment.

Integration Objective

- To support the National Ports Policy and European TEN-T policy by creating a High-Quality Route from the Port at Ringaskiddy to the N40.

For further details on the Need for the Project and Policy refer to **Chapters 1** and **2** respectively.

4.1.2 Constraints

The key constraints which have been identified in relation to the environment are:-

- Natural Heritage Areas (NHA) including Douglas River Estuary pNHA, Monkstown Creek pNHA, and Lough Beg pNHA;
- Special Protection Areas (SPA) - Cork Harbour SPA;
- Natural and semi natural habitats;
- Seveso sites;
- Protected breeding birds in field near Lough Beg pNHA;
- Ecological sensitivities at Raffeen Quarry (also known as Ballyhemiken Quarry);
- Recorded monuments, architectural heritage protected structures and architectural conservation areas;
- Scenic views/scenic areas (Coolmore);
- Protected monuments and structures and buildings to be preserved;
- Dismantled railway in the Carrigaline Area (Passage West to Carrigaline Greenway);
- Planning and landuse zonings;

- Community facilities including churches, schools, health/educational or care centres and golf courses;
- Proximity to residential receptors;
- Geological heritage areas and karst features; and
- Dairy farms and horses.

4.1.3 Outline of Alternatives

At a strategic level, the choices considered are:-

- Do-Nothing/Do-Minimum or reference alternative.
- Alternative Corridor Assessment.
- Route Corridor Strategic Alternative including-Traffic Management Alternative (TMA) exploring lower-cost measures to address the problems identified with the route corridor by making best use of the existing infrastructure, Do-Nothing and Major Investment Option.
- Local route options and junction strategy/layout options.

4.2 DO-NOTHING/DO-MINIMUM ALTERNATIVE

The Do-Nothing scenario assumes there will be no other investment in the transport network other than regular maintenance during the study period. The Do-Minimum scenario includes the Do-Nothing scenario plus any transportation improvements in the study area that are committed or planned. It is the baseline alternative to implementing any project.

A number of transportation studies and strategies relevant to the area have been considered including the *N40 Demand Management Study*, *Douglas Land Use and Transportation Study* and *Carrigaline Area Transportation Study*. Generally, it was considered that none of these studies/strategies contained recommendations that are currently "committed". The only significant transportation project considered to be committed is the proposed N8/N25 *Dunkettle Interchange Improvement Scheme*. This project is thus considered to be completed in the future year Do-Minimum scenario as TII have confirmed that the Dunkettle Interchange Scheme will be constructed and open to traffic in advance of the proposed M28 Road Project. Thus, the future year analysis assumes that the future year Do-Minimum road network will be the same as the base year network plus the proposed upgrade of the Dunkettle Interchange. Therefore, the future year analysis assumes no "bottleneck" for traffic at Dunkettle.

The assessment of the Do-Minimum alternative concluded that projected growth within the study area will result in higher traffic demand. This increase in traffic demand will result in increased congestion within the N28 corridor which will result in greater travel delay and deterioration of the environment particularly in terms of road traffic noise and severance. The objectives of the project will not be met which would constrain the development of the Port facilities in Ringaskiddy and also economic development generally within the study area including the Ringaskiddy Strategic Employment Area.

The Do-Nothing/Do-Minimum alternative does serve as a reference project for the consideration of other alternatives. See **Section 4.4.3** below.

4.3 ALTERNATIVE CORRIDOR ASSESSMENT

In consideration of alternatives to the proposal to upgrade the existing N28 corridor, a number of alternative corridors have been assessed. These options were compared to the option to upgrade along the existing N28 corridor. The options generated for assessment are:-

- An option to upgrade from the Kinsale Road Interchange;
- An option to upgrade from the Sarsfield Road Interchange; and
- An option to upgrade from the Bandon Road Interchange.

In each of these alternative options, the existing N28, north of Shannonpark would be retained as it currently is.

Other alternatives including an option to upgrade from the Mahon Interchange and a second option from Bandon Road Interchange, running to the south of Cork Airport were also considered but these were removed from further consideration for the following reasons: -

- **Mahon Interchange Option:** this option would have a significant adverse impact on the Douglas Estuary, would be the most expensive and would have a significant adverse impact on the operation of the existing N40 interchange and the residential amenity on Jacob's Island.
- **Bandon Road Option 2:** Offers little advantage compared to the shorter more direct Bandon Road Option 1.

Figure 4.1 illustrates the alternative corridors assessed.

The alternative corridors were assessed and compared in the context of the project objectives, outlined above in **Section 4.1.1**.

The key economic objectives are for the proposed road project to serve and support the development of the Port facilities and the economic development of the strategically zoned lands at Ringaskiddy. Traffic analysis of the alternative corridors shows that the alternative corridors would only attract some of the traffic from the Ringaskiddy peninsula and that significant traffic demand to and from Ringaskiddy would continue to utilise the existing N28 as the most economical route. The existing N28 would remain the most efficient route to and from the M8 and N25 via Dunkettle Interchange. The analysis suggests that approximately 50% of the traffic generated by the facilities in Ringaskiddy would utilise the alternative corridor. Similarly, approximately 50% of the traffic generated in Carrigaline would use the proposed alternative corridors. From the context of the economic objectives of the project, it was concluded that the alternative routes will only partially achieve the goals and will not perform as well as the proposal to upgrade the existing N28 corridor in this regard.

As approximately only 50% of the traffic from south of Shannonpark is predicted to utilise the proposed alternative corridors, 50% of this traffic would continue to utilise the existing N28. Under the alternative route corridor options, the existing N28 would not be improved. Over time, traffic demand continues to grow and whilst there is less growth on the N28 compared to the Do-Minimum scenario, the traffic related impacts would nonetheless be significant. Congestion and adverse noise impacts similar to the current existing situation would be predicted. The proposed road project includes the objective to improve the existing traffic related environment on the existing N28 corridor by improving journey times and reliability and by mitigating adverse environmental impacts, particularly noise. This objective would not be achieved under the scenario of an alternative route corridor as the unimproved N28 corridor would continue to carry significant traffic volumes in excess of its capacity. The option to upgrade the N28 corridor caters for larger traffic demand but the proposed increased road carrying capacity (motorway standard) and the implementation of environmental mitigation measures such as noise barriers, low noise surfacing and compensatory landscaping will improve the traffic related impacts on the environment.

The proposed road project has a road safety objective to improve safety by reducing the number of road collisions and associated injuries/fatalities in the N28 corridor. Even though higher traffic volumes will be catered for by the proposed upgrade along the N28 corridor, this objective is best met by the N28 upgrade, as:-

- The existing N28 will be upgraded to motorway standards between Bloomfield and Carr's Hill to cater for the predicted traffic volumes. As noted in **Section 1.3.4.1** of this EIS, motorways are statistically 4 times safer than single carriageway roads for the equivalent vehicle kilometres travelled.
- Substantial removal of existing northbound weaving problem between Rochestown Road and Bloomfield by providing the M28 to Westbound N40 link in advance of the traffic joining the M28 from Rochestown Road.

The alternative route corridor options would not include for any road safety improvements to the existing N28 corridor.

The Project's social inclusion and accessibility objective to facilitate improved accessibility to the Ringaskiddy peninsula for cyclists and other vulnerable road users is best met by the proposal to upgrade along the N28 corridor as this would remove all strategic traffic from the existing N28 and greater scope for upgrading the existing road to include facilities for cyclists and other vulnerable road users. Under the proposed alternative corridor options, significant traffic volumes, similar to current existing volumes, continue to utilise the existing N28, rendering it an unsafe environment for the promotion of vulnerable modes such as cycling and walking.

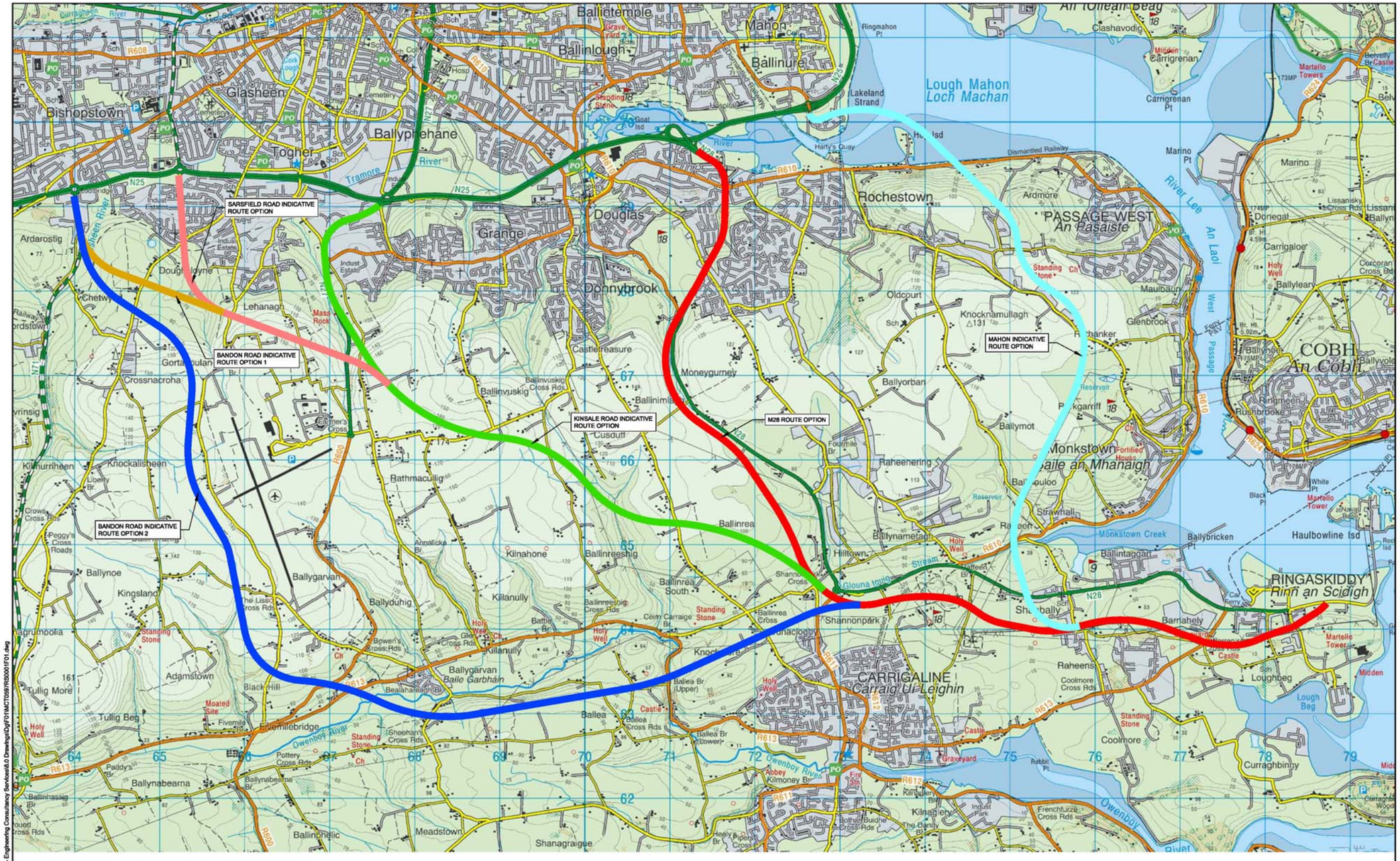
Traffic assignments relating to the proposed alternative corridors are illustrated in **Figure 4.2.** The predicted traffic volumes related to the proposed road project are illustrated in **Figures 5.13** and **5.14** in **Chapter 5: Traffic and Transportation**.

The integration objective of the Project is to support the National Ports Policy and European TEN-T policy by creating a High-Quality Road from the Port at Ringaskiddy to the N40. Each of the options considered in this appraisal provide for a high-quality road from the Port of Ringaskiddy to the N40 and in this context, each option meets with the integration objective. However, the traffic modelling suggests that Port related traffic to/from Dunkettle and beyond will continue to use the existing, un-upgraded N28 route. Thus, the alternative route corridor options are significantly less effective in

meeting this objective as significant portions of the Port traffic will deviate from the designated route. In TEN-T policy context, however, it is noted that the alternative route corridors do offer opportunities for a designated TEN-T route directly to and from Cork Airport.

In consideration of the foregoing, the assessment of alternative route corridor options concludes that the proposal to upgrade within the existing N28 corridor best meets the Project objectives in relation to environment, economy, safety, social inclusion and accessibility and integration.

Figure 4.1: Alternative Corridor Options



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Project: M28 CORK TO RINGASKIDDY PROJECT
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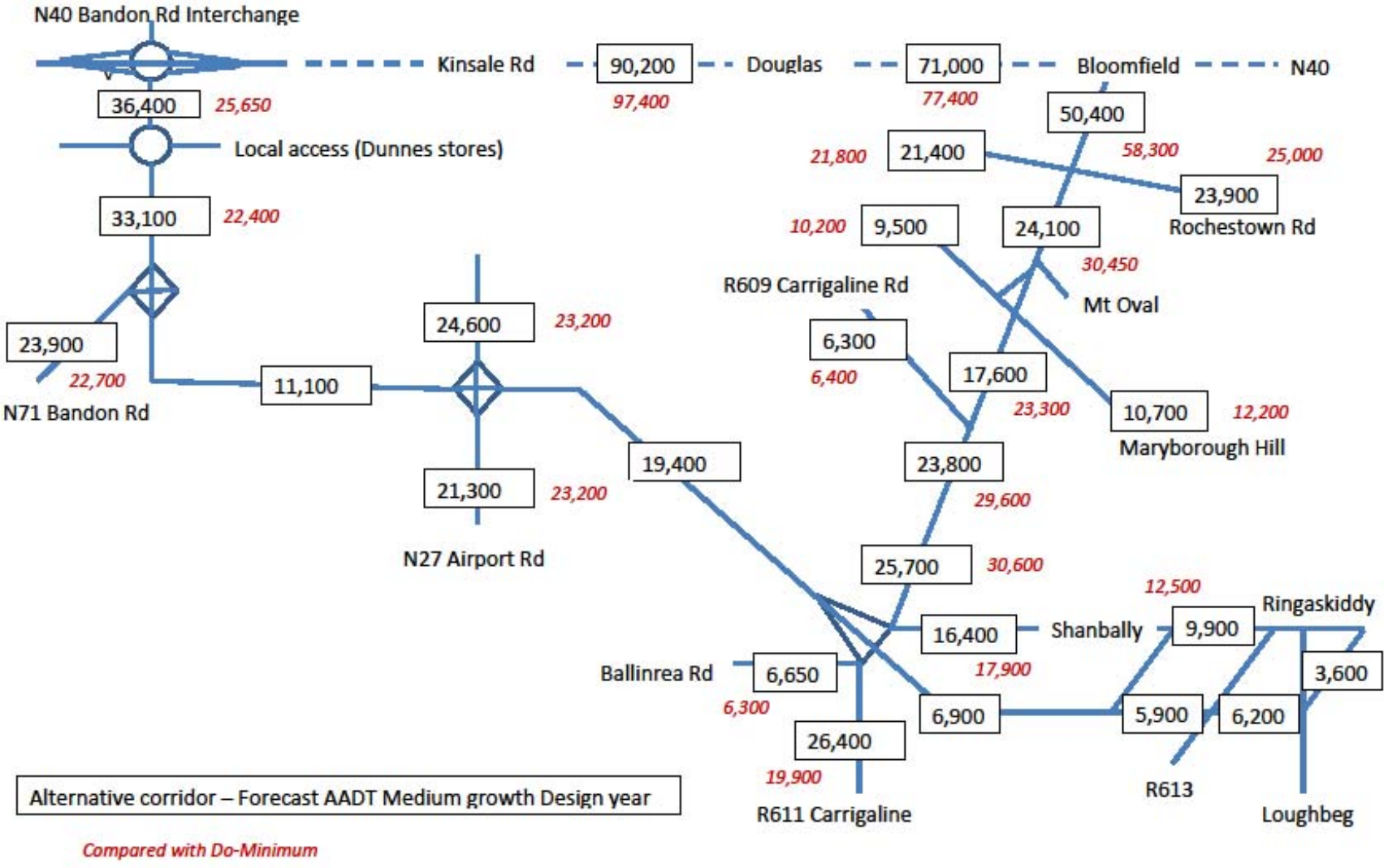
Figure 4.2: Alternative Corridor Traffic Analysis (illustrated for Bandon Road Option 1)



4.4 ROUTE CORRIDOR STRATEGIC ASSESSMENT

Within the context of the existing N28 corridor, a number of alternatives were assessed further. Alternatives considered include route options, a Traffic Management Alternative (TMA) and junction strategy/layout alternatives. Some further local alternatives were also considered to mitigate local specific environmental impacts.

4.4.1 Traffic Management Alternative (TMA)

Alongside the process of developing options, TII Project Appraisal Guidelines requires the consideration of possible measures that could comprise a "Traffic Management Alternative". The TMA can include:-

- Removal of bottlenecks through targeted local investment;
- Local road safety improvements;
- Fiscal or traffic control measures to manage traffic demand;
- Public transport priority, capacity and/or public transport services;
- Corridor or area-wide improvements to pedestrian or cycling provision; and
- Intelligent Transport Systems (ITS) to improve reliability, safety and operating capacity.

For the N28, the Project Team assessed the scope for measures in each of these categories to address the existing problems of the N28 corridor. Traffic modelling was undertaken on a series of possible traffic management solutions or low cost improvements to alleviate congestion on the N28, as well as future scenarios of absorbing the extra capacity of traffic resulting from an increase in operations at the Port of Cork along with Ringaskiddy's designation as a Strategic Employment Area under the Cork CDP, 2014-2020.

The optimal TMA considered for the proposed M28 Road Project included targeted local improvements to respond to transportation problems exhibited along the N28 corridor. The TMA includes the following:-

a) Partial grade-separation at Shannonpark roundabout, with the heaviest north-south traffic flow on an overbridge.

b) Limited on-line widening of the existing N28 at the crest of the hill, south of Carr's Hill.

c) Lane-gain at the Maryborough merge on-line widening to give a second lane northbound from the Maryborough merge to the Rochestown Road junction.

d) Providing a single-carriageway bypass of Shanbally village, connecting to an improved western Port entrance.

Accidents are not concentrated at any particular location, so there is considered to be little scope for effective local safety improvements. A local safety improvement scheme is currently being considered by Cork County Council at Raffeen Junction to deal with the risk of right-turn accidents at this junction.

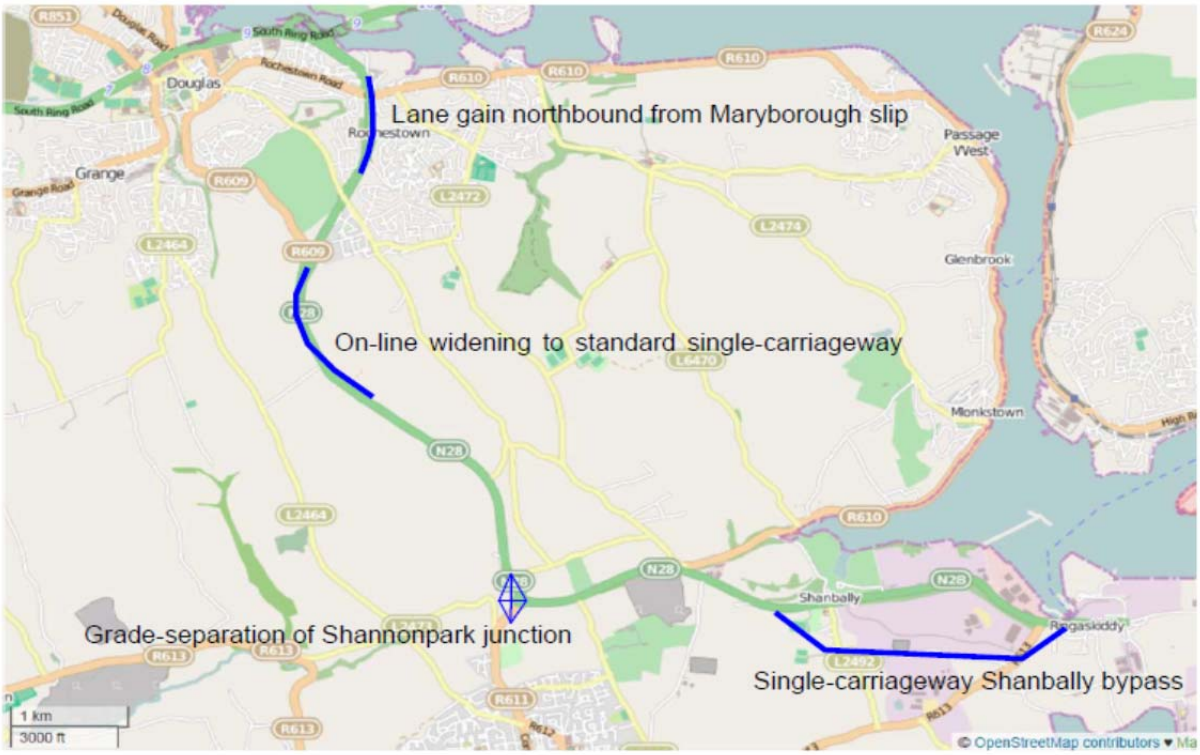
Under fiscal or traffic control measures, consideration was given to road pricing (road tolls, congestion charges, etc.). This is not considered suitable for the N28 due to lack of relatively uncongested alternative routes. Introduction of traffic light control systems may bring local benefits but would not bring significant enhancement of capacity. ITS may offer some benefits but again in the context of the N28, this would not be expected to be significant, e.g., temporary peak hour lower speed limits. Cork County Council is also considering a number of interventions to improve transport choice within the N28 corridor. The measure likely to have most impact on traffic flows is the proposal for Workplace Travel Planning by major employers in the Ringaskiddy area. It is also noted that the recent planning permission for the expansion of the Port facilities at Ringaskiddy includes demand management measures in respect to the traffic generated by the increase in activities at the site. This includes a managed system for timing of arrivals and departures from the facility so as to not increase peak hour demand. These measures are likely to lead to modest reductions in peak hour travel demand, obtainable for minimal investment cost but as a solution to the traffic problems on the N28, the impact is likely to be relatively minor. Fiscal control and ITS measures are assessed to offer limited benefit to the N28 corridor.

Currently public transport systems in the area are poor. The option of introducing a bespoke peak hour public transport service has been considered. Whilst such a service would result in some modal shift and consequent reduction in peak hour trips, it would not in itself be sufficient to resolve the observed transportation problems experienced on the N28. Thus this option was not considered further as a TMA.

Most of the N28 trips are too long for walking to be a viable alternative. Cork County Council has developed a Cycle Network Plan for Metropolitan Cork in partnership with Cork City Council and the National Transport Authority. The primary objective of this network plan is to identify the cycle network required to support the achievement of high levels of cycling, particularly for access to work and to education throughout Metropolitan Cork, which incorporates the Ringaskiddy and Carrigaline areas. This plan would not be expected to result in sufficient mode change to significantly improve the transportation performance of the N28.

The conclusion is that while the measures considered are worthwhile in their own right, the only option with a large enough impact to be considered as an alternative to major highway investment is the option of a significantly lower level of highway investment that is strongly targeted at solving the most significant transportation problems along the route. Such a package of traffic management measures is likely to involve the four elements identified above and illustrated in **Figure 4.3** below.

Figure 4.3: Concept-Level Traffic Management Alternative



4.4.2 Major Investment Alternative

Route options which comprise major investment alternatives are considered at a strategic level and compared to the Do-Minimum and Traffic Management scenarios. From **Section 4.3** above, the major investment option which best achieves the project objectives, is the proposal to upgrade within the existing N28 route corridor. At this strategic level, the major investment alternative includes for the upgrade of the existing corridor to a higher standard of quality and service.

4.4.3 Comparison of Strategic Alternatives

The strategic alternatives were assessed and compared in the context of the project objectives, outlined above in **Section 4.1.1**. The assessment is summarised in **Table 4.1** below.

Table 4.1: Assessment of Options

Criteria	Do-Minimum	Traffic Management Alternative	Major Investment Alternative
Accessibility & Social Inclusion	Will not achieve objectives of improving access to employment centres on the Ringaskiddy peninsula for non-car-owners and safer access for local communities	Will not achieve objectives of improving access to employment centres on the Ringaskiddy peninsula for non-car-owners and safer access for local communities.	Will remove significant traffic volumes from the existing N28. This reduction in traffic offers opportunities to improve facilities for alternative travel modes along the existing N28 road for non-motorway and other vulnerable road users. Reduce severance in villages, i.e., Shanbally and Ringaskiddy. Provides benefits for pedestrians and cyclists by providing a safer N28 with reduced traffic volumes and through the project design of including access to existing greenway initiatives and future plans for pedestrian and cycling in the area.
Integration	Does not integrate with national and European policy as it will not improve capacity and linkages with the N40 or Dunkettle Interchange. It will not comply with TEN-T requirements for a high-quality route.	Does not integrate with national and European policy as it will not improve capacity and linkages with the N40 or Dunkettle Interchange. It will not comply with TEN-T requirements for a high-quality route.	Meets the requirements of European, national and local policy including:- ▪ Infrastructure – TEN-T – Connecting Europe, 2014 ▪ National Ports Policy, 2013 ▪ Department of Transport: Statement of Strategy, 2015 – 2017 ▪ Investing in our Transport Future: Strategic Investment Framework for Land Transport, 2015 ▪ Spatial Planning an National Roads: Guidelines for Planning Authorities, 2012 ▪ Smarter Travel, A New Transport Policy for Ireland, 2009 – 2020 ▪ National Roads Authority Service Area Policy, 2014 ▪ National Development Plan, 2007 – 2013 ▪ Building on Recovery: Infrastructure and Capital Investment 2016 – 2021 ▪ National Spatial Strategy for Ireland, 2002 – 2020 ▪ Our Sustainable Future: A Framework for Sustainable Development, 2020 ▪ Regional Planning Guidelines for the South-West Region 2010 – 2022 ▪ Cork Area Strategic Plan (CASP): Strategy of Additional Economic and Population Growth Update, 2008 ▪ Cork County Development Plan 2014 – 2020 ▪ Carrigaline Electoral Area, Local Area Plan 2015 ▪ Draft Ballincollig-Carrigaline Municipal District Local Area Plan, November 2016.

Criteria	Do-Minimum	Traffic Management Alternative	Major Investment Alternative
Environment	Traffic will continue to increase and the existing N28 will have further traffic, noise, congestion and emissions impacts in the future as the Do-Minimum option will not provide traffic relief. Will result in continued delays to travel time. Existing drainage regime will remain unchanged.	Preferred in terms of avoiding impacts to natural resources. However will not reduce air emissions and noise associated with existing and future traffic congestion.	The proposed road project has been developed through an iterative process that has sought in the first instance, to avoid adverse impact on the environment and sensitive sites. The proposed road project will provide the following benefits – improved traffic movements, reduced congestion, improved journey times, encouraging infrastructure and future development resulting in improved employment opportunities. Improved drainage and pollution control. The proposed road project will however result in residual negative impacts to landscape and local ecological resources which would be expected from any project of this nature.
Economy	Does not cater for existing and future development of IDA lands, Strategic Employment Area in Ringaskiddy, Port of Cork, Housing etc. Will not result in improved travel times	Some improvement in travel times. It has little capacity to cater for existing and future growth and development of IDA lands, Strategic Employment Area in Ringaskiddy, Port of Cork, Housing etc.	The proposed road project will result in significant transportation time savings and benefits. Removing large volumes of traffic off the existing N28 and local road network and improving access by providing a motorway/protected road/service area coupled with improved road safety and reduced journey times, will promote regional growth and improve economic growth and tourism development in the area. Will facilitate the regeneration of brownfield sites within the City. Supports the potential for increased tourism in the area.
Safety	Will only provide for localised safety improvements	Will only provide for minor/local safety improvements	Significant improvement in road safety by providing a high-quality route for the majority of traffic movements and significant reductions in traffic volumes utilising the existing N28, improving the safety of that route.

The Major Investment Alternative is the most appropriate for the area as both the Do-Nothing/Do-Minimum and the TMA approaches cannot meet the project objectives. They would not have capacity to cater for a significant increase in traffic volumes to cater for future demands associated with the growth in residential and employment zones as well as the Port facility in Ringaskiddy. Neither the Do-Minimum nor the TMA meet the objectives and standards of the TEN-T and the Ports Policy referred to in **Chapter 2: Planning and Policy Context**.

4.5 CONSIDERATION OF ALTERNATIVES WITHIN THE ROUTE CORRIDOR

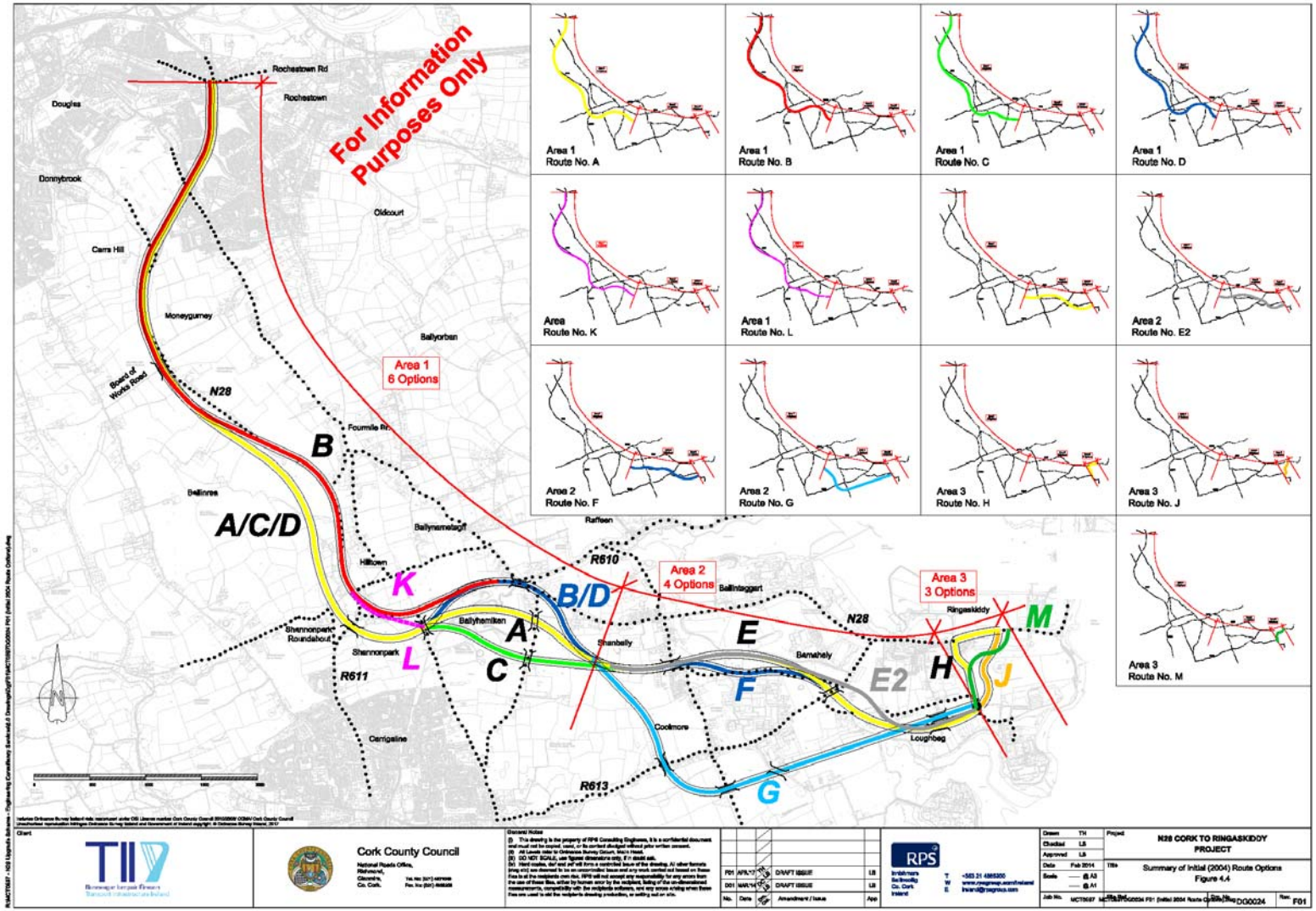
4.5.1 Options Developed between 2004 and 2008

Between 2004 and 2006, an initial route selection process was carried out. This study set out to identify an improvement scheme to upgrade the N28 to a high quality dual-carriageway standard between Bloomfield Interchange and Ringaskiddy Village. This brought the project to a stage where engineering and environmental solutions were sought to identify whether or not elements of different routes were feasible and if they met the project objectives. The study considered traffic projections, engineering feasibility and environmental constraints. These studies led to the emergence of a number of different sections of route options labelled A-M within three separate areas of the project. These are detailed in **Table 4.2** and **Figure 4.4**.

Table 4.2: Route Option Areas

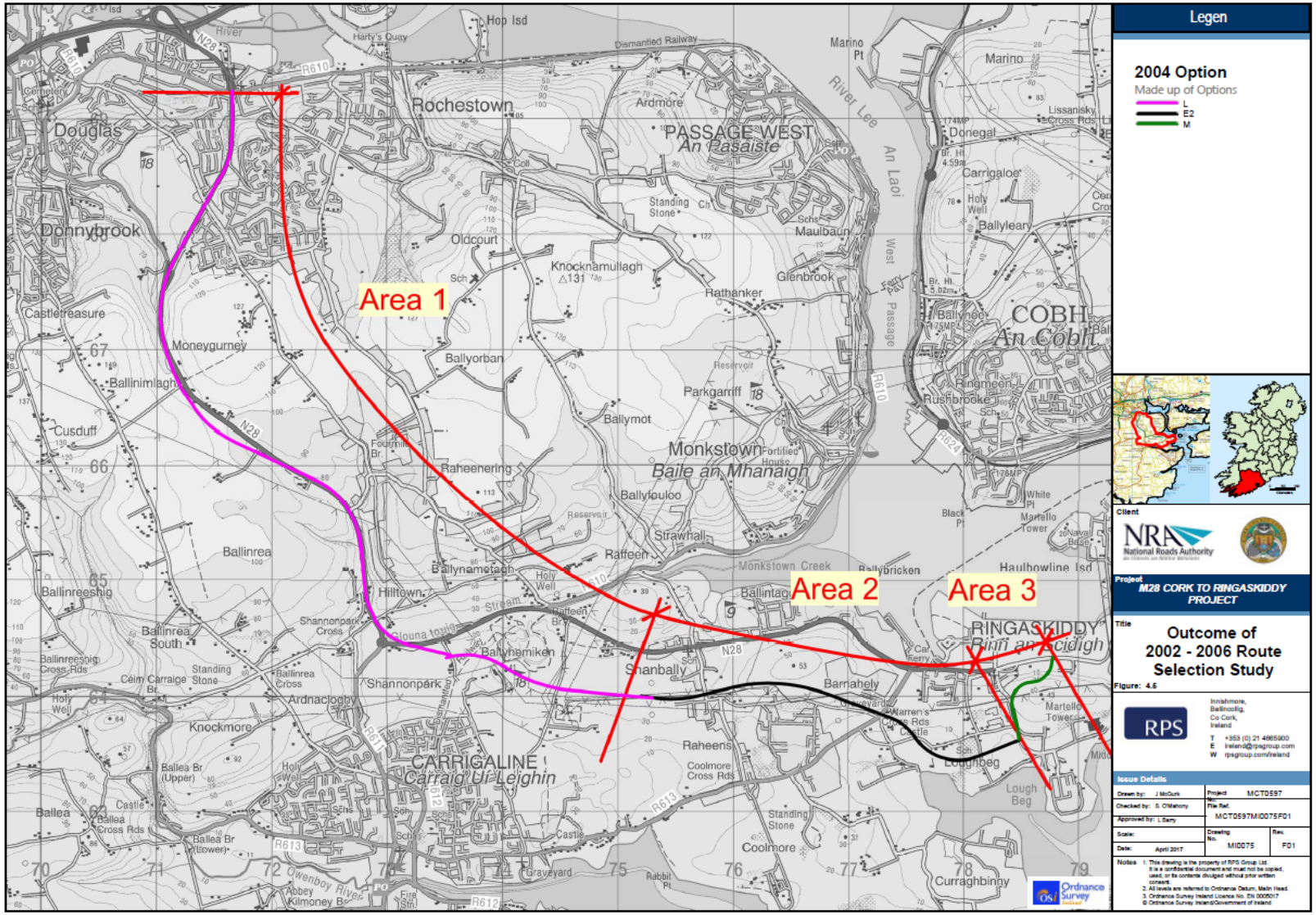
Area	Route Options
Area 1: Bloomfield to east of Shannonpark	Route Options A to D, K and L
Area 2: Shanbally to Loughbeg	Route Options E, E2, F and G
Area 3: Ringaskiddy	Route Options H, J and M

Figure 4.4: Summary of the Initial (2004) Route Option



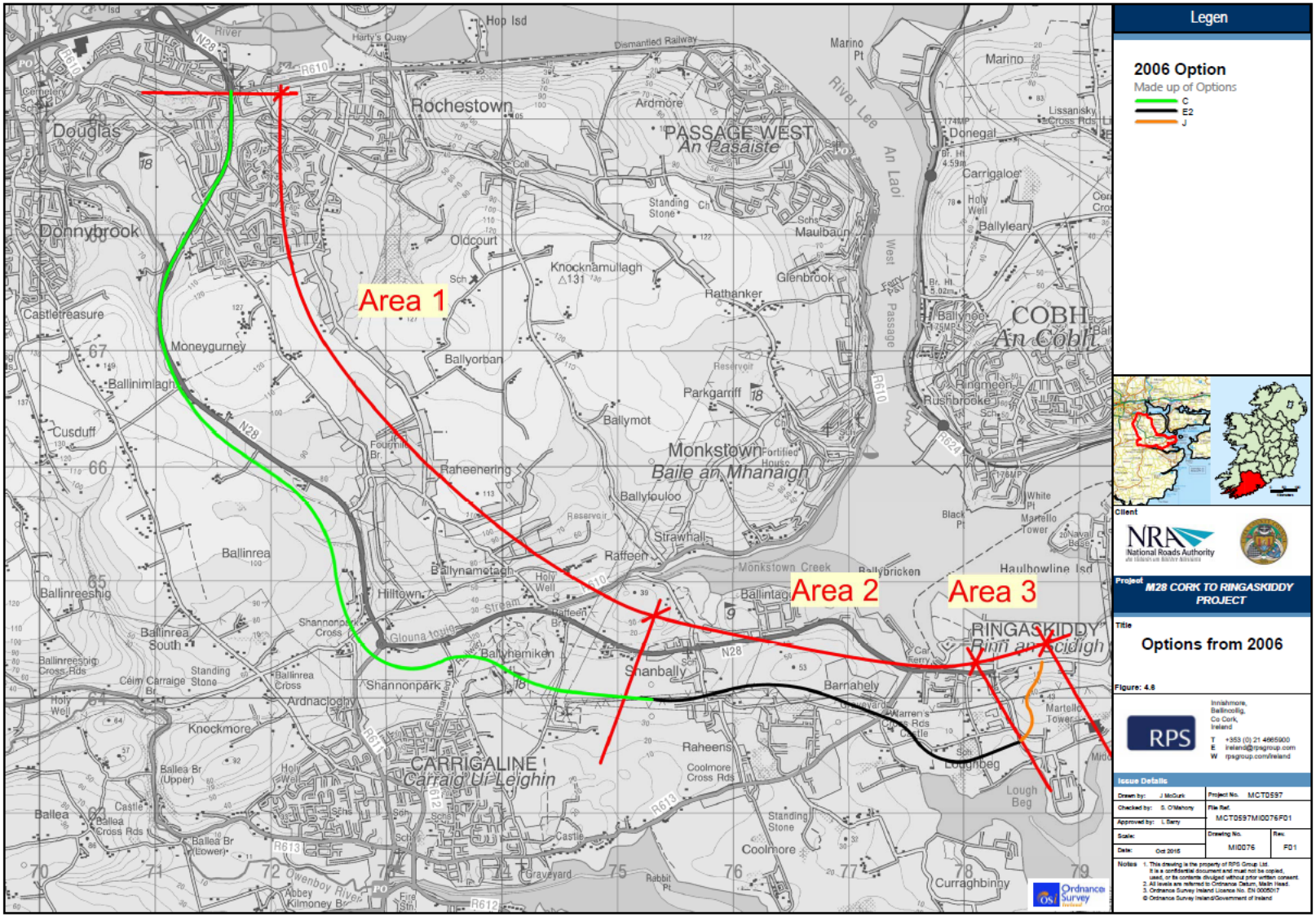
At the time, each option was analysed against a range of constraints and assessed in terms of their economic effects, safety impacts, accessibility impacts, integration and impact on the environment. This analysis along with multiple public consultation periods, culminated in the emergence of a preferred route corridor. The outcome of this 2002-2006 study identified an Option L, E2 and M as the preferred option (**Figure 4.5**).

Figure 4.5: Outcome of 2002-2006 Route Selection Study



Subsequently, Halcrow Barry was appointed by Cork County Council to review the route selection process and further develop the emerging preferred route for the project. Following this further analysis, a different option was identified which included an offline version of Option C. This was considered to have the least impact on human beings, ecology and the greater environment, as well as being the most suitable when considering engineering and economic factors. The outcome of this study identified an Option C, E2 and J as the preferred option (**Figure 4.6**).

Figure 4.6: Outcome of 2008 Route Selection Addendum Study



4.5.2 Review of Route Selection Process in 2014

Following on from the publication of the National Ports Policy in 2013, the scheme was revisited by Cork County Council and RPS were appointed to reassess the studies carried out to date and to bring the project to completion of Phases 1 to 4 of the NRA Project Management Guidelines[1].

The first step in this process was a review and analysis of the historical work summarised above. Given the time lapse between the current proposal and the 2002-2008 studies, this review process commenced with an update of constraints within the study area to fully inform the review. Each of the options A-M and Sections 1-3 were reviewed and analysed to determine if the previous conclusions were still valid. The review process was based on a number of factors *inter alia*, environmental, economic, engineering, land use and traffic patterns.

The analysis of Area 1 indicated that Option L was a viable option along with Options A and C which were also identified as worthy of further consideration. This was consistent with the outcomes from the 2002-20068 route selection studies.

The initial analysis for Area 2 indicated that Option E2 was the preferred option. In the updated review of the route selection process, Option E was considered of similar merit to Option E2 and both were therefore identified as being worthy of further consideration.

The analysis for Area 3 indicated that Option M was the preferred option in the original 2002-2006 route selection. However it was identified as Option J in the 2008 addendum. At that time a dual carriageway was proposed for the full length of the route. In the update of the route selection process, it was considered realistic to consider single carriageway options in the vicinity of Ringaskiddy as the predicted traffic demand would not warrant a dual carriageway. As this was a significant change it was determined that a full review of options would be considered for the Ringaskiddy area, including options for a single carriageway. This assessment would also consider the option to complete the scheme at the R613 at Barnahely and not provide a route to the east side of Ringaskiddy village. Refer to **Section 4.5.3** below for a more detailed description of the consideration of alternatives and route selection process in the Ringaskiddy area.

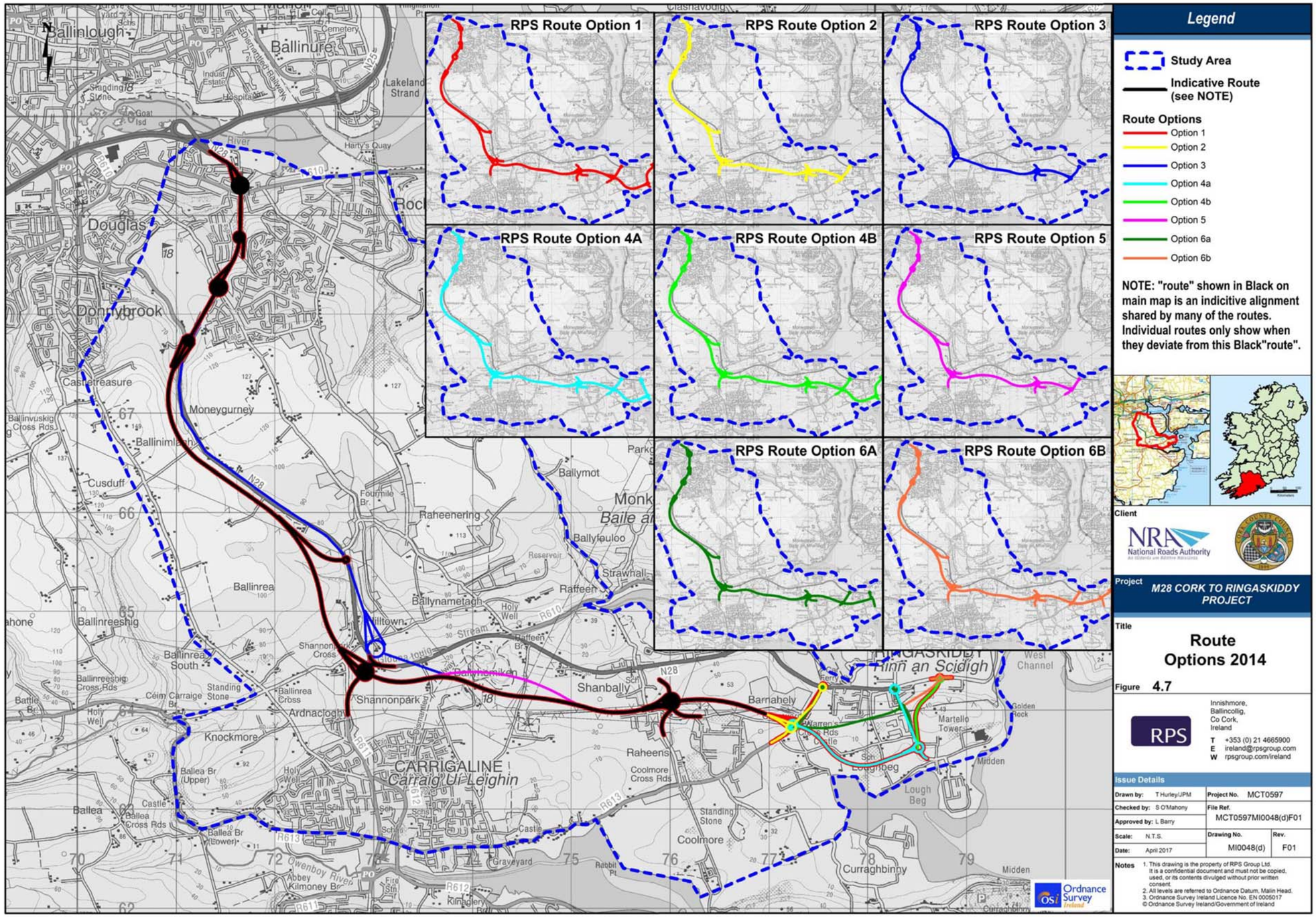
The review and update of the route selection process led to the identification of eight route corridors as described in **Table 4.3** and shown in **Figure 4.7**. Note, for the updated route selection a new naming protocol was applied to the A-M notation and this is explained in the table.

[1] NRA, 2010 Project Management Guidelines

Table 4.3: Route Options Identified Following 2014 Review

2014 Route Name	Description	Equivalent 2002-2008 Notation
Option 1	This option emerged as the preferred route from the 2008 review. The Route is a dual carriageway from Bloomfield to Ringaskiddy.	Options C + E2 + J
Option 2	This option is the same as Option 1 except that the proposed Route is completed at the R613 at Barnahely. The Route is a dual carriageway from Bloomfield to Barnahely.	Option C + part of Option E2
Option 3	This option consists of a partially online option between Carr's Hill and Shannonpark. This option terminates at Barnahely as per Option 2. The Route is a dual carriageway throughout.	Option L + part of Option E2
Option 4a	This option consists of Option 2 plus a single carriageway extension along the route of Option E2 (east of Barnahely) plus a single carriageway along the existing route of the L6517 IDA Road (or Loughbeg Road). The Route is dual carriageway to Barnahely and single carriageway from Barnahely to Ringaskiddy.	Options C + E2 + H
Option 4b	This option consists of Option 2 plus a single carriageway extension along the route of Option E2 (east of Barnahely) plus a single carriageway along the proposed route of Option J. The Route is a dual carriageway to Barnahely and single carriageway from Barnahely to Ringaskiddy.	Options C + E2 + J
Option 5	This option consists of Option 2 except that the route from Shannonpark to Shanbally passes through Raffeen Quarry instead of the Fernhill Golf & Country Club. The Route is a dual carriageway to Barnahely. This option terminates at Barnahely.	Option A + part of Option E2
Option 6a	This option consists of Option 2 plus a single carriageway extension along the existing services corridor between Barnahely and the L6517 IDA Road. From the L6517 IDA Road the route follows the existing L6517 IDA Road to Ringaskiddy. The Route is a dual carriageway to Barnahely and single carriageway from Barnahely to Ringaskiddy.	Option C + part of Option E2 + a new option
Option 6b	This option consists of Option 2 plus a single carriageway extension along the existing services corridor between Barnahely and the L6517 IDA Road. From the L6517 IDA Road the route extends into the lands to the north of the Martello Tower to the local road to Haulbowline. The Route is a dual carriageway to Barnahely and single carriageway from Barnahely to Ringaskiddy.	Option C + part of Option E2 + part of Option M.

Figure 4.7: Route Options 2014



4.5.3 Descriptions of 2014 Routes

Option 1

Option 1 is a proposed dual-carriageway from Bloomfield Interchange to Ringaskiddy including a route to the east side of Ringaskiddy. Commencing at the Bloomfield Interchange, the route follows the existing N28 southwards through the urban Douglas/Rochestown area. The route continues on-line as far as Carr's Hill where the existing partial interchange at Carr's Hill would be upgraded as part of this proposal. South of this location, the proposed mainline diverges to the west of the existing N28 where it continues adjacent to and to the west of the existing N28 through the townlands of Moneygourney and Ballinimlagh. An underbridge is proposed where the route passes over the existing Board of Works Road and the T-junction between the existing N28 and the Board of Works Road would be retained.

From the Board of Works Road, the route continues south of the existing N28 through the townland of Ballinrea towards the existing Shannonpark Roundabout. A partial interchange is proposed at this location with the mainline passing over the existing R611 to Carrigaline. From here the route continues in an easterly direction to the south of the existing N28 through the townland of Ballyhemiken, where it passes through Fernhill Golf & Country Club. The route continues in an easterly direction to the south of Shanbally Village. The Shanbally Interchange is located immediately east of the L2492 local road and would facilitate access to/from the village of Shanbally. From here the route continues in an easterly direction, with Janssen (formerly Centocor) to the north and Novartis to the south, as far as the R613 Regional Road at Barnahely. A partial interchange (Barnahely Interchange) would be required at this location to allow eastbound traffic to diverge from the new M28 and join the R613. In addition traffic from the R613 would be able to merge with the new M28 westbound carriageway.

From here the route continues in a south-easterly direction before crossing the L6518 local road to the west of Ringaskiddy Lower Harbour National School. The route continues to the south of the L6518 through the townland of Loughbeg before meeting the L6517 IDA Road. An at-grade roundabout (Loughbeg Roundabout) is proposed at this location. From here the route continues in a northerly direction to the east of the L6517 IDA Road. Due to the existing topography a significant cut would be required in this area. The route passes to the west of the Martello Tower before eventually meeting the L2545 local road to the west of the entrance to the National Maritime College of Ireland (NMCI). A roundabout (proposed Ringaskiddy Roundabout) would be proposed here.

Option 2

Option 2 is identical to Option 1 to a point immediately west of the R613 at Barnahely. Instead of a partial grade separated interchange it is proposed to terminate the dual carriageway and to provide an at-grade roundabout (Barnahely Roundabout) where the mainline meets the existing R613 Regional Road. Option 2 does not include a route to the east side of Ringaskiddy. Instead it is proposed to upgrade the existing R613 between the new Barnahely Roundabout and the existing N28. This upgrade would include the alteration of a section of the R613 to improve the vertical alignment and the construction of a roundabout (Port Roundabout) where the upgraded R613 meets the existing N28. The intention would be to replicate the existing R613 cross-section, which currently includes a southbound climbing lane.

Option 3

Option 3 is identical to Option 2 with the exception of the section between Carr's Hill and Shannonpark. In this option, the route is essentially an on-line improvement scheme between Carr's Hill and Shannonpark. In this option the existing N28 cross-section is widened to accommodate a motorway cross-section. A major engineering consideration for Option 3 would be maintaining access to a number of properties that currently have access directly onto the existing N28 and providing a viable alternative for non-motorway users.

Option 4a and 4b

Option 4a is identical to Option 2 from Bloomfield to the proposed at-grade roundabout at the R613 at Barnahely. From here the route continues as a single carriageway road in the corridor of Option 1, which is a south-easterly direction before crossing the L6518 local road to the west of Ringaskiddy Lower Harbour National School. The route continues to the south of the L6518 through the townland of Loughbeg before meeting the L6517 IDA Road. A reduced size at-grade roundabout is proposed at this location (Loughbeg Roundabout).

From the proposed roundabout, option 4a proposes to upgrade the existing L6517 IDA Road to its junction with the N28 at the existing Port entrance. This upgrade would include a lowering of a section of the existing L6517 IDA Road to improve the vertical alignment and the construction of a roundabout (Port Roundabout) where the upgraded L6517 IDA Road meets the existing N28. The intention would be to replicate the existing L6517 IDA Road cross-section, which currently includes a southbound climbing lane.

Option 4b is identical to Option 4a as far as the proposed Loughbeg Roundabout on the L6517 IDA Road. From the proposed Loughbeg Roundabout the route continues in a northerly direction to the east of the L6517 IDA Road, following a similar corridor to Option 1 but as a single carriageway alternative. Due to the existing topography a significant cut is required in this area. The route passes to the west of the Martello Tower before eventually meeting the L2545 local road to the west of the entrance to the NMCI. It is proposed that a roundabout (Port Roundabout) would be constructed here.

Option 5

Option 5 is similar to Option 2, except that instead of traversing Fernhill Golf & Country Club in the townland of Ballyheimeken, Option 5 traverses Raffeen Quarry (also known as Ballyhemiken Quarry), which extends along the northern boundary of the Golf Club. Option 5 joins Option 2 to the east of local road L6472 (Raffeen Road). In total Option 5 deviates from Option 2 for approximately 1.7km of its length.

Option 6a and 6b

Option 6a is identical to Option 2 to an at-grade roundabout (Barnahely Roundabout) where the new M28 mainline meets the existing R613 Regional Road. From the proposed Barnahely Roundabout, Option 6a continues as a single carriageway in an easterly direction through agricultural lands. The route traverses a services corridor which currently accommodates a gas transmission main, overhead 110kV and 38kV ESB lines. It crosses a local road (Old Post Office Road), and from there the route continues along the 'services corridor' before meeting the L6517 IDA Road (or Loughbeg Road). Another at-grade roundabout (Loughbeg Roundabout) is proposed here.

From the proposed Loughbeg Roundabout this option includes the upgrade of the existing L6517 IDA Road to its junction with the N28 at the existing Port entrance. This upgrade would include a lowering of a section of the existing L6517 IDA Road to improve the vertical alignment and the construction of a roundabout (Port Roundabout) where the upgraded L6517 IDA Road meets the existing N28.

Option 6b is identical to Option 6a as far as the proposed Loughbeg Roundabout. From the proposed Loughbeg Roundabout, Option 6b continues in a north-easterly direction. Due to the existing topography a significant cut would be required in this area. The route passes to the north of the Martello Tower before eventually meeting the L2545 local road to the west of the entrance to the NMCI. A roundabout (Port Roundabout) is proposed here.

4.5.4 Assessment of 2014 Route Options

In accordance with the government's Common Appraisal Framework for transport schemes, five core criteria were considered in assessing the route options for the proposed M28 Road Project, these are Accessibility & Social Inclusion, Integration, Environment, Economy and Safety. The eight routes have been subject to detailed assessment, in relation to their impacts under these various aspects, bearing in mind the stated project objectives. It should be noted that at several points along the route there is only a single viable corridor for an improved road and as a consequence this has limited the clear separation of options that might otherwise occur in a route selection process.

4.5.4.1 Accessibility and Social Inclusion

Overall the impacts of each option under this heading are largely similar and no clear preference is identified. Post-construction, the existing N28 will be reclassified as a Regional or Local Road. This would facilitate the possibility of developing a cycle route along the existing N28 between Carr's Hill and Ringaskiddy. The existing N28 could facilitate this with minimal difficulty, given the additional road space that would be available due to lower traffic volumes and an alternative route for heavy goods vehicles.

4.5.4.2 Integration

Integration criteria are concerned with how well or otherwise a proposed road project fits with wider aspects of government policy. All the options presented here are considered to achieve the TEN-T goal of providing a high-quality route connecting the Cork Harbour Port facilities at Ringaskiddy to the core road network. Similarly other relevant national, regional and local policies are similarly met by each of the alternatives considered. Overall the impacts of each option under this heading are largely similar and no clear preference is identified.

4.5.4.3 Environment

Impact on the environment was considered under two broad categories: Human Environment and Natural Environment. The Human Environment included assessments of air quality and climate; noise and vibration; archaeology, architecture and cultural heritage; socio-economic; agronomy; and landscape and visual. The Natural Environment included assessments of ecology; water quality and fisheries; soils and geology; and hydrology and hydrogeology.

Air Quality and Climate

Overall there is no significant variation between the options in terms of air and climate. When considered against the existing N28 alignment, all options are predicted to have a slight net benefit as a result of moving the traffic source away from more sensitive receptors. Consequently, all options are considered to have a neutral to minor positive effect.

Noise and Vibration

The main differences between the route options relates to the Ringaskiddy section. Options 4b and 1 are furthest from the village area (but nearest the Lower Harbour National School). In options where there is no route to the south of the village, there will be increased noise and vibration effects as traffic utilise the existing N28 through the village. Options which utilise the services corridor to the south of the village will result in increased noise and vibration at the southern end of the village but reduced effects at the existing N28 through the village.

Overall Option 4b is considered the preferred option from a noise perspective. Option 1 is considered a close second preference as property counts in the different bands are identical. However an underbridge is required at Barnahely for Option 1, thus raising the mainline which would have the effect of raising the noise source and increasing the area impacted.

Cultural Heritage (Archaeology & Architecture)

Overall proposed Option 5 is considered to have the least potential for impact (minor negative score) on archaeology, architecture and cultural heritage and is therefore considered to be the most preferred. It is a shorter route terminating at Barnahely and avoids the recorded complex at Castle Warren but does pass through the archaeological buffer zone associated with the graveyard at Barnahely. It does not impact on any sites of architectural heritage significance. It also passes through a quarried area that has been previously excavated and is heavily disturbed.

As Option 2 is also a shorter route and also avoids the complex at Castle Warren but does pass through the archaeological buffer zone associated with the graveyard at Barnahely and does not contain any sites of architectural heritage significance and it is considered to be the next preferred route. The difference between Options 2 and 5 is that the former travels through Fernhill Golf and Country Club where there are known recorded upstanding monuments and intact historic field and tree boundaries.

Option 3 has a direct impact on a levelled recorded ringfort in Hilltown townland but is a shorter route which terminates at Barnahely and avoids the castle complex and travels on-line for over half of the proposed route. Options 1, 4a and 4b each impact on the setting of the Castle Warren complex at Barnahely and have the potential to reveal subsurface archaeological remains. Options 6a and 6b have the same level of impact on archaeological and architectural heritage. As both traverse a prehistoric enclosure site identified by geophysical survey and pass through the Castle Warren archaeological and architectural heritage complex, they are jointly considered to be the least preferred route options in terms of archaeology, architecture and cultural heritage.

Agronomy

All options are considered to have an impact on agronomy due to the land acquisition effects on agriculture. Overall Options 2 and 5 are considered to have the least impact due to both the length

and alignment of these options in relation to agricultural properties. Options 1, 4a and 4b are considered to have potentially slightly greater negative impact due to landtake requirements.

Socio-Economic and Community

Overall Option 5 is considered to have the least impact (minor negative) followed closely by Option 2. There is potential for severance of the local population as a result of Options 1, 4a and 4b in the area south of Loughbeg where an existing north-south minor road serving this area will be severed. This would require a slightly longer trip via an existing alternative route at the eastern end of Loughbeg. Options 2, 3, 5, 6a and 6b would not result in any significant severance in this area.

There are a number of schools in the area. The southern property boundary of Ringaskiddy Lower Harbour National School is approximately 80m from the road centreline for Options 1, 4a and 4b compared to approximately 280m for Options 6a and 6b and 570m for Option 2. In terms of the number of properties within 50m of the road centreline, Option 4b has the lowest number of properties (20 no.) compared to Option 3 which has the highest number of properties (97 no.). All of the commercial premises at Shanbally are located at the same distance from the route options. There are a number of B&B premises and commercial premises located off the existing N28 between Raffeen Bridge junction and Shanbally. All route options are off-line in this area and are therefore considered equivalent in relation to access to the B&B's and commercial premises. All route options are considered to have an equal socio-economic impact in terms of reducing passing trade at the filling station and shop adjacent to the existing N28 at Hilltown.

Landscape and Visual

Overall Option 5 is considered the preferred option from a landscape and visual perspective. The route is one of the shorter routes, has the lowest rating for potential visual impacts and avoids Fernhill Golf & Country Club. There is limited difference between the various route options with all registering as a potential moderate negative impact. However from a landscape and visual perspective, Options 2, 3 and 5 (terminating at Barnahely) are shorter routes and as such will have less overall impact than the proposed longer routes (1, 4a, 4b, 6a and 6b) terminating at Ringaskiddy.

Ecology

Overall Option 3 emerges as the preferred route option from an ecological perspective. Option 3 follows the course of the existing N28 over the greatest distance thereby reducing the need for additional land-take and disturbance of adjoining and adjacent habitats. It also avoids sensitive ecological receptors including Raffeen Quarry and Lough Beg pNHA.

Options 1, 4a and 4b are considered to have a major negative impact as all of these routes will intersect with Lough Beg pNHA. This is a nationally important site and the aforementioned routes will result in direct land take and disturbance (permanent impact) of its habitats.

These routes will also intersect improved grassland fields identified as intermittently utilised feeding habitats for over-wintering Curlew and Oystercatcher associated with nearby areas of Cork Harbour SPA. Impacts to over-wintering avifaunal species using these areas are considered in detail in the Appropriate Assessment prepared for this project. Option 5 will traverse Raffeen Quarry which is evaluated as being of County Importance and is therefore considered to have a major negative impact.

The remaining Options, i.e., 2, 3, 5, 6a and 6b are all considered to have a moderate negative impact. These routes will result in permanent impacts to small areas of habitat considered *High Value, Locally Important*.

Options 1, 2, 4a, 4b, 6a and 6b will all follow the same course between the northernmost section of the route (south of the N28/N40 intersection) to the proposed Barnahely roundabout. Within these areas, each of these six routes will adjoin or intersect nine Ecological Receptors. Option 5 will follow the same course as the aforementioned route options, deviating only at the townland of Ballyhemiken where it will traverse through Raffeen Quarry an area comprising an assemblage of habitats and species considered to be of County Importance.

Water Quality and Fisheries

Overall there is little variation between the options in terms of water quality and fisheries, however Options 2, 3, 5 6a and 6b have emerged ahead of Options 1, 4a and 4b. These latter set of route options require crossing of a stream which will discharge to Lough Beg pNHA and as such were identified as having minor negative impact. All of the proposed routes cross over 3 no. existing stream crossings on the Woodbrook Stream, all have 4 no. new crossings on the Glounatouig Stream and 1 no. new crossing on the Donnybrook Stream.

Soils and Geology

Options 2 and 3 have a neutral impact and are therefore considered the preferred options as they are not mapped as having soft ground along the route, they do not impact on the quarry site or the geological heritage sites. In addition they have a lower potential for karst features. This is due to the shorter length within the Waulsortian Limestone Formation which has been identified as having a potential for the occurrence of karst features. Options 1 and 4b are considered to have a minor negative impact and are least preferred. Overall they were assessed as having a higher number of least preferred occurrences including potential for soft ground, length in karst and proximity to areas of geological heritage.

Hydrology and Hydrogeology

The results conclude that overall Option 2 is considered to have the least impact and is preferable to all other route options. Options 1, 4a and 4b are considered to be least preferred as they have potential to have a minor negative impact on hydrology and hydrogeology.

Environmental Assessment

In terms of Natural Environment, Option 2 is the preferred option, followed closely by Option 3, principally on hydrology and hydrogeology grounds. Option 2 has a shorter length of route in vulnerable aquifer, shorter length in locally important karst aquifer and there are no springs in its vicinity. It is noted that Option 3 is the preferred option for ecology as it follows the course of the existing N28 over the greatest distance thereby reducing the need for additional land take and disturbance of adjoining habitats.

The assessments undertaken in relation to Human Environment indicate that overall, Option 5 is the preferred option, followed closely by Option 2. The principle difference between these two routes relate to differences in archaeology, architecture and cultural heritage and also socio-economic and community. By avoiding Fernhill Golf & Country Club, Option 5 avoids impact on recorded upstanding monuments and intact historic field and tree boundaries, located therein. It also avoids socio-economic impacts by traversing a quarry rather than the golf course.

Overall Option 2 is therefore the emerging preferred route from an environmental perspective as it is the preferred option from a Natural Environment perspective and a close second preference from a Human Environment perspective.

4.5.4.4 Safety

Accident rate models from the *National Secondary Roads Needs Study* (NSRNS) were used to estimate the road safety implications of each option.

The analysis of safety for the route options determined that there is little difference in the estimated level of monetised safety benefit for each option analysed. Furthermore the link from Barnahely to east of Ringaskiddy (Options 1, 4a, 4b, 6a and 6b) gives a positive safety benefit through an additional reduction in numbers of collisions relative to options without this link (Options 2, 3 and 5). The preferred options for road safety were Options 4b, 6a and 6b as these options offer the greatest traffic relief to Ringaskiddy Main Street.

4.5.4.5 Economy

Cost-benefit analysis was undertaken, using the TUBA software. The analysis concluded that:-

- The off-line option north of Shannonpark performs better economically than the on-line option (Option 3).
- The options at Ballyhemiken – the choice of alignments between the quarry and the golf club – do not involve a significant traffic impact or difference in the benefits of the proposed road project; the choice between these is an issue of construction costs, land acquisition costs, and of minimising the risk that these costs will escalate significantly above expectations.
- Extending the proposed road project eastward from Barnahely to include a link to the eastern side of Ringaskiddy village is economically justified, with marginal Benefit to Cost Ratio (BCR) being greater than 1 for all the single-carriageway route options. However, the projected traffic levels for this link do not justify the additional cost of this section being to a dual carriageway standard (Option 1).
- The economic difference between Options 4a and 4b, and between 6a and 6b, is minimal.
- The relative economic performance of Option 4 and Option 6 depends on the spatial pattern of future traffic-generating land uses – the extent to which additional future traffic seeks to access the current major employment centre at Loughbeg (better served by Option 4) or the Port and the development land around the Haulbowline Road (better served by Option 6).

4.5.4.6 Summary Assessment

Table 4.4 provides a summary of the assessment of the eight route options under the Major Investment Alternative.

Table 4.4: Overall Assessment under 5 Core Criteria

Route Options	Accessibility & Social Inclusion	Integration	Human Environment	Natural Environment	Safety	Economy
1	Neutral	Neutral	Intermediate	Least Preferred	Intermediate	Neutral
2	Neutral	Neutral	Next Preferred	Preferred	Least Preferred	Neutral
3	Neutral	Neutral	Least Preferred	Next Preferred	Least Preferred	Neutral
4a	Neutral	Neutral	Least Preferred	Least Preferred	Intermediate	Neutral
4b	Neutral	Neutral	Intermediate	Least Preferred	Preferred	Neutral
5	Neutral	Neutral	Preferred	Intermediate	Least Preferred	Neutral
6a	Neutral	Neutral	Intermediate	Intermediate	Preferred	Neutral
6b	Neutral	Neutral	Intermediate	Intermediate	Preferred	Neutral

4.5.5 Localised Alternatives

It should be noted that at several points along the route there is only a single viable corridor (the core corridor) for an improved road and as a consequence this has limited the clear separation of options that might otherwise occur in a route selection. This has been reflected in the assessment process presented.

There are three local areas along the route where significant option variation can be clearly addressed. These are:-

1. Between Carr's Hill and Shannonpark, where the choice is between Option 3 (on-line upgrade) and the core route option, alignment to the west/south of the existing N28.
2. At Ballyhemiken, where the choice is between Option 5 (through the Raffeen Quarry) and the core route option (through Fern Hill Golf and Country Club).
3. At Ringaskiddy, where the choice is between:-

   - Options which does not extend east of Barnahely,
   - Options 4a or 6a, terminating at the existing entrance of the Port and incorporating improvements to the L6517 IDA Road, or
   - Options 1, 4b or 6b, terminating at the proposed new eastern entrance to the Port.

4.5.5.1 Options between Carr's Hill and Shannonpark

The core proposal runs southwest of the existing Shannonpark Roundabout and to the west of the existing N28 immediately north of Shannonpark. Option 3 runs to the northeast of the existing Shannonpark Roundabout and on-line immediately north of Shannonpark. A comparison of the two indicates that:-

- Option 3 would have a slightly greater impact on sensitive receptors for air quality and noise.
- Option 3 would have greater adverse impact on existing properties at Hilltown and Shannonpark.
- The core option avoids direct impacts to a levelled ringfort in Hilltown.
- They both traverse a similar number of Ecological Receptors, however Option 3 is located within the footprint of the existing N28 thus reducing the need for additional land-take, though removal of roadside hedgerows will be necessary. Also the Donnybrook and Glounatouig streams run adjacent to the existing N28 in this location and so the potential for adverse impact on water quality and aquatic ecology increase due to the proposed road widening associated with Option 3.
- Option 2 is slightly preferable in terms of aquifer vulnerability as this route would involve a shorter length of road where the geology implies a risk of groundwater pollution.
- Option 3 would have greater negative impact on the Glounatouig Stream.
- The difference in the cost of the two route options is small.
- The on-line upgrade (Option 3) would make it more difficult, if not impossible to accommodate non-motorway users, as the existing road would not be available as an alternative route.

Option 2 emerges as the preferred option at this location.

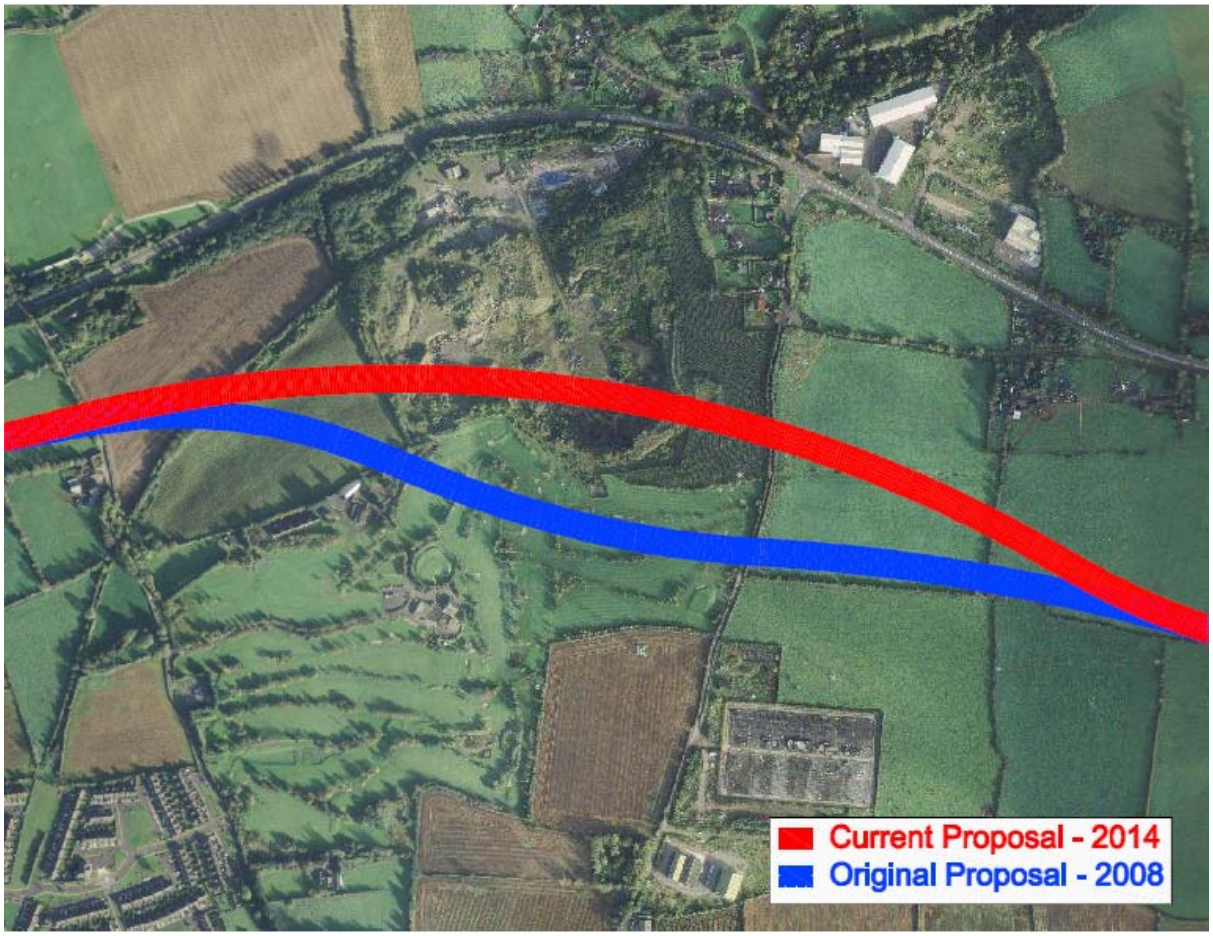
4.5.5.2 Options in Ballyhemiken Area

Option 5 runs through Raffeen Quarry while the core option (Option 2) crosses Fernhill Golf & Country Club refer to **Figure 4.8**. Option 5 impacts on potential future operations of the quarry. The core Option 2 would have a significant negative impact on Fernhill Golf & Country Club as an 18-hole golf course.

A comparison of the two indicates that:-

- Option 2 will have significant negative impact on the operation of Fernhill Golf & Country Club which may threaten its viability as an 18-hole golf course.
- Option 5 avoids potential landscape and visual impacts to Fernhill Golf & Country Club, and associated loss of community facilities.
- Option 5 is located at a greater distance from the houses within the golf course (1 house, 10 no. guest cottages) and the hotel rooms, and thus has potentially lower air quality and noise impacts to these receptors.
- Option 5 also avoids a direct impact on a recorded ringfort (CO087-116).
- Option 5 provides excellent potential for a source of high quality construction material adjacent to the construction site.
- Option 5 will bisect the southern half of Raffeen Quarry, resulting in the direct habitat loss of semi-natural habitats with associated direct and indirect impacts to their component flora and fauna (including Pennyroyal and Peregrine falcon).
- Option 2, in this area, will primarily involve the removal and disturbance of amenity grassland.
- Groundwater is at greater risk of pollution along Option 5 compared to Option 2.
- There are minimal differences between the options in terms of economic and safety benefits.

Figure 4.8: Alternatives at Raffeen



The route through the quarry (Option 5) emerges as the preferred option at this location, on the grounds that it avoids the need to acquire golf course lands, threatening the viability of this local amenity and business and the better opportunity for possible use of the quarry as a source of high quality construction material. The owners of the quarry have an existing planning permission, which included an Environmental Impact Assessment dating from 2008. This permission is valid for 30 years.

The direct impact of the route through the quarry on flora and fauna (including Pennyroyal and Peregrine falcon) will require mitigation. Options include translocation of plant species and habitats and possible provision of alternative nesting sites for the Peregrine falcon.

4.5.5.3 Options at Ringaskiddy

The alternatives considered in the Ringaskiddy area may be summarised as:-

a) Do Minimum – Options 2, 3 and 5 finish at the R613 and do not complete a route to the east side of the village.
b) Full dual carriageway to east side of Ringaskiddy village on route closest to Loughbeg bay – Option 1.
c) Single carriageway to east side of Ringaskiddy village on route closest to Loughbeg bay – Option 4b.

d) Single carriageway to Ringaskiddy village via an upgraded Loughbeg Road on route closest to Loughbeg bay – Option 4a.

e) Direct route from R613 through the 'services corridor' to the east side of Ringaskiddy village as a single carriageway – Option 6b.

f) Direct route from R613 through the 'services corridor' to Ringaskiddy village via an upgraded Loughbeg Road as a single carriageway – Option 6a.

Option 1 is the most expensive and has the most significant impact in terms of scale of footprint and earthworks. The projected traffic volumes do not justify a dual carriageway standard road. On this basis, this alternative is eliminated from further consideration.

The Do-Minimum options (Options 2, 3 and 5) do not relieve Ringaskiddy village of through traffic and traffic related effects. These options include the upgrade of the R613 to provide the route to the port. This entails that the western access into the Port would be the access served by the proposed TEN-T route. This proposal is not consistent with the Port of Cork plans which envisage an eastern access to cater for future expansion, particularly of a RoRo service. Furthermore, economic analysis has shown that a single carriageway route to the east side of Ringaskiddy Village represents good value for money with a positive BCR. On the basis that a proposed route represents a good economic investment, provides traffic relief to the village and best aligns with the Port development plans, the Do-Minimum options were eliminated from further consideration.

The remaining options are single carriageway options providing routes to either the junction of the N28 and Loughbeg Road (Options 4a and 6a) or to the east side of the village (Options 4b and 6b).

The alternatives 4a and 6a provide for access to the Port at the location of the existing car ferry entrance in Ringaskiddy village. They include for a significant upgrade of the Loughbeg Road and a proposed roundabout entrance to the Port within the village. These options will provide for traffic relief to the village but will also have the effect of severing Martello Park from the village centre. The access to the Port does not align with the Port of Cork plans which indicate a new entrance further east of the village. On the basis that these options do not provide for the best alternatives for Ringaskiddy village and do not align with the Port development plans, they were discounted from further consideration.

An assessment of the remaining options (Options 4b and 6b) concludes the following:-

- As Option 6b is shorter and a more direct link to the proposed road project at Barnahely, the analysis shows that it provides marginally greater traffic relief to Ringaskiddy village and consequent reduction in traffic nuisance.
- Option 6b is significantly closer to the southern edge of Ringaskiddy village and will have a greater adverse impact in terms of road traffic noise and visual impact on sensitive receptors in this location.
- Option 6b is significantly further away from the Cork Harbour SPA than Option 4b and avoids a feeding area for Curlew, a qualifying feature of the SPA.
- Option 6b is further away from the Lough Beg pNHA than Option 4b, which does traverse part of the designated area.
- Option 6b is preferred in terms of land use and planning in that it predominantly aligns with the services area, zoned green space in the area defining the southern extents of development with

the village. Option 4b severs the extensive area of strategic employment zoned lands to the south of Ringaskiddy.

- Option 6b does not require the acquisition of any dwellings, while Option 4b requires the acquisition and demolition of two dwellings.
- Option 6b has fewer conflicts with existing utilities when compared to Option 4b and it is slightly to moderately preferred by both ESBI and Bord Gáis Networks.
- The Option 6b requires less land acquisition than Option 4b due to its reduced footprint and shorter length. Option 6b is 0.5km shorter and has an indicative land requirement of 8.51ha compared to 13.78ha for Option 4b, 61% larger.
- As outlined in **Table 4.5** below Option 6b requires less earthworks than Option 4b due to its reduced footprint, improved vertical alignment and shorter length. The following table compares the differences in scale between the two options.

Table 4.5: Route Characteristic of Option 4b and 6b

Route	Option 4b	Option 6b	Difference Compared to Current Route
Length (m)	2,100	1,550	550 (+35%)
Landtake (Ha)	13.78	8.51	5.27 (+61%)
Earthworks (m^3 cut)	262,000m^3	126,000m^3	+136,000m^3 (+108%)
Earthworks (m^3 fill)	164,400m^3	71,000m^3	+93,400m^3 (+131%)
Topsoil Strip (m^2)	25,650m^2	16,450m^2	+9,200m2 (+56%)

- The additional cut is mostly in the section from Loughbeg to the Port and the additional fill is mostly in the section from Barnahely to Loughbeg. Option 4b has a greater negative impact on the landscape due to it being notably bigger than Option 6b. The additional cost of earthworks alone is estimated as €1.36m excl. of VAT. The only significant structure required for Option 6b is the proposed underpass at Old Post Office Road, while Option 4b requires an additional 2 no. road bridges.
- Option 6b can be designed to meet with optimal standards and has the least steep gradient from the Ringaskiddy Roundabout. Option 4b has a steeper gradient and can only be designed to less than desirable standards.
- Option 6b is a more direct route from the proposed Port entrance east of Ringaskiddy village to the start of the proposed road project at Barnahely. This shorter route leads to lower costs for both construction and maintenance, and higher time savings for Port traffic. Option 6b represents better value for money.

Taking all these factors together, Option 6b emerges as the preferred option in the Ringaskiddy area, because:-

- It meets with the project objective to provide improved access to the TEN-T sea-port at Ringaskiddy;
- It fits best in terms of land use and planning being aligned within the buffer lands defining the southern extents of development within Ringaskiddy village;
- It aligns with the Port of Cork Masterplan for the redevelopment of the Port facilities at Ringaskiddy;
- It is the most direct route, compliant with standards, least expensive, least intrusive on the landscape and best value for money;

- The adverse impacts at the southern side of Ringaskiddy village can be mitigated to reduce the severity of the impact;
- It provides significant traffic relief to Ringaskiddy village and consequent reduction in traffic nuisance within the village centre;
- It has least adverse impact on the natural environment;
- The alignment of Option 6b accommodates the best vertical alignment in terms of catering for HGV traffic from the Port.

4.5.6 Conclusion of Route Selection Process

The outcome from the route selection process is the Core Route (Option 2) using the localised quarry alternative at Ballyhemiken (from Option 5) and extending to Ringaskiddy using Option 6b. This finalised route is shown in **Figure 4.9** overleaf.

***Outcome of Route Selection**: The outcome from the route selection analysis is a combination of Options 5 and 6b.*

Figure 4.9: Preferred Route

4.5.7 Junction Strategy and Layout Alternatives

Following the emergence of the preferred route option, a junction strategy, including particular design layouts and local road connectivity was developed for the northern section of the proposed road project. In order to ascertain feedback from the public and local residents, a dedicated consultation day was organised by the Project Team. The purpose of this public consultation was to inform local residents of proposed changes to the road project in the vicinity of Bloomfield Interchange and Carr's Hill in comparison to earlier published options and to receive their feedback. This element of the public consultation process was held in November 2015. Refer to **Chapter 6: Non-Statutory Consultation** for further details of the public consultation process.

The following sections describe the proposed junction strategy and layouts as initially presented at the public consultation.

4.5.7.1 Initial Junction Strategy – Northern Section

The junction strategy for the northern section of the proposed road project as presented to the public in November 2015 consisted of the following aspect:-

- Closure of the sub-standard existing merge from Maryborough Hill;
- Closure of the substandard diverge to Mount Oval;
- Replacement with a full motorway interchange at Carr's Hill with additional local connection to the Maryborough Ridge housing estate;
- Retention of the merge and diverge at Rochestown Road, incorporating improved M28 northbound diverge to N40 westbound; and
- Introduction of a right turn lane junction to Clarke's Hill from Rochestown Road.

Figure 4.10 illustrates the proposed layout at Carr's Hill Interchange providing full motorway interchange and link to the Maryborough Ridge housing estate in lieu of closure of the existing sub-standard slip roads at Maryborough Hill and Mount Oval.

These proposals were met with significant local opposition and concerns. Refer to **Chapter 6**: **Non-Statutory Consultation** for further details of the feedback received from the public. In response to the feedback received, it was agreed by the Project Team that further alternatives should be developed and assessed.

4.5.7.2 Alternative Junction Strategy and Layout Proposals – Northern Section

The following is a description of the alternatives developed for further consideration at the northern section of the proposed road project.

Option 1

This option is the option presented at the public consultation (as per **Figure 4.10**) and was retained for consideration in the assessment process.

Figure 4.10: Carr's Hill Interchange – November 2015

Option 2

The second option considered consisted of the following elements:-

- Proposals at Rochestown Road to remain as per Option 1.
- Maryborough Hill merge and Mount Oval diverge to remain open and redesigned to comply with standards without departures.

- Carr's Hill Interchange to revert to 2 no. movements only – M28 northbound diverge to R609 and M28 southbound merge from R609 (the existing movements at this junction).

Option 3

The third option for consideration consisted of the following elements:-

- Proposals at Rochestown Road to remain as per Option 1.
- Maryborough Hill merge and Mount Oval diverge to remain open, with departures from standards.
- Carr's Hill Interchange to revert to 2 no. movements only – M28 northbound diverge to R609 and M28 southbound merge from R609 (the existing movements at this junction).

Option 4a

This option consisted of the following elements:-

- Proposals at Rochestown Road to remain as per Option 1.
- Mount Oval diverge to remain open and redesigned to comply with standards without departures.
- Existing Maryborough Hill merge to be closed.
- Carr's Hill Interchange redesign that includes the following:-
  - Proposed two-way link road from the west roundabout along the boundary with Douglas golf course to Maryborough Hill to replace the access link to Maryborough Ridge.
  - R609/old N28 to M28 southbound merge.
  - M28 northbound diverge to R609.
  - R609 to M28 northbound merge to replace the closed merge at Maryborough Hill.
- New right-turn lane on Maryborough Hill in conjunction with the proposed 2-way link to Carr's Hill interchange.

Option 4b

This option consisted of the following elements:-

- Proposals at Rochestown Road to remain as per Option 1.
- Mount Oval diverge to remain open and redesigned to comply with standards without departures.
- Existing Maryborough Hill merge to be closed.
- Carr's Hill Interchange redesign that includes the following:-
  - Proposed two-way link road from the west roundabout along the boundary with Douglas golf course to Maryborough Hill to replace the access link to Maryborough Ridge.
  - R609/old N28 to M28 southbound merge.
  - M28 northbound diverge to R609.
  - R609 to M28 northbound merge to replace the closed merge at Maryborough Hill.
  - M28 southbound diverge to R609/old N28.

- New right-turn lane on Maryborough Hill in conjunction with the proposed 2-way link to Carr's Hill interchange.

Option 4c

This option consisted of the following elements:-

- Proposals at Rochestown Road to remain as per Option 1.
- Mount Oval diverge to remain open and redesigned to comply with standards without departures.
- Existing Maryborough Hill merge to be closed.
- Carr's Hill Interchange redesign that includes the following:-
  - Proposed one-way link road to the west roundabout along the boundary with Douglas golf course from Maryborough Hill.
  - R609/old N28 to M28 southbound merge.
  - M28 northbound diverge to R609.
  - R609 to M28 northbound merge to replace the closed merge at Maryborough Hill.
  - M28 southbound diverge to R609/old N28.
- New right-turn lane on Maryborough Hill in conjunction with the proposed 1-way link (southbound) to Carr's Hill interchange.

Option 5

- Exactly the same as Option 1 except that the Mount Oval diverge is to remain open and be redesigned to comply with standards.

A feasible design solution for Option 2 could not be determined as the design requirements for a compliant merge from Maryborough Hill were too onerous for this particular location. On this basis, this option was discounted from further consideration.

The remaining options were assessed under the following headings; local traffic impact, economy, safety, environmental impacts, accessibility and social inclusion and integration.

Option 3 did not comply with the design standards for a modern motorway and for road safety reasons was discounted from further consideration.

Options 1 and 5 were assessed to have a greater adverse impact on the environment due to their significant footprint in comparison to the other options without presenting any clear advantage. These options were thus discounted from further consideration.

The three different Option 4 alternatives offered the most effective solutions. They retained the local road connectivity by the proposed Maryborough Hill to Carr's Hill Link Road, which is significantly less environmentally intrusive and less expensive to implement than the option to link to Maryborough Ridge.

Further analysis of the three Option 4 variants identified Option 4b as the preferred junction strategy for the northern section of the proposed road project as it provides the best accessibility to the local road network with the addition of the proposed southbound diverge at the interchange.

In April 2016, a further public consultation took place on the *Preferred Route Alignment incl. Revised Junction Strategy* for the proposed M28 Road Project which included the revised junction strategy and layouts, refer to **Figure 4.11**.

Figure 4.11: Carr's Hill Interchange – April 2016

4.5.7.3 Shannonpark Interchange

Carrigaline is a significant centre of population in the area with a strong travel demand to/from Cork City and the wider region. For much of the day, the two way flow between Cork City and Carrigaline is the dominant movement at the existing Shannonpark Roundabout.

To facilitate this demand, a grade-separated interchange with a northbound merge and southbound diverge is proposed at Shannonpark. Two alternative arrangements were assessed as follows:

4.5.7.4 Shannonpark – Option 1

Option 1 is illustrated in **Figure 4.12**. The existing Shannonpark Roundabout is retained as part of this proposal. In order to minimise the number of arms to link to the existing Shannonpark roundabout, it was proposed that the southbound off-slip would be located some distance north of the roundabout, connecting into a new roundabout on the existing N28. The length of the existing N28 between the two roundabouts would be upgraded to a 2+1 cross-section, with 2 lanes southbound and 1 lane northbound as illustrated in **Figure 4.12**.

The northbound on-slip would access the M28 via a priority junction, located to the south of the mainline, on the R611 Carrigaline Road. The proposed Shannonpark Interchange Underbridge would be widened to facilitate a right-turn lane for vehicles wishing to access the M28 northbound. The Ballinrea Access Road would be diverted to tie-in to the R611 Carrigaline Road closer to Carrigaline.

4.5.7.5 Shannonpark – Option 2

The existing Shannonpark Roundabout would again be retained as part of the design of this junction and the southbound off-slip would tie-in at the existing roundabout. Traffic analysis confirms it is feasible for the existing roundabout to cater for this additional arm.

Due to the volume of traffic wishing to leave the M28 at this location, the southbound off-slip would need to consist of 2 lanes. It is proposed that appropriate traffic signs and road markings would be provided such that both of these traffic lanes can access the R611 to Carrigaline via the Shannonpark Roundabout. The proposed Shannonpark Interchange Underbridge would accommodate the 2 lanes of traffic to Carrigaline, refer to **Figure 4.13**.

The northbound on-slip would access the M28 via a new roundabout, located to the south of the mainline, on the R611 Carrigaline Road. The Ballinrea Access Road would be diverted to tie-in to this new roundabout. The proposed interchange would form a standard dumbbell arrangement.

4.5.7.6 Preferred Option

Both options were assessed in terms of traffic, environmental impact, cost and engineering (incl. geometry and earthworks). Option 2 was assessed to be the preferred option for the following reasons:-

- Option 1 has a significantly larger footprint and therefore requires the acquisition of more land.

- Option 1 requires that a section of the existing N28 be upgraded to a 2+1 cross-section, with resultant issues for access to properties currently fronting onto the N28.
- Option 2 would be less expensive to construct resulting in better value for money.

Figure 4.12: Shannonpark Interchange – Option 1

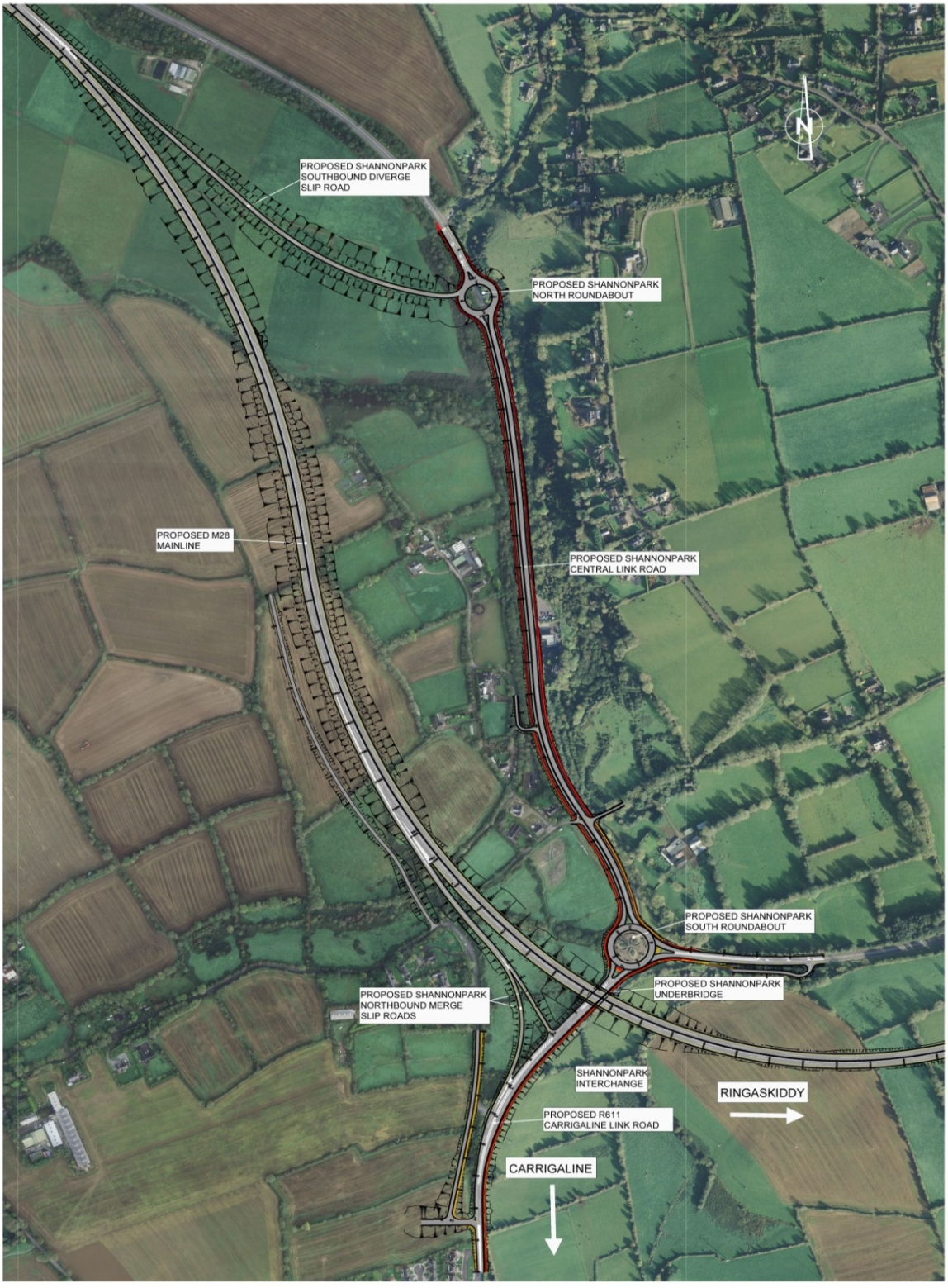


Figure 4.13: Shannonpark Interchange – Option 2

4.5.7.7 Shanbally Interchange

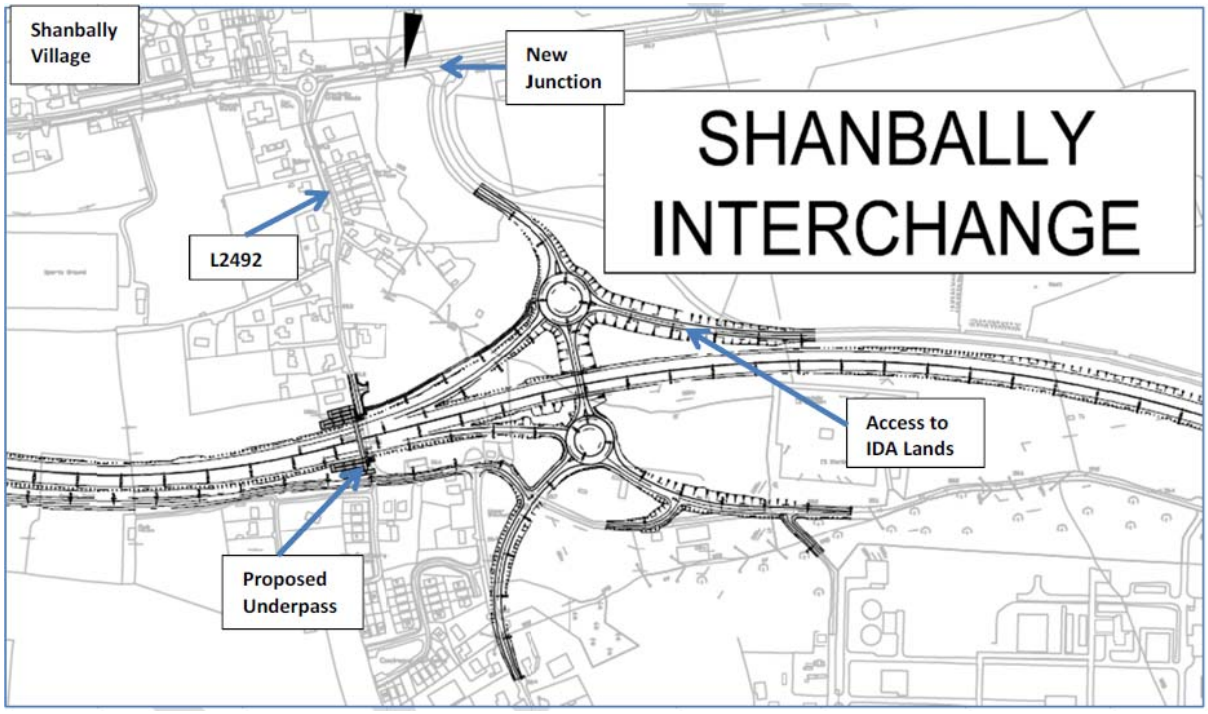
Shanbally village is a settlement predominantly located along the existing N28 and the L2492 local road towards Coolmore Cross. The section of the village located on the L2492 will be bisected by the M28 mainline. Severence of the existing local road L2492 would result in a number of dwellings in Coolmore Close, Coolmore Gardens etc. being isolated from the local school, church, shop etc.

Six alternative arrangements were considered to the south and east of Shanbally village with regard to access arrangements to the village. These options are outlined below.

Option 1 – Grade-Separated Interchange

The proposed layout of a grade-separated interchange (dumbbell arrangement) is shown on **Figure 4.14** below.

Figure 4.14: Grade-Separated Interchange



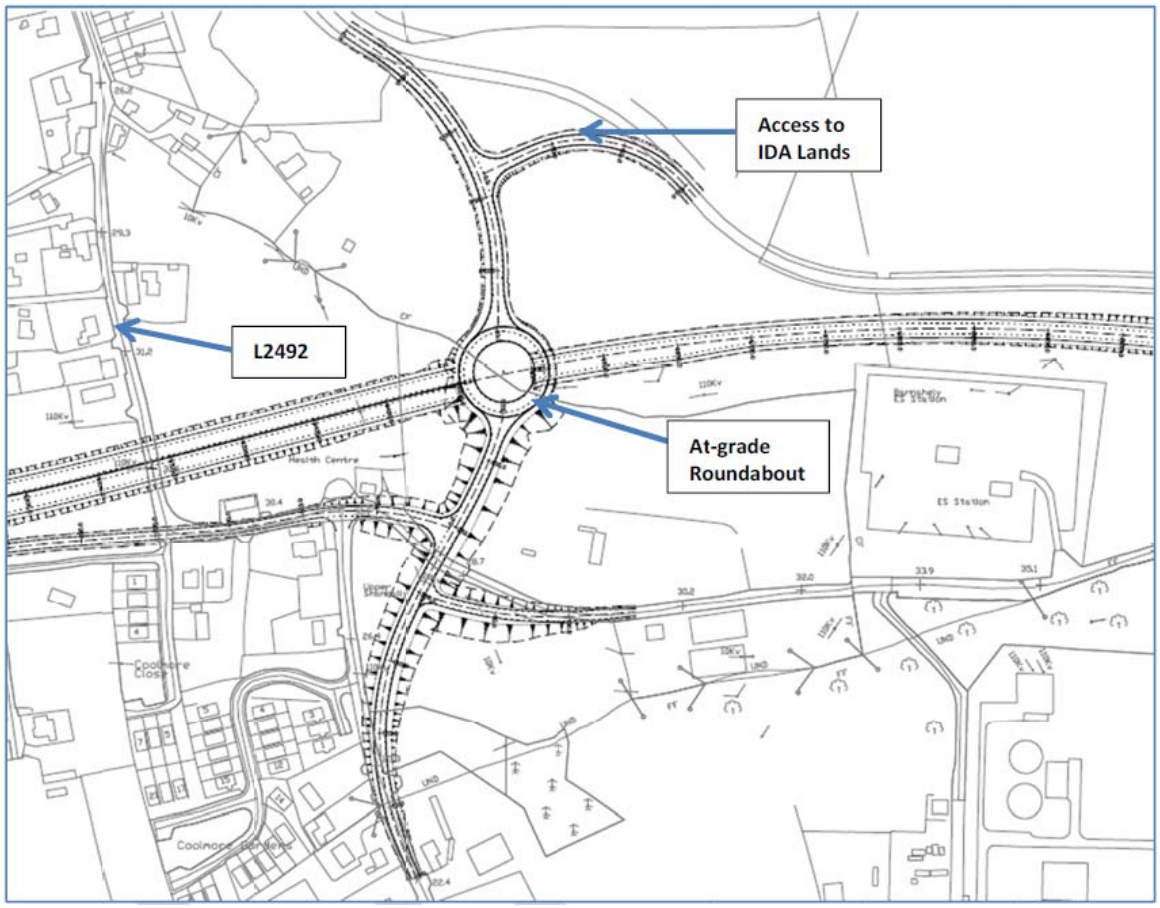
- The interchange consists of:-
  - A westbound merge.
  - An eastbound diverge.
  - 2 no. roundabouts with a link road between them in a dumbbell arrangement.
  - An underbridge which allows mainline M28 traffic to pass over the proposed local road network.
  - Substantial local road realignments to tie-in to the proposed roundabouts, particularly on the south side of the mainline.
- The L2492 will become a cul-de-sac along its current alignment.
- A footbridge or underpass for pedestrians and cyclists is proposed where the L2492 is severed.

- The M28 mainline cross-section has 2 lanes in each direction, the diverge and merge slip roads are single carriageways, designed to appropriate standards.
- A new public road junction will be formed with the existing N28 immediately east of the existing Shanbally Roundabout.
- Disruption to existing services, particularly overhead high voltage ESB and possibly the 1200mm diameter Cork City and Harbour watermain.
- Access to the IDA lands will be provided directly from the northern roundabout.

Option 2 – At-Grade Roundabout

The proposed layout of an at-grade roundabout is indicated on **Figure 4.15** below.

Figure 4.15: At-Grade Roundabout



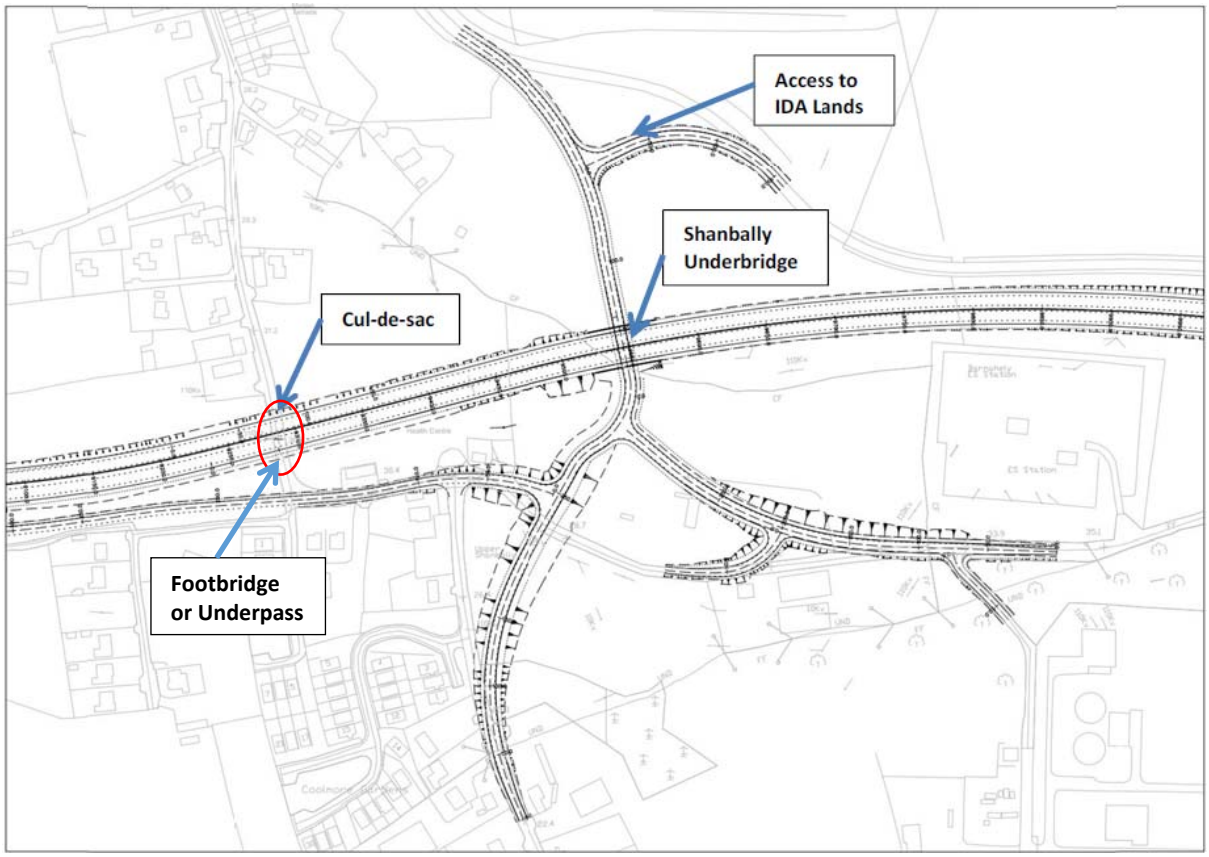
- The at-grade junction consists of:
  - 1 no. roundabout with 4 arms.
  - Tie-ins to the local road network from the proposed roundabout.
- The L2492 will become a cul-de-sac along its current alignment.
- A footbridge or underpass for pedestrians and cyclists is proposed where the L2492 is severed
- The M28 mainline cross-section has 2 lanes in each direction to the west of the roundabout, and a single lane in each direction to the east of the roundabout.

- A new public road junction will be formed with the existing N28 immediately west of the existing Shanbally Roundabout.
- Disruption to existing services, particularly overhead high voltage ESB.
- Access to the IDA lands will be provided immediately north of the proposed roundabout.
- This proposal requires an at-grade roundabout to be constructed on a Motorway, with the potential for increased journey times for motorway traffic having to negotiate the roundabout, particularly at peak times.

Option 3 – Underbridge

The proposed layout of an underbridge is indicated on **Figure 4.16** below.

Figure 4.16: Underbridge



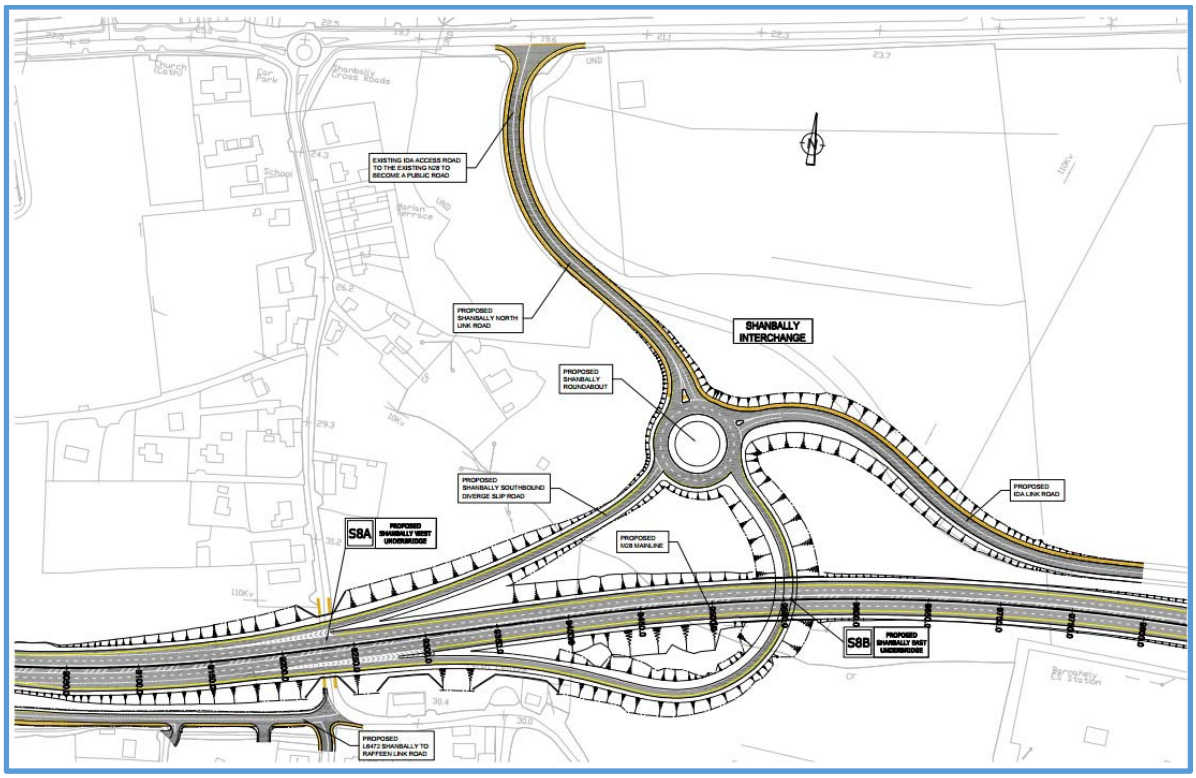
- This proposal consists of:
  - An underbridge to take local traffic from one side of the M28 mainline to the other.
  - Alterations to the local road network to access the underbridge.
- The L2492 will become a cul-de-sac along its current alignment.
- A footbridge or underpass for pedestrians and cyclists is proposed where the L2492 is severed.
- The M28 mainline cross-section has 2 lanes in each direction.
- A new public road junction will be formed with the existing N28 immediately west of the existing Shanbally Roundabout.
- There will be no direct access to (or from) the M28 at this location.

- Disruption to existing services, particularly overhead high voltage ESB.
- Access to the IDA lands will be from the existing N28 and the local road network.

Option 4 – IDA Road/M28 Interchange

This proposal consists of a grade separated interchange between the IDA Road and the M28. The proposed layout is shown in **Figure 4.17** below.

Figure 4.17: IDA Road/M28 Underbridge



This interchange proposal consists of an at-grade roundabout to connect the IDA Road, east and west to the interchange merge and diverge slip roads. Only west-facing slip roads are proposed, to facilitate trips between the M28 and the industrial area north of the existing N28.

In this proposal, the M28 mainline is raised and an additional underbridge is provided to cross over the local road network. Thus, other than the IDA Road (currently a private development road), the layout of the local road network is not affected by this proposal.

A summary of the main aspects of this option includes:-

- Two underbridges:-
  - Shanbally West Underbridge S8a to take the M28 mainline over local road L2492.
  - Shanbally East Underbridge S8b to allow vehicles from the existing N28, Shanbally village, IDA Link Road etc. to merge with the proposed M28 westbound and vice versa.
- Raised mainline through existing service corridor between Shanbally Mews and Marian Terrace. This will increase the visual impact of the proposed road project locally.

- Local road layout is unaffected by the proposal.
- Motorway connection is to the private IDA road only, which will become a public road between the proposed roundabout and the existing N28.
- Disruption to existing services, particularly overhead high voltage ESB.
- Retaining walls are required to avoid acquisition of private property and adverse impact on the existing grotto at Shanbally Mews.
- The westbound merge slip road is designed as a one way loop connector road as per TD 22/06: Layout of Grade-Separated Junctions.

Option 5 – Lane Gain/Drop

This option retains the grade-separated junction at Shanbally as per Option 1, but as a lane-drop / lane-gain junction so that only one lane in each direction continues to Barnahely.

Option 6 – Local Road Severed

In this option, there is no junction at Shanbally with severance of the local road and the M28 continuing as dual-carriageway to Barnahely.

Assessment

Traffic analysis identified transport benefits at least comparable to additional construction costs for the options which include a grade separated interchange at Shanbally (Options 1, 4 and 5). Option 2 has least capacity and network resilience, with the proposed at grade roundabout nearing its capacity at peak times in the design year. Options without a junction at Shanbally (Options 3 and 6) resulted in additional traffic demand on the existing N28 at Shanbally, minimising the traffic relief in the village due to the project. The objective to provide a high quality TEN-T route to the Port is best met with by options which maintain a dual carriageway through a grade separated interchange. Options which sever the village or provide for extended alternative routes would have a significant adverse impact on residents living on the south side of the proposed road project.

Taking into consideration the extent of land required and the potential for conflict with existing utilities and, in particular, the 1,200mm Cork Harbour and City watermain, Option 4 emerged as the preferred grade separated junction option. Option 2, at-grade roundabout also emerged for further consideration.

Options 2 and 4 were brought forward for further environmental assessment where Option 2 emerged as the preferred design. Option 4 was assessed to have greater adverse environmental landscape and visual impact. However, it is an objective of the proposed road project to provide environmental relief to villages along the route and the significant reduction in community severance associated with Option 4 off-sets the negative impacts. Option 4 results in an intact existing local road network while giving all traffic associated with the Port and the Strategic Employment Areas the option of avoiding Shanbally Village entirely.

Recommendation at Shanbally

It was recommended that the grade separated interchange, providing connection to the IDA Road (Option 4), be provided at Shanbally. The particular benefits are:-

- Maintains existing accessibility in the Shanbally area providing a major benefit to the local community;
- Maximises the bypass effect of Shanbally Village;
- Access to IDA lands will be provided at the proposed roundabout, making the site more attractive to potential investors;
- Option 4 avoids the need for another at-grade roundabout on the route and allows the motorway cross-section extend to Barnahely. This is a benefit for the large proportion of HGV traffic expected from the Port development;
- Option 4 avoids need to divert the 1,200mm watermain;
- Option 4 requires less land acquisition compared to Option 1;
- Option 4 provides for greater network resilience than Option 2 as it has greater capacity to cater for future growth;
- The adverse environmental landscape and visual impact is off-set by the significant reduction in community severance; and
- Similar economic return in comparison to Option 1.

4.5.7.8 Old Post Office Road

During the April 2016 public consultation concern was expressed by some members of the community about the option to provide pedestrian access only along the Old Post Office Road. This resulted in the Project Team assessing 11 options which are broadly considered as the following 4 alternative arrangements:-

- Option 1: Close Old Post Office Road to vehicular traffic and provide an underpass/subway for pedestrians and cyclists i.e. the option that was presented at the public consultation in April 2016.
- Option 2: Restricted height underpass along the line of the existing road - 2.5m vertical clearance, 3.5m wide carriageway + 1 no. footway. *Note: A number of alternatives were considered in relation to restricted height access and each Option 2 can be also considered as an alternative pedestrian/cyclist underpass as the width and headroom requirements for both are sufficiently similar.*
- Option 3: Full height underpass - 4.5m vertical clearance, 5m wide carriageway + 1 no. footway. The vertical alignment will need to comply with standards therefore the approaches to the underpass would need to run parallel to the mainline on either side for a suitable distance to achieve the vertical clearance required.
- Option 4: Upgrade local road between Old Post Office Road junction and Loughbeg Road junction - pedestrian underpass to be retained as part of this.

There are a number of existing services in the vicinity of Old Post Office Road. Based on information received from the service providers, the following is a list of the significant utilities that can be found in the vicinity:-

- 300mm GNI Transmission main; and
- High voltage ESB overhead lines (110kV and 38kV).

In addition to the above, there are a number of smaller services located here also, including low and medium voltage ESB and a watermain.

Restricted height vehicular underpasses were eliminated from further consideration due to the operation and maintenance problems associated with such vehicular structures.

Traffic counts were undertaken on the Old Post Office Road on Thursday 16th April 2015 between the hours of 7:00 and 19:00. In the 12-hour period there was a total of 171 no. motor vehicles counted (122 northbound and 49 southbound). This is an average of 14 vehicles per hour over the count period. The peak periods for vehicular trips are between 08.00 and 10.00 and 14.00 to 16.00 broadly coinciding with school drop-off and pick-up times. Over these periods, 105 out of the total of 171 vehicular trips were made.

In the 12-hour period, 222 pedestrian trips were counted. Again, these trips are concentrated around the school drop-off and pick-up periods, with some 163 of the 222 trips recorded during these peaks.

There is greater demand for pedestrian movements than vehicular movements and the demand is predominantly generated by Ringaskiddy Lower Harbour National School. The school is situated along the existing east-west local road (Tower Road) between Loughbeg and Barnahely. This local road is very narrow and does not permit two vehicles to easily pass each other. During school drop-off and pick-up periods, an informal 'one-way' system operates. The system is west to east from the R613 at Barnahely to the school. After leaving the school, traffic decides to use the Old Post Office Road or Loughbeg Road to access Ringaskiddy village. This is reflected by the peak in northbound vehicles on Old Post Office Road in the morning.

The distance to travel from Tower Road to the centre of Ringaskiddy is:-

- Via Old Post Office Road - 560m - all narrow road.
- Via Loughbeg Road - 1,120m - only 330m narrow road.

The Loughbeg Road route is 560m longer but the majority of the longer journey is on higher quality roads.

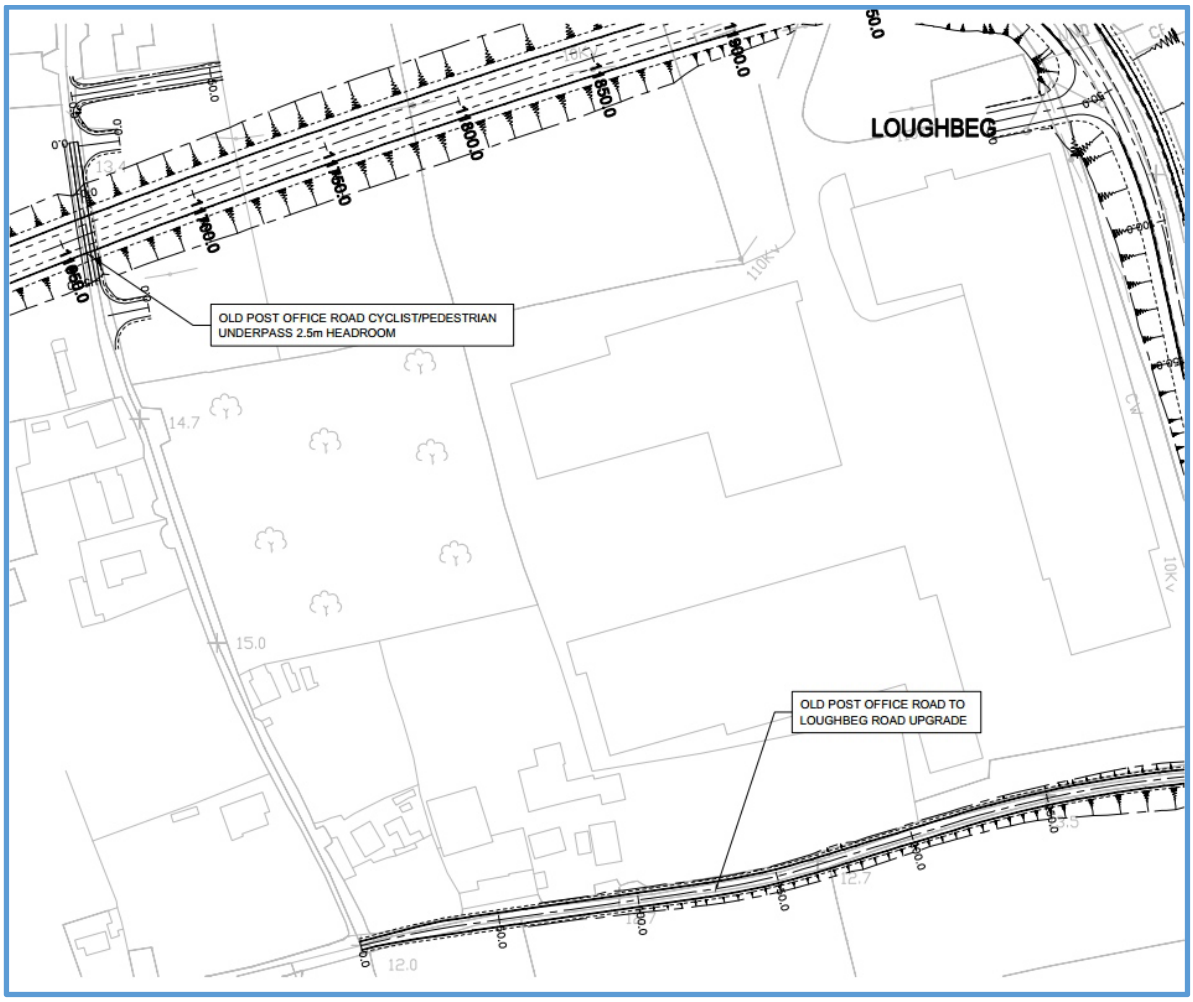
The assessment of the alternatives considered the following:-

- Low vehicular demand;
- Poor condition of existing Tower Road;
- Longer vehicular travel distances;
- Significant pedestrian demand;
- Attractiveness of underpass for use by pedestrians;
- Cost and impact on existing utilities;
- Need to raise the mainline to accommodate an access structure; and
- Land acquisition requirements.

In consideration of the issues outlined above the preferred alternative is Option 4, incorporating the alignment of the underpass contained in Option 2G. This preferred alternative is illustrated in **Figure 4.18**. This option incorporates the following aspects:-

- As vehicular demand is very low and as the alternative vehicular route is at maximum 1km longer, provision for vehicular access in not provided;
- Provision of a pedestrian/cyclist underpass to meet with the existing pedestrian demand. The alignment of the underpass is straight along the line of Old Post Office Road with clear lines of sight through the structure, increasing the attractiveness of the proposal for vulnerable users. This proposal avoids deep underpasses with the on-going need to manage the drainage system. It also avoids excessively curved horizontal alignments with their restricted lines of sight, adding to trepidation with regard to use of the underpass by pedestrians;
- The alignment avoids the need to divert the gas transmission main and the high voltage electricity lines and avoids the need for costly diversions. As such, this option is the underpass option which offers best value for money. Lower voltage ESB lines will however require diversion;
- The proposed realignment of the east-west local road (known locally as Tower Road) between Old Post Office Road and Loughbeg Road is incorporated to mitigate the additional journey distance due to closure of Old Post Office Road to vehicles. A maximum additional travel distance of less than 1km from the severed part of Old Post Office Road to Ringaskiddy village has been assessed, the majority of which will be on higher quality roads when the proposed upgrade is implemented;
- Provision of a pedestrian/cyclist underpass optimises the extent to which the mainline needs to be raised. Nonetheless, the outcome is the need for significant embankment, circa 2.2m to 4m maximum embankment as the road passes St. Carthage Place. The maximum height of the proposed embankment is approximately 5m between Old Post Office Road and Loughbeg Road. This will have a negative visual impact which will require to be mitigated, principally by landscaping with predominantly native species plants and trees. Development of this preferred option will include considerations to mitigate the adverse impact on the visual environment;
- Upgrade of the section of Tower Road is designed to resolve local flooding issues by raising the road over a local low spot on the existing road; and
- The preferred underpass option requires the least amount of land acquisition as it aligns with the existing road. Provision is made for turning heads for vehicles.

Figure 4.18: Preferred Option at Old Post Office Road



4.6 SERVICE AREA

A major element of the proposed road project is the provision of a Service Area (SA) in line with EU Directives and Regulations[2]. This will assist the road safety campaign put forward by the Road Safety Authority and the reduction of driver fatigue and accidents on the national primary road network by providing rest and refreshment facilities. It will also provide facilities for HGV drivers to park up and take their required resting periods.

4.6.1 Service Area Options

The methodology employed in the identification of alternative sites and selection of a preferred site followed four broad steps:-

1. Identification of a study area for provision of facilities based on TII Policy;
2. Identification of suitable stretches within the study area which satisfy broad engineering criteria;

[2] EU Directive 2006/22/EC on Road Transport Activities and Chapter II of the EU Regulations 561/2006.

3. Desktop review and windshield survey of environmental constraints within each possible alternative site;
4. Assessment of the alternative sites put forward; and
5. Identification of preferred site.

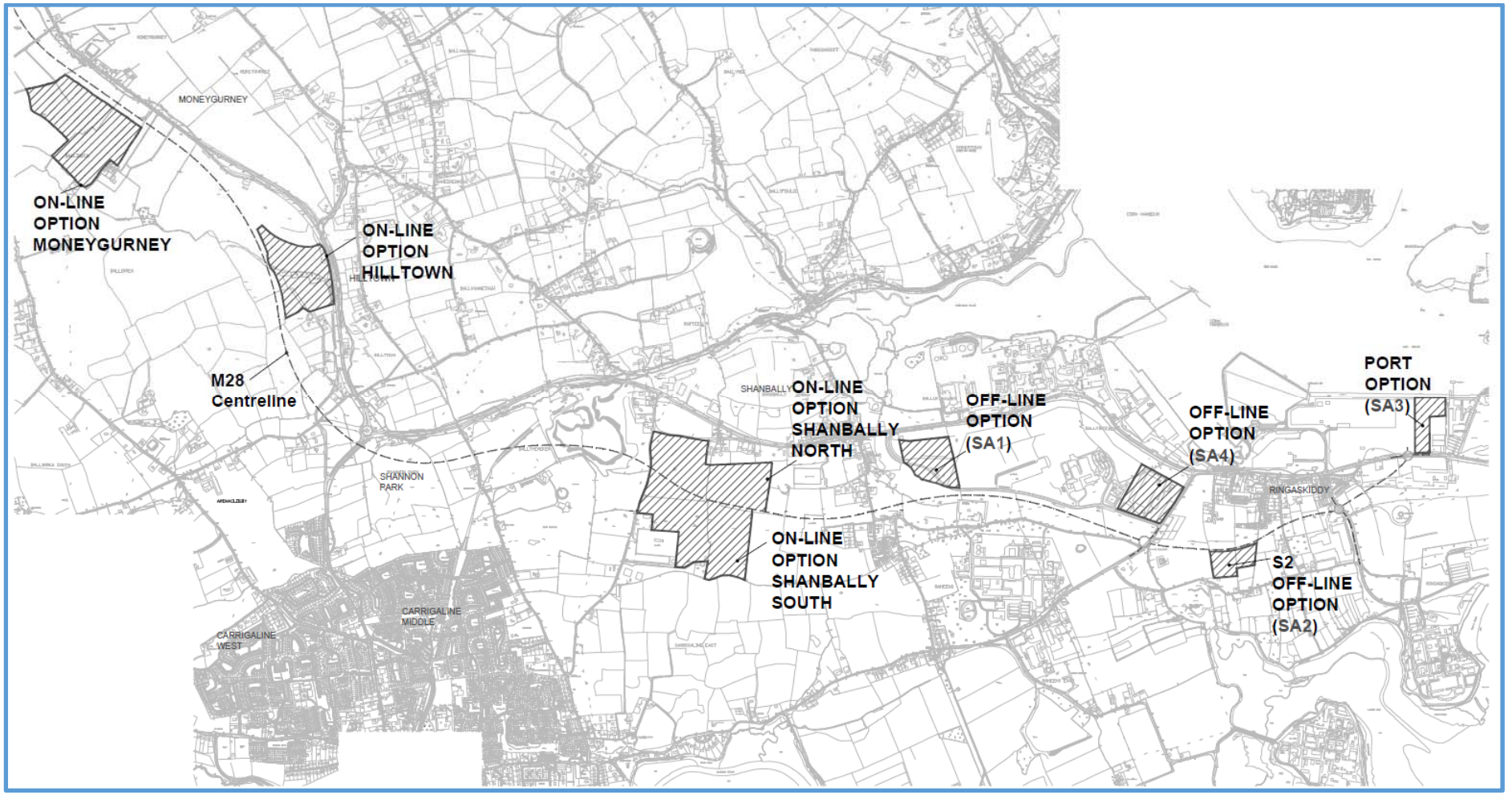
This option assessment considered different alternative approaches to facilitating the Service Area including a Do-Nothing/Do-Minimum approach by utilising an existing Maxol Station at Hilltown; on-line options along the existing N28 route to the west of the proposed road project and service area sites to the east of the proposed project close to Ringaskiddy Village and the Port.

4.6.2 Identification of Sites

The site selection process identified three categories of constraints – natural (including environmental), physical and engineering which, along with a high level consideration of planning guidelines and TII policy, identified seven sites (**Figure 4.19**).

The environmental criteria avoid proximity to houses, woodland, protective features (including designated sites, cultural heritage features and particular land holdings (dwellings & farms).

Figure 4.19: Site Options for Proposed Service Area



TII's advice note TA 90; *The Location and Layout of National Road Service Areas* identifies a number of criteria for consideration when siting on-line SAs. These include:-

- Road category type;
- Quality of site;
- Projected AADT;
- Potential for environmental impacts;
- Projected % HGVs;
- Road geometry;
- Spacing to adjacent on-line service areas or locally available amenities;
- Land requirements;
- Availability of services/utilities;
- Availability of local staff; and
- Physical characteristics of the site.

These broad criteria were taken into account in assessing alternative possible locations for the proposed Service Area. Once a broad study area was identified based on policy and constraints, possible site locations within the study area were determined based on broad engineering criteria. These criteria include:-

- Geometric design standards;
- Location of existing structures;
- Sufficient land area for the provision of slip lanes and service area;
- Constraints associated with staff access roads;
- Constraints relating to the existing topography; and
- Existing services and utilities.

These sites included both on-line and off-line options in line with TII policy. However preference to off-line sites emerged after the on-line options failed to comply with *Spatial Planning and National Roads Guidelines* as they could become a destination for local customers. It is contrary to government planning policy to permit a Service Area to become a destination for local customers (*Retail Planning Guidelines*, Department of the Environment, Community and Local Government, 2012). An off-line or at-grade site would best avoid weaving and junction overlap issues, which is important when considering the length of the M28 and the frequency of proposed grade-separated service junctions.

Further assessment of the seven sites, which included site visits as well as desktop surveys dismissed three sites and saw the eventual emergence of four remaining sites which offered the best engineering and environmental benefits. These four sites outlined in **Table 4.6** below and on **Figure 4.20**, are the SA1 Off-line Option, the SA2 On-line Option, the Port Option and the Barnahely Option. The locations of these sites are shown in **Figure 4.20**.

Table 4.6: Service Area Options

Site Option	Location	Reference
Off Line Option	Shanbally Junction	**SA1**
On-line Option	Loughbeg	**SA2**
Port Option	Port of Cork Ringaskiddy	**SA3**
Barnahely Option	Barnahely	**SA4**

4.6.3 The Off Line Option (SA1)

The off-line option (SA1) is located in IDA Industrial/Enterprise land directly north of the proposed Shanbally Junction. The site is bisected by a surfaced private road and also has palisade fencing which cuts off a section to the east which has a large wind turbine supplying power to the nearby Janssen Biologics Ireland plant. The rest of the neighbouring land is agricultural in nature. The slope of the land at SA1 is at a fall of 10m for the proposed area and is serviced by the already mentioned road, associated drainage, footpath and street lighting. Some previous landscaping was carried out which consists of tree planting as well as wooden post and rail fencing bordering the roadway. Much of this is now overgrown however as is evident from gorse growing sporadically throughout the site, as well as mosses and algae on the road and pavements.

The closest dwellings are c.75m to the west of the site at Marian Terrace, and the Raffeen Creek Sports Centre is located immediately north of the existing N28, north of the site. There are views to the west of the site of Shanbally Village, in particular of the primary school, church and Shamrock GAA grounds. The site is traversed with pylons and associated electricity infrastructure running in a north-east to south-west orientation.

4.6.4 The On-Line Option (SA2)

The on-line option (SA2) is located on IDA Industrial/Enterprise land directly south of the M28 Barnahely - Loughbeg Link Road and has commanding views of both the waterfront, as well as the nearby ruins of Castle Warren.

The site, located 115m north of Ringaskiddy Lower Harbour National School is currently in use as agricultural land surrounded by hedges. The site is partially flat, with a steep gradient to the south towards Loughbeg. Land uses bordering the site involve agriculture with arable crops to the west and dairy pastures to the east, there is also a small well to the south-west of the site which carries water across the road to Lough Beg.

Access is available via a laneway located between two ruined houses, off a narrow by-road known as the School Road. Immediately to the north of the site lies St. Carthage Place, a terrace of residential dwellings, c.75m from the site boundary. There are also a number of dwellings and farmyards to the east of the site. A graveyard is located to the north-west of the site, between agricultural land and the R613.

A number of pylons carrying high voltage electricity run immediately north of the site in an east-west orientation.

4.6.5 The Port Option (SA3)

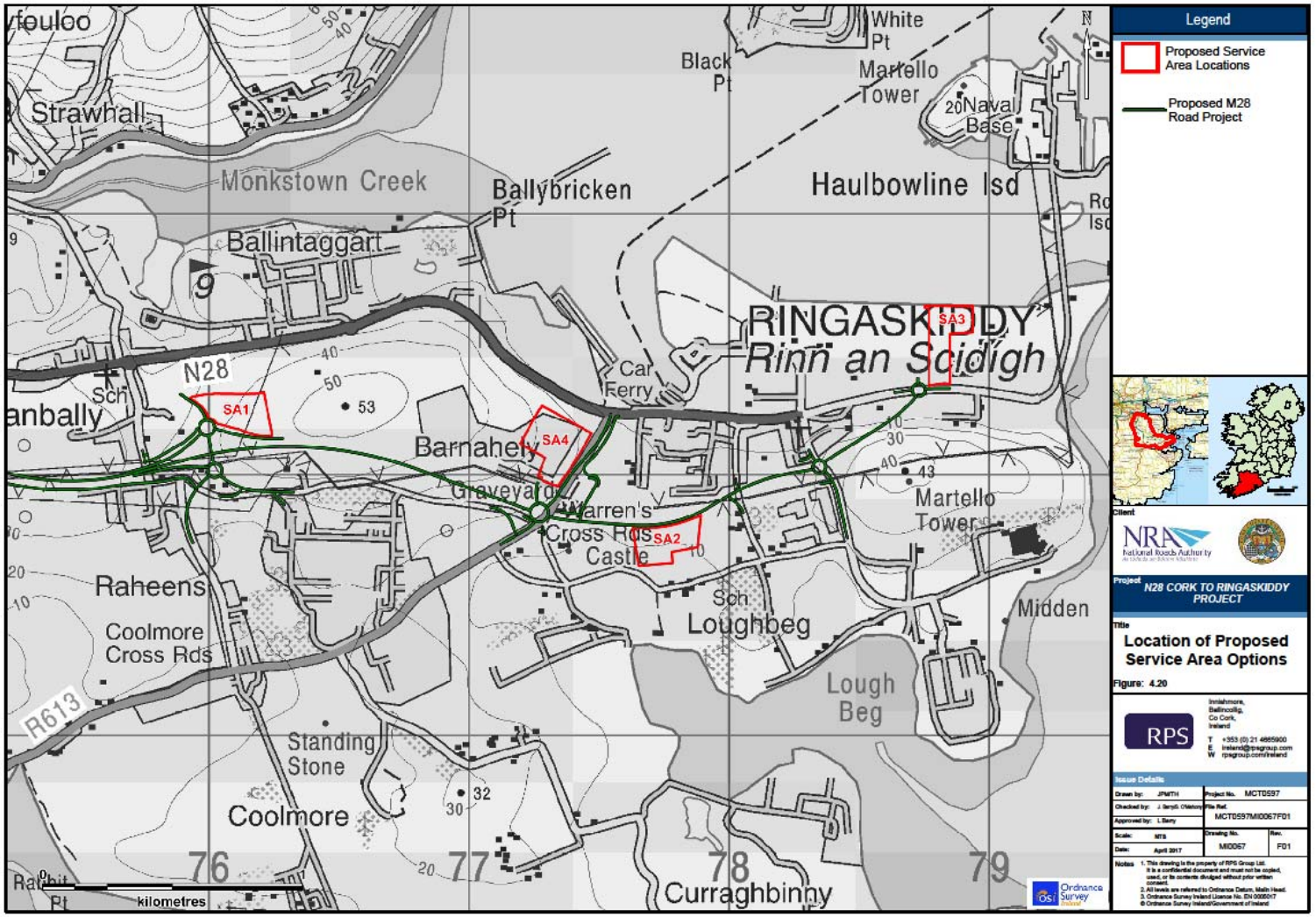
SA3 is located in the Port area, east of Ringaskiddy Village and currently in use as a holding area for imported vehicles before distribution. The site is adjacent to the Port of Cork ferry terminal to the west with a parcel of scrubland/vegetation to the east and the existing N28 immediately to the south.

The site is flat with some screening available from existing vegetation on the site boundary with the M28. Wire mesh fencing is currently surrounding the site. The western and eastern boundaries comprise of palisade fencing where the site meets the adjoining National Vehicle Distribution lands to the west, along with the National Maritime College of Ireland (NMCI) campus and the disused Ringaskiddy Logistics Centre to the east. The northern boundary slopes down to the shoreline of Cork Harbour.

There are eight houses, which form part of the Martello Park Estate, facing the site on the opposite side of the N28, as well as a number of detached houses and the Ringaskiddy Oratory. The closest residential dwelling to the site, Ring House, is listed on the National Inventory of Architectural Heritage (NIAH) and lies approximately 200m to the south-east on the opposite side of the L2545. This appears to be currently unoccupied, although habitable.

This L-shaped site currently has no vehicular access points. There is currently informal pedestrian access available at the southern boundary of the site with the L2545. From here a track runs through the site to the north-west corner and joins a public amenity walkway on the waterfront. The nearby Martello Tower is visible from the site, located 350m to the south. The settlements of Cobh and Monkstown can be seen in the distance from the subject site to the north and north-west respectively.

Figure 4.20: Location of Proposed Service Area Options



4.6.6 The Barnahely Option (SA4)

SA4 is located in the townland of Barnahely, to the south of the existing N28 and west of the R613. The site is c. 4ha in size and is currently in use as a warehousing and logistics facility (Primeline) with a large warehousing building located within the centre of the site. The site is flat with a boundary wall running along its perimeter; it is accessed from a link road off the R613.

Within the site land use surrounding the building comprise of hard surfaced areas including car parking and access road with some landscaped pockets of grassed areas, low level shrubbery and tree planting along the perimeter of the site. A large water reservoir lies within the north-eastern corner of the site.

Immediately outside of the site boundary to the north and east lies a parcel of what appears to be un-managed mature vegetated/scrub land. A line of mature trees are present at the northern boundary of this parcel of land where the area meets the N28. To the west of the site lies mature scrub which is contained within the Janssen Biologics site.

The external eastern boundary of the site with the R613 comprises an old stone wall and the southern external boundary comprises a newer stone wall. Access to the site is to the south of the site via a private road which also leads to Janssen Biologics and comprises of a barrier controlled gate.

Janssen Biologics is located to the west of the site, Barnahely graveyard and Castle Warren are located to the east of the site across the R613 and lands to the south comprise of a large greenfield site which contains a number of overhead power lines.

4.6.7 Do-Nothing/Do-Minimum Approach

In addition to the provision of a new Service Area facility, consideration was given to an alternative option of utilising the existing Maxol filling station at Hilltown. This service station connects directly onto the existing N28 and has no right turn facility into the site. The facilities currently comprises of a:-

- MACE convenience store (240m²);
- LV forecourt;
- HGV parking area (5 units);
- Car wash facility; and
- ATM.

4.6.8 The Preferred Option

The criteria used in the comparative assessment were:-

- Engineering:-
  - Geometry;
  - Proximity of Junction;

- Utility and
- Hydraulics/Hydrology.

- Human Environment:-
  - Landscape and Visual;
  - Archaeology, Architecture and Cultural Heritage; and
  - Socio-Economic and Community.

- Natural Environment:-
  - Ecology;
  - Water Quality and Fisheries;
  - Soils and Geology; and
  - Hydrology and Hydrogeology.

The site which emerged as the most suitable for the proposed Service Area was the Port Option (SA3) as outlined in **Table 4.7** below. This site complies with TII policy for the provision of services for vehicles travelling long distances, as well as avoiding short, local trips as its location within the Port will primarily serve those travelling to and from the Port of Cork itself. This option reinforces the requirements of planning guidelines which require a Service Area for those travelling long distances on inter-regional routes. As the M28 is part of the TEN-T network, which aims to improve accessibility and connectivity between the Port at Ringaskiddy and our core road network, the SA3 site best serves the needs of those utilising these major European routes.

Table 4.7: Engineering and Environmental Assessment Matrix

Site Option Reference	Engineering	Environmental	Total Score
SA1	(14) Low Preference	(21) Medium Preference 2	(35) Low Preference
SA2	(22) Medium Preference - 1	(15) Least Preferred	(37) Low Preference
SA3	(27) Preferred	(21) Medium Preference 1	(48) Preferred
SA4	(18) Medium Preference - 2	(24) Preferred	(42) Medium Preference

***Outcome of Site Selection**: The preferred site based on planning, policy, engineering and environmental criterion is site option SA3.*

5 TRAFFIC AND TRANSPORTATION

5.1 INTRODUCTION

This chapter of the EIS assesses the impact of the proposed M28 Road Project in terms of traffic flows and journey times along the new preferred alignment, the existing N28 corridor and key links and junctions on the adjacent local road network. It includes a comprehensive description of the transportation characteristics of the receiving environment including the existing N28 route and key sensitive locations in the local road network.

5.2 ASSESSMENT METHODOLOGY

The traffic and transportation assessment has been undertaken having regard to the National Roads Authority's (NRA) document "*Traffic and Transport Impact Assessment Guidelines*", May 2014 and Institution of Highways and Transportation's (IHT) document, "*Guidelines for Traffic Impact Assessment*", September 1994.

Traffic modelling work was undertaken to forecast road traffic conditions with and without the proposed road project. These traffic forecasts were used as part of the assessment of air quality impacts (**Chapter 13**), noise assessments (**Chapter 14**) and community severance impacts (**Chapter 7**) in this EIS.

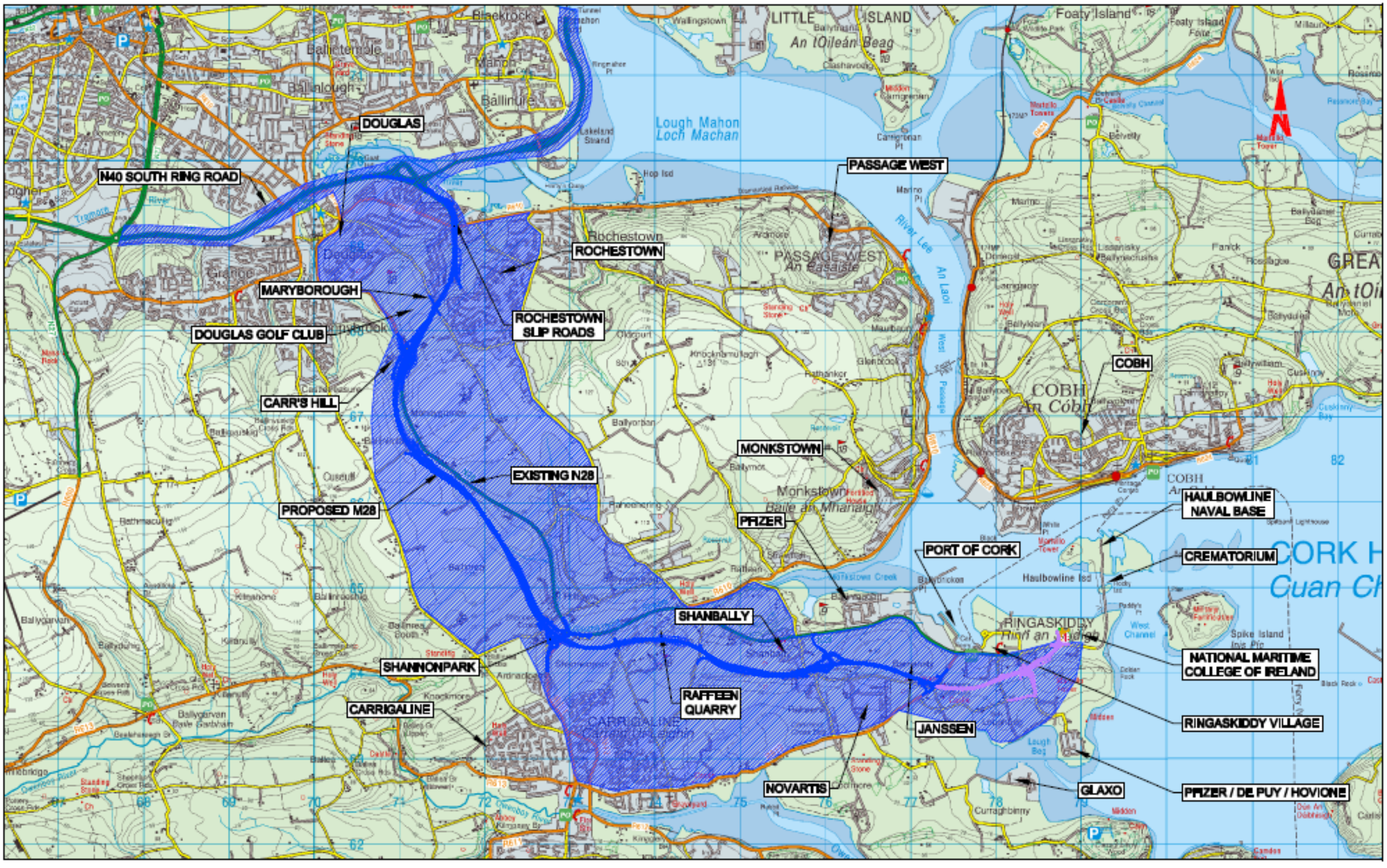
Section 5.9 addresses the impacts of the proposed M28 Road Project for sustainable transport modes.

5.2.1 Assessment Area

The proposed assessment area primarily incorporates the existing N28 route, the N40 (between Kinsale Road Roundabout and the Jack Lynch Tunnel, the proposed M28 alignment and includes a number of key Regional Roads (R609, R610, R611 and R613), which link the existing N28 to urban areas such as Douglas and Carrigaline, and to the employment area south of Ringaskiddy. In addition, the assessment area includes a number of local roads which are located in close proximity to the N28 which are used as alternative routes linking Carrigaline to Douglas.

The full traffic model developed for the M28 road project covers the south-east quadrant of Cork City, Carrigaline and the Ringaskiddy peninsula, and the routes within this area. The traffic model shows that although there will be some changes in traffic flows across the broader study area, the predominant traffic impacts will occur on the routes described above and shown indicatively in **Figure 5.1.**

Figure 5.1: M28 Cork to Ringaskiddy Road Project– Traffic Impact Assessment Area



5.3 TRAFFIC MODELLING

The traffic figures presented here are taken from the Design Stage traffic model, which was developed using the SATURN software. The network and matrices were developed from those used in the N40 Demand Management Study (N40DMS), with greater detail added in the N28 corridor. The model was calibrated to traffic counts and journey time data collected in April 2014, plus data from the N40DMS, plus traffic counts from earlier studies. **Table 5.1** summarises the available data.

Table 5.1: Summary of Available Existing Traffic Survey Data

Source	Date	Automatic Traffic Counters (ATCs) in Study Area	Junction Traffic Counts (JTCs) in Study Area
Douglas Land Use and Transportation Strategy for Cork Co. Co.	April 2012	14 sites	19 sites
N40 Demand Mgmt Study for Transport Infrastructure Ireland (TII)	Nov/Dec 2013	8 sites	24 sites
Port of Cork Company Surveys	2011-2012	11 sites	-
Carrigaline Area Transportation Study for Cork Co. Co.	2007	7 sites	8 sites
TII permanent counters	March 2013 Onward	7 sites	-

Forecast levels of traffic growth in the study area were taken from a pre-publication version of the 2015 Project Appraisal Guidelines (PAG) forecasts, supplied by the TII Strategic Planning Unit. Forecast growth in traffic to and from external zones was taken from the N40DMS model, which used the same set of traffic growth inputs. Future traffic growth was distributed locally taking account of the Carrigaline Electoral Area Local Area Plan and land use planning for residential development and industry development in in the area.

For assessment purposes the study assumed a scheme Opening Year of 2020 with a corresponding Design Year of 2035. In accordance with TII standard forecasting methods, three growth scenarios are used – Low, Medium and High, developed in accordance with TII PAG Guidelines. **Table 5.2** shows the overall growth in demand for highway travel over the study area under the various growth scenarios. As outlined above, this growth was distributed across the study area using the Carrigaline Electoral Area Local Area Plan to guide this process.

Table 5.2: Forecast Growth in Travel Demand (Relative to Base Year 2014)

Growth Scenario	2020	2035
Low	7.3%	17.7%
Medium	9.9%	26.0%
High	11.2%	29.8%

Part of the study area including the N40 and northern parts of the N28 corridor regularly experience peak hour congestion and high demand traffic flows. In addition, the traffic patterns are complex due to the city centre, Little Island and Ringaskiddy employment zones attracting traffic in the morning and vice versa in the evening peak. Thus employment related trips are in both directions on the N40 and the N28 in the morning, with this trend reversed in the evening peak. Typically these travel demands are high and therefore the peak traffic flows spread beyond the normally observed 1 hour peak. In order to assess this particularly important feature of traffic flow within the study area, the traffic model comprises average weekday peak hours (3 morning peak hours, 07.00 to 08.00, 08.00 to 09.00 and 09.00 to 10.00 and 3 evening peak hours, 16.00 to 17.00, 17.00 to 18.00 and 18.00 to 19.00 individually modelled) together with average weekday interpeak hours. For presentation purposes, Annual Average Daily Traffic (AADT) is estimated by multiplying the 12-hour weekday flow (summing modelled hours) by a factor of 1.129 (calculated from the TII permanent counter at Carr's Hill).

For the purpose of assessment (noise and air quality assessments) and subsequent mitigation, high growth traffic forecasts were used, this is a conservative approach to ensure sufficient levels of mitigation are adopted. However, in this section for the purposes of assessing traffic growth in the area and its impact on the proposed and existing local road network, the medium traffic growth forecast scenario has been used.

5.4 RECEIVING ENVIRONMENT

5.4.1 Existing Road Network

The existing N28 is characterised by a range of road types and qualities, reflecting the incremental improvement of the road over time. The road has a short section of dual carriageway at Bloomfield Interchange but is single carriageway for most of its length, with limited hard shoulder and overtaking opportunities. The horizontal and vertical geometry is sub-standard in many places and the cross-section varies along its length. The junction types and layouts also vary and are sub-standard in some cases. A description of the existing conditions on the N28 is provided in **Chapter 1: Introduction and Need for the Proposed Road Development** and **Chapter 3: Description of Proposed Road Development** of this EIS.

5.4.2 Overview of Existing Traffic Demand

The existing road network receiving environment experiences high peak hour travel demand. The N40, northern sections of the N28 as well as other N28 bottlenecks, such as the Shannonpark roundabout and the Shanbally roundabout regularly experience peak hour delay and congestion. As a result of the high travel demand, the morning and evening peaks extend well beyond the normally observed one hour peak.

Base year AADT traffic flows at key locations in the study area are shown in **Figure 5.2**. Traffic flow on the N40 is very high, with AADTs estimated at 50,470 between Bloomfield and Mahon Interchange and 60,913 between the Douglas Slips and Kinsale Road Interchange. **Figure 5.2** also shows very high levels of flow (>20,000 vehicles per day) on single-carriageway sections of the N28 together with high flows on the R610 Rochestown Road and the R611 to Carrigaline.

Traffic congestion at key junctions in the local area typically occurs in the Douglas area, at Shannonpark outside of Carrigaline and at the mini roundabout in Shanbally. Key junctions in the Douglas area include the N28/R610 Rochestown Road Interchange (both the existing roundabout (St. Patrick's Church Roundabout) and right-turn priority junction) and the 'Fingerpost Roundabout' in Douglas.

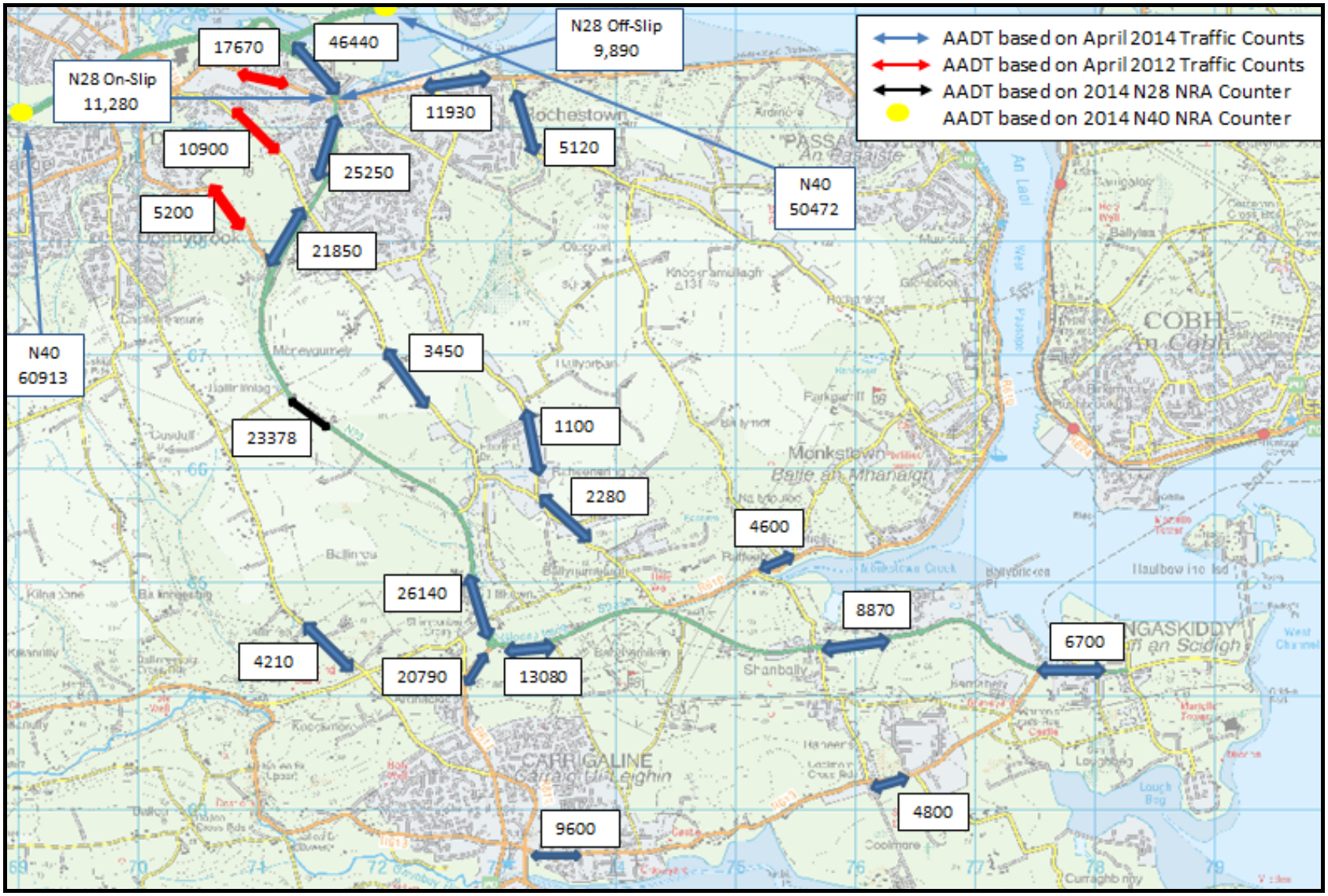
The existing traffic flows demonstrate that the heaviest flows occur on the N28, north of Shannonpark where flows range between 21,850 and 26,140 vehicles per day. At Bloomfield the traffic volumes increase to 46,440 vehicles per day as the traffic from Rochestown Road links to the N28.

Important local distributor roads in the area include Rochestown Road (R610), Maryborough Hill, R609 to Carr's Hill, R611 from Carrigaline and R613 which links Carrigaline to Ringaskiddy.

The N28 corridor also frequently experiences northbound peak hour delays with traffic often backing up from the N40 as far as Carr's Hill in the morning peak period. Northbound delays on the N28 corridor typically arise from problems with merging traffic from Rochestown Road meeting N28 traffic and from problems with merging traffic from Maryborough Hill meeting N28 traffic. Delays also frequently occur at the existing roundabouts at Shannonpark and Shanbally.

Traffic flows on the existing N28 between Shannonpark and Ringaskiddy are lower with AADTs estimated between 6,700 and 13,080 vehicles per day.

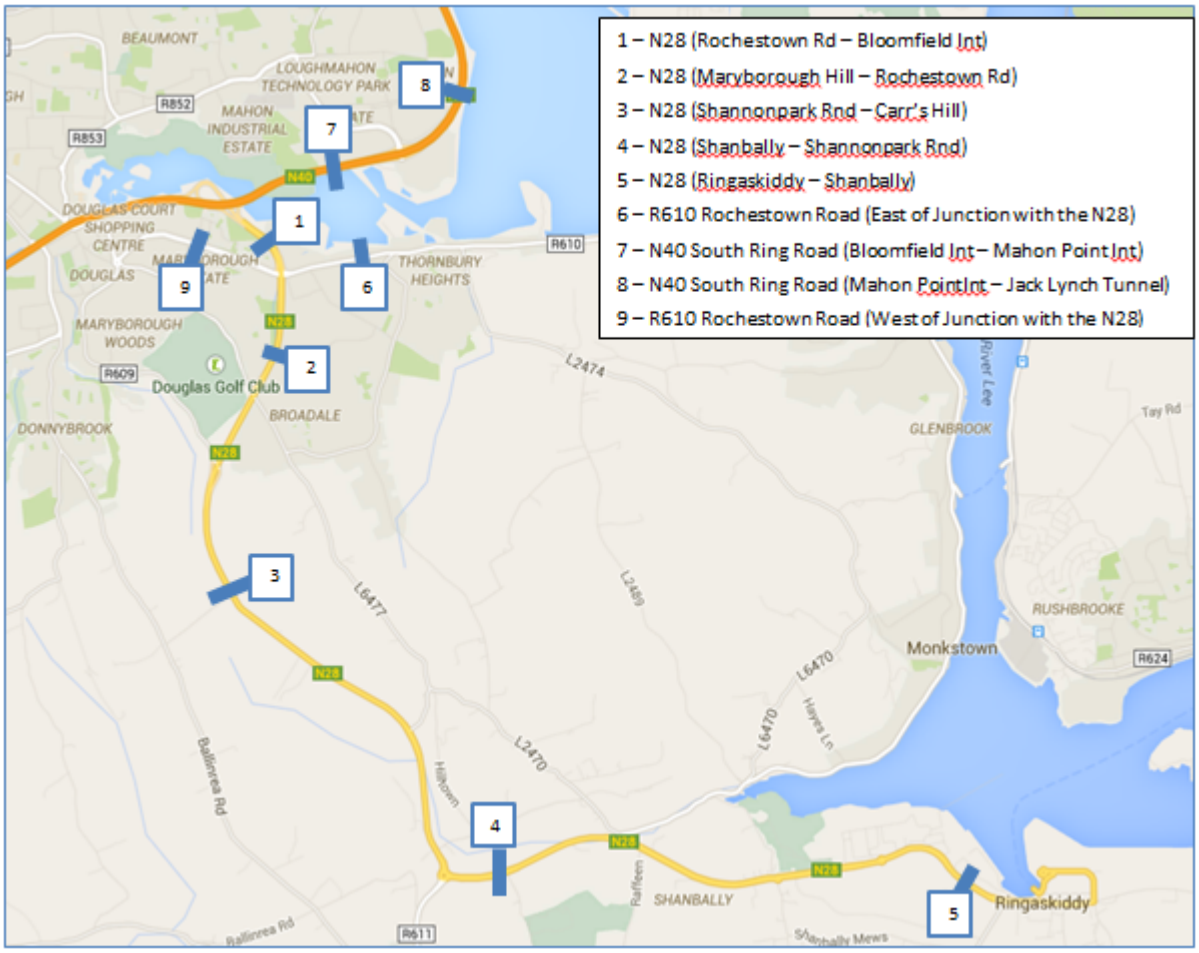
Figure 5.2: Existing Roads - AADT



5.4.3 Weekly and Daily Traffic Flow Profiles

An extensive set of link flow traffic count data is available from Automatic Traffic Counters (November 2011 and April/May 2012) on key sections of the existing N28 and on the R610 Rochestown Road. In addition, the TII currently has permanent traffic counters located on the N40 South Ring Road and the N28 at Carr's Hill. This data provides information on the profile and composition of traffic flow in the area. The locations of the link flow traffic counters used are shown in **Figure 5.3** below.

Figure 5.3: Daily Traffic Flow Counters



The link flow traffic counters at the above locations recorded the volume and composition of vehicles on a daily basis. This data is utilized to illustrate a profile of traffic flow over a seven day period at each of the locations and then establish the peak day for traffic flow across the existing road network. Since the traffic flow pattern on Mondays and Fridays can be inconsistent with the standard patterns throughout the rest of the week, it was considered prudent to evaluate in detail the traffic flows from Tuesday through to Thursday (but still take cognisance of the flows on Monday and Fridays) to establish a typical weekly pattern.

An appraisal of the traffic flow during the peak day provides a detailed hourly profile of traffic at each location, which is fundamental baseline data for establishing the peak periods for traffic movement throughout the day. The daily traffic profiles at each of the specified locations on the N28, N40 South Ring Road and R610 Rochestown Road are shown in **Figures 5.4 – 5.12**.

Figure 5.4: Daily Traffic Profile – N28 (Rochestown Road – Bloomfield Interchange)

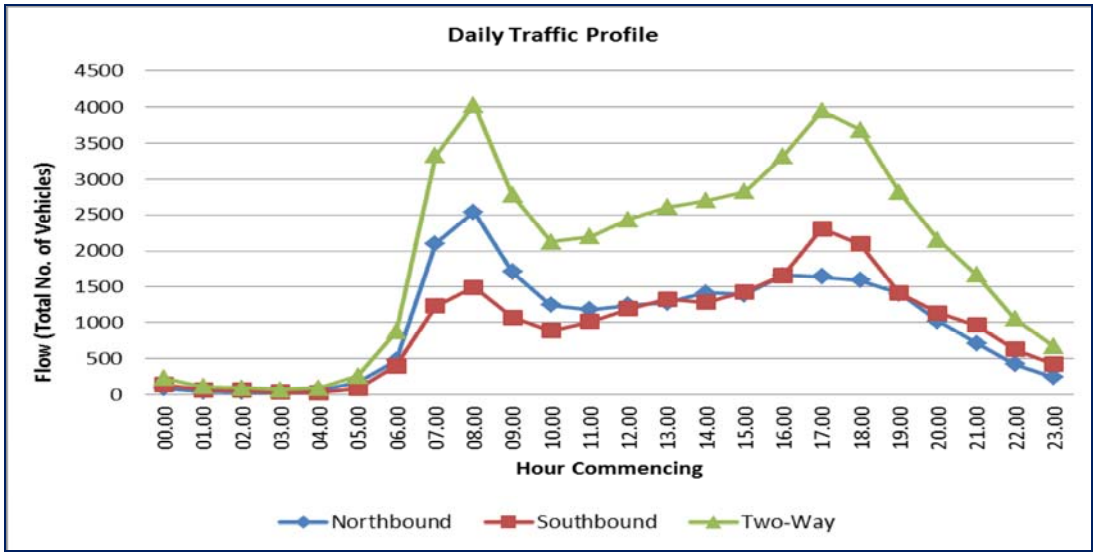


Figure 5.5: Daily Traffic Profile – N28 (Maryborough Hill – Rochestown Road)

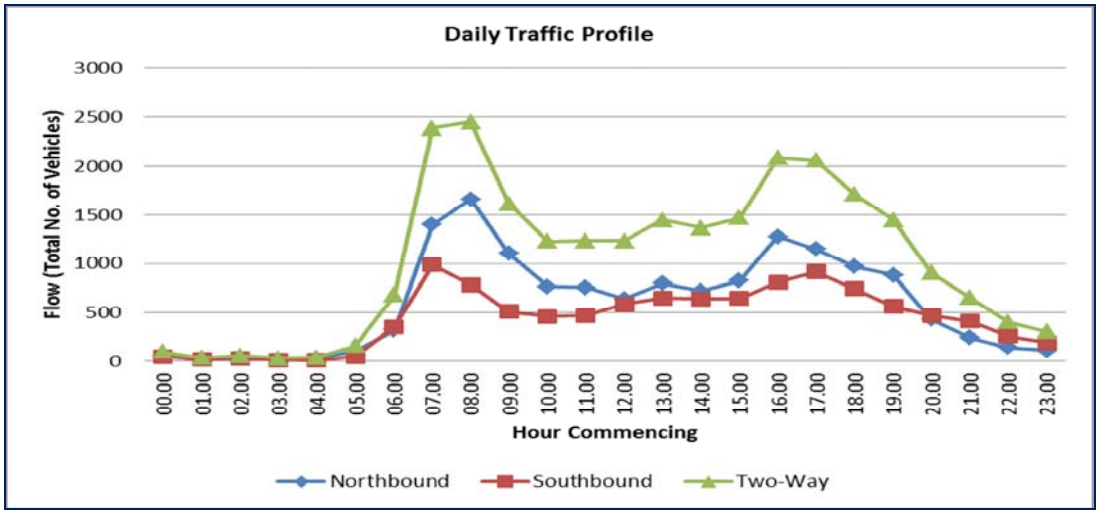


Figure 5.6: Daily Traffic Profile – N28 (Shannonpark Roundabout – Carr's Hill)

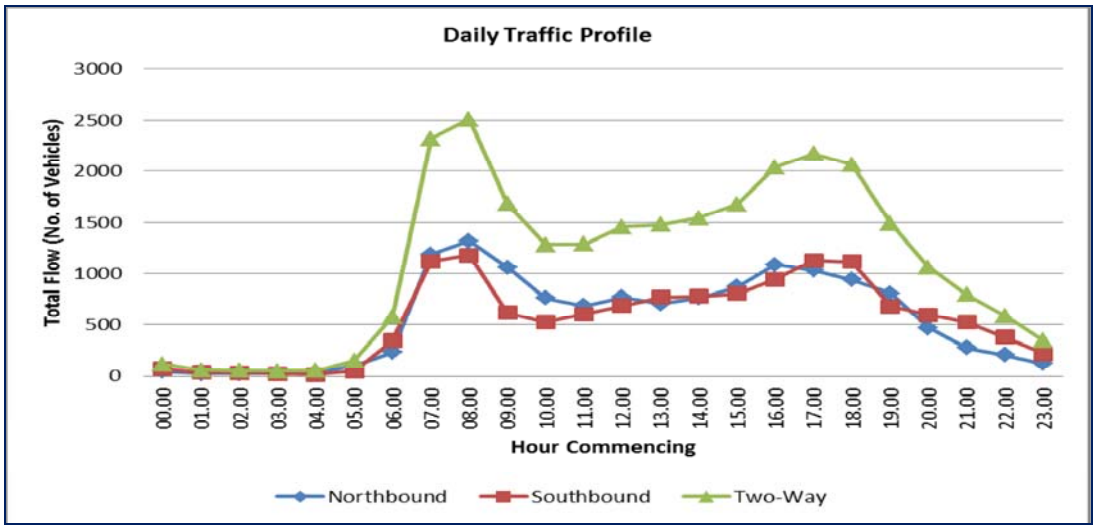


Figure 5.7: Daily Traffic Profile – N28 (Shanbally – Shannonpark Roundabout)

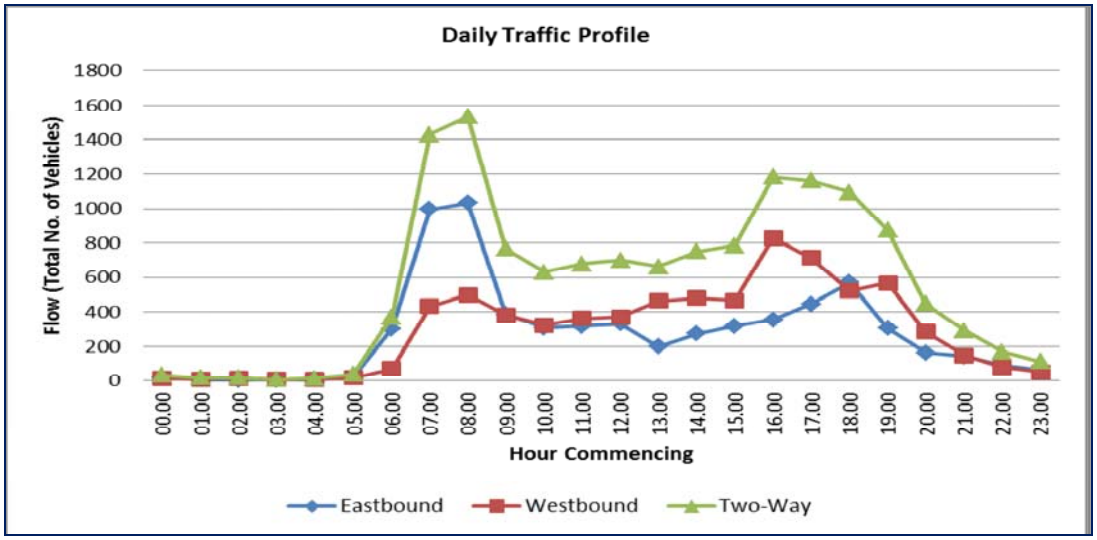


Figure 5.8: Daily Traffic Profile – N28 (Ringaskiddy - Shanbally)

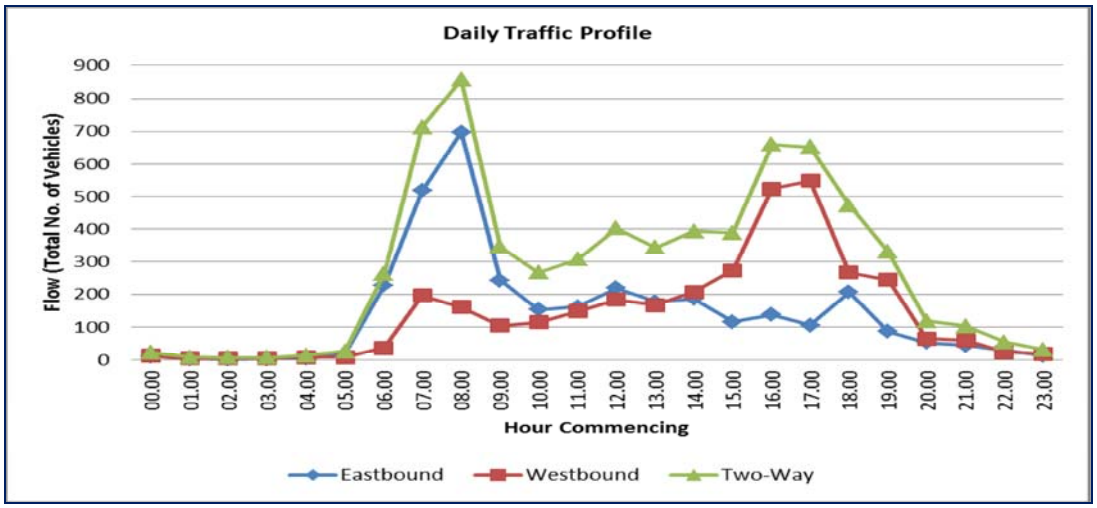


Figure 5.9: Daily Traffic Profile - R610 Rochestown Road (East of Junction with the N28)

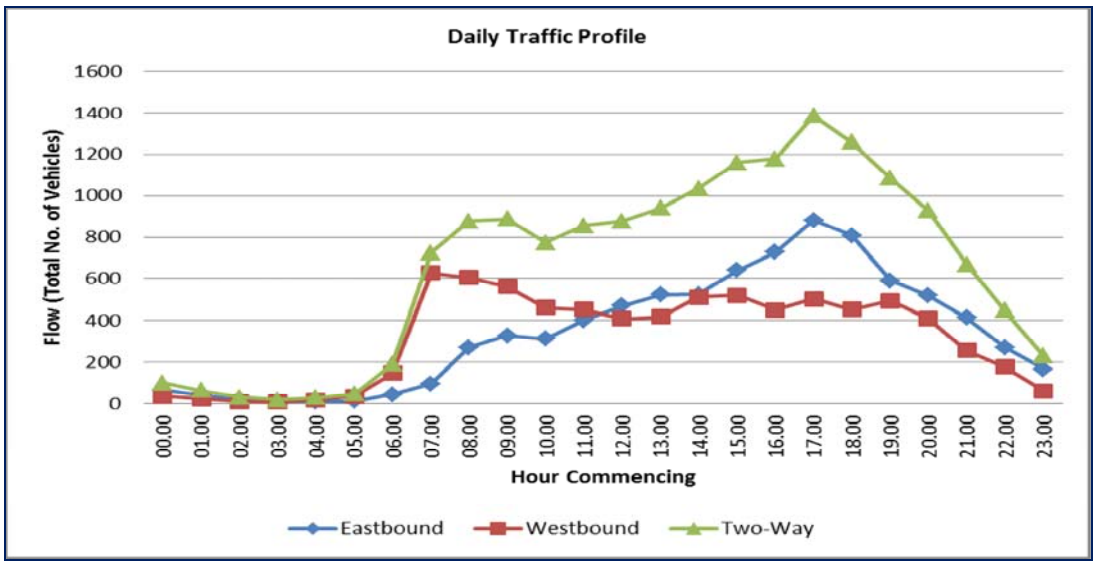


Figure 5.10: Daily Traffic Profile - N40 South Ring Road (Bloomfield Int. – Mahon Int.)

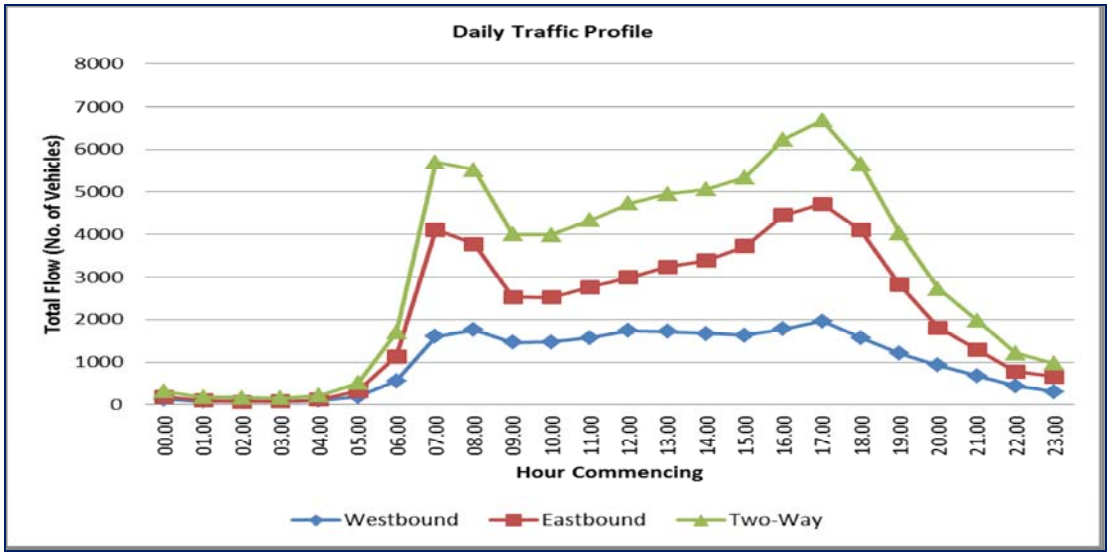


Figure 5.11: Daily Traffic Profile - N40 South Ring Road (Mahon Int. – Jack Lynch Tunnel)

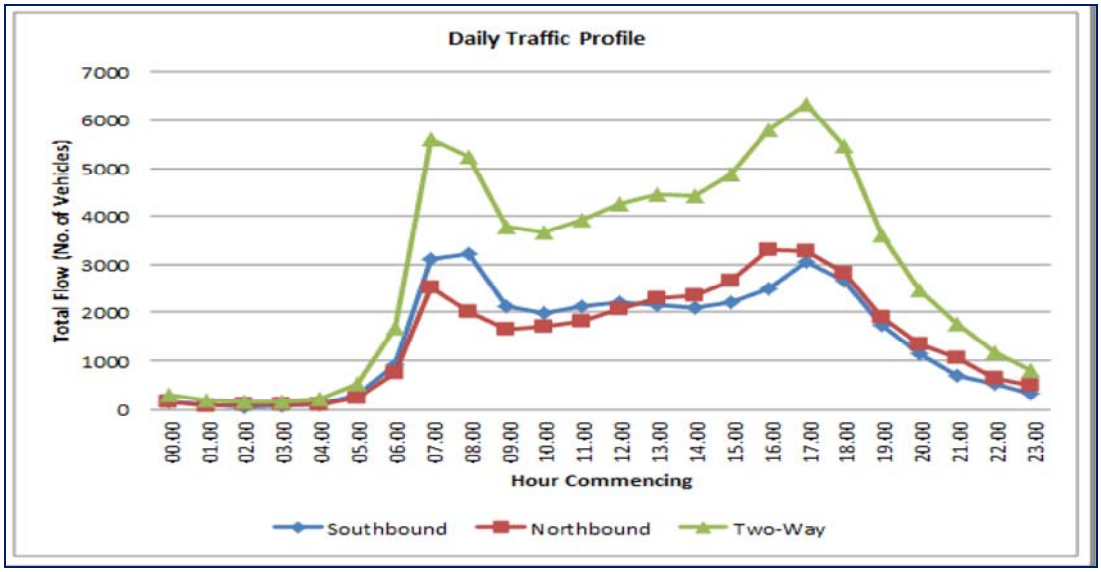
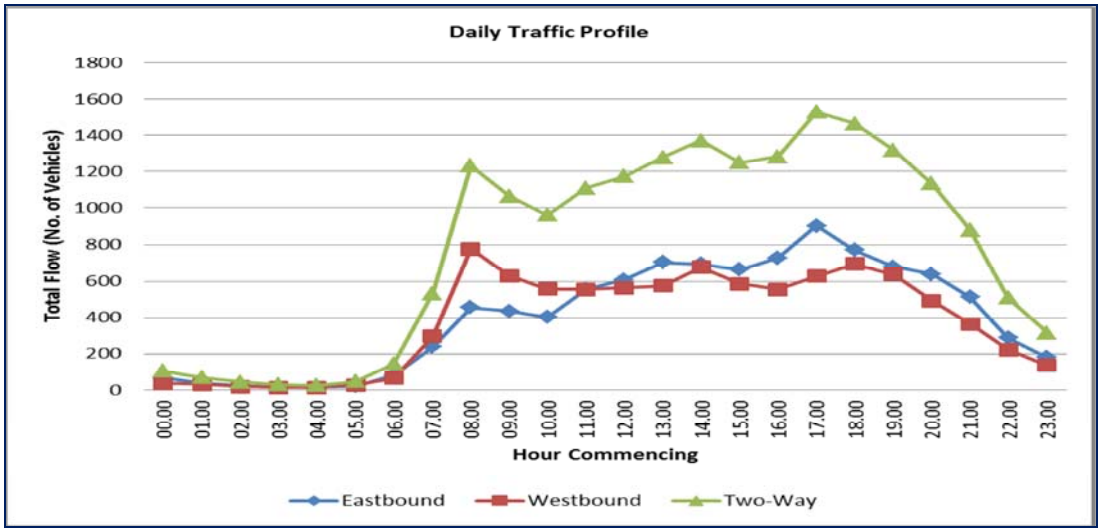


Figure 5.12: Daily Traffic Profile - R610 Rochestown Road (West of Junction with the N28)



The profiles of daily flows on the N28 confirm morning peaks in both directions on the N28 between Shannonpark and Bloomfield and then eastbound morning peaks from Shannonpark and Ringaskiddy. Directional evening peaks on the northern section of the N28 are less distinct but the peak in two way flow is evident. Typically the two way traffic peaks on the northern section of the N28 are spread over a longer period than the usually observed 1 hour peak.

Daily traffic flows on the R610, Rochestown Road are quite high but do not show a distinct morning peak. This is likely to be indicative of the local congestion that occurs on this important link with peak demand being spread out over a longer time as delays are experienced. The evening peak on Rochestown Road is more discernable.

Traffic flow on the N40 is high with distinct two way morning and evening peak periods. The traffic directional traffic flows also exhibit both morning and evening peaks.

5.4.4 Peak Periods for Assessment

The daily traffic flow graphs show a general profile that is consistent with daily traffic flow in an urban area, where traffic flow increases sharply for a morning peak period, reduces for an inter-peak period during the middle of the day and then increases again for an evening peak period. **Table 5.3** summarizes the observed peak times for traffic demand.

Table 5.3: Peak Times for Traffic Flow along Sections of the Existing N28, N40 South Link Road and R610 Rochestown Road

Locations	Morning Peak Period	Evening Peak Period
1 – N28 (Rochestown Rd. – Bloomfield Int.)	7:00am-10:00am (peak hour: 8:00 -9:00)	4:00pm-7:00pm (peak hour:5:00-6:00)
2 – N28 (Maryborough Hill – Rochestown Road)	7:00am-10:00am (peak hour 8:00-9:00)	4:00pm-7:00pm (peak hour 4:00-5:00)
3 – N28 (Shannonpark RA – Carr's Hill)	7:00am-10:00am (peak hour 8:00-9:00)	4:00pm-7:00pm (peak hour 5:00-6:00)
4 – N28 (Shanbally – Shannonpark RA)	7:00am-10:00am (peak hour 8:00-9:00)	4:00pm-7:00pm (peak hour 4:00-5:00)
5 – N28 (Ringaskiddy – Shanbally)	7:00am-10:00am (peak hour 8:00-9:00)	4:00pm-7:00pm (peak hour 4:00-5:00)
6 – R610 Rochestown Road (East of Junction with the N28)	7:00am-10:00am (peak hour 9:00-10:00)	4:00pm-7:00pm (peak hour 5:00-6:00)
7 – N40 South Ring Road (Bloomfield Int. – Mahon Point Int.)	7:00am-10:00am (peak hour 7:00-8:00)	4:00pm-7:00pm (peak hour 5:00-6:00)
8 – N40 South Ring Road (Mahon Point Int. – Jack Lynch Tunnel)	7:00am-10:00am (peak hour 7:00-8:00)	4:00pm-7:00pm (peak hour 5:00-6:00)
9 – R610 Rochestown Road (West of Junction with the N28)	8:00am-10:00am (peak hour 8:00-9:00)	4:00pm-7:00pm (peak hour 5:00-6:00)

Table 5.3 indicates that the daily peak hour in the morning and evening period can vary from location to location along the route but in general the busiest hour for traffic flow is between 8:00am–9:00am in the morning and between 5:00pm-6:00pm in the evening.

In order to account for the subtle variations in traffic demand in the area, the traffic flows/journey times for the full peak periods are assessed in this EIS to establish the likely significant traffic impact of the M28 Road Project on the receiving environment:-

- 7:00am-10:00am – 3 no. peak hours
- 4:00pm-7:00pm – 3 no. peak hours

5.4.5 Description of Existing Traffic Conditions

5.4.5.1 Existing N40 South Ring Road (Kinsale Road Interchange – Jack Lynch Tunnel)

The N40 South Ring Road is a critical part of the Cork City road network. From a national road perspective, it links the M8, N25 (East), N22 (West), N28 (South to the port at Ringaskiddy) and N27 (Airport and Cork City). The N40 South Ring Road is used by traffic travelling between these five primary national routes and key port and airport. It also provides access to the suburbs on the south side of Cork City (i.e., Douglas, Rochestown, Ballyphehane, Wilton and Bishopstown) as well as large-scale employment zones at Little Island (via the N25), Ringaskiddy (via the N28) and Cork University Hospital, UCC and CIT.

The morning peak eastbound on the N40 South Ring Road is 8.00am to 9.00am between Kinsale Road Roundabout and Jack Lynch Tunnel. The average observed travel time for this journey between 8:00am and 9:00am is 12 minutes which would equate to an average speed of 39kph.

The morning peak westbound on the N40 South Ring Road between Jack Lynch Tunnel and Kinsale Road Interchange is 8:00am to 9:00am. Typically the average observed travel time for this journey is 7.5 minutes which equates to an average speed of 67kph.

The traffic travelling eastbound on the N40 South Ring Road during the morning peak period typically consists of local journeys to Little Island and Ringaskiddy (via the N28) with traffic accessing the M8 and N25. Typical constraints along the route are traffic light control at the Dunkettle Interchange, traffic diverging backing up onto the mainline and traffic flow instability due to the significant volumes merging at the various junctions.

The traffic travelling westbound on the N40 South Ring Road during the morning peak period typically consists of local journeys to Cork City, Ringaskiddy (via the N28) with traffic travelling to the N27 and N22. Typical constraints along the route are the traffic flow instability due to significant traffic volumes merging at various junctions (especially from the N28 at Bloomfield Interchange and diverging to the N27 at the Kinsale Road Interchange) and traffic diverging backing up onto the mainline. In addition, the significant amount of vehicles travelling westbound through the Jack Lynch Tunnel are only beginning to build up speed after going through the Dunkettle Interchange, which impacts on the cruise speeds along the N40 South Ring Road.

The evening peak eastbound on the N40 South Ring Road between Kinsale Road Interchange and Jack Lynch Tunnel is 5:00pm to 6:00pm. Typically the average observed travel time for the journey from Kinsale Road Interchange to Jack Lynch Tunnel is 10.5 minutes which equates to an average speed of 45kph.

Traffic travelling eastbound on the N40 South Ring Road during the evening peak period typically consists of traffic from the west and centre of Cork City travelling to the East Cork area together with traffic to the M8 and N25. The constraints of the traffic light control at the Dunkettle Interchange, traffic flow instability due to the significant volumes merging from the N27 (east of the Kinsale Road Interchange) and the backing up of diverging traffic onto the mainline at the two Douglas slip roads have a significant impact on eastbound traffic evening flows.

The evening peak westbound on the N40 South Ring Road, between Jack Lynch Tunnel and Kinsale Road Interchange is 5:00pm to 6:00pm. Typically between 5:00pm and 6:00pm the average observed travel time for the journey from Jack Lynch Tunnel to Kinsale Road Interchange is 5.2 minutes which equates to an average speed of 91kph.

The traffic travelling westbound on the N40 South Ring Road during the evening peak period typically consists of local traffic from Little Island and Ringaskiddy (via the N28) travelling towards the west and centre of Cork City together with other traffic travelling to the N27 and N22. Traffic flow instability can be caused by significant volumes merging from the Mahon Interchange.

The overall conclusion is that the N40 South Ring Road currently operates at/close to practical capacity and generally provides a low level of service during the peak hours.

5.4.5.2 Interface between N28 and N40 (Between Bloomfield Interchange and Rochestown Road)

The section of the existing N28 between Bloomfield Interchange and Rochestown Road (R610) is characterised by the inter-weaving of traffic as it interchanges with the N40, N28 (south of R610) and Rochestown Road. The junction with the R610 is grade separated with a northbound merge and a southbound diverge. This is a key junction as it links Douglas Village, Passage West and the extensive residential developments in the Rochestown/Douglas suburban area to the N40. This is the only access route to the Douglas area for westbound traffic on the N40.

Table 5.4 shows the traffic flows and average journey times from the 2014 Base Year Traffic Model for the N28 between the Rochestown Road and Bloomfield Interchange in the morning peak period.

Table 5.4: 2014 AM Base Year Model Traffic Flows and Journey Times between Rochestown Road and Bloomfield Interchange

N28	Traffic Flows (Veh/Hr)			Journey Times (minutes)		
Rochestown Road – Bloomfield Interchange Length (1km)	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am
Northbound	2611	2898	1709	1.4	1.4	1.1
Southbound	1413	1553	920	1.0	1.0	1.0

In the morning peak period, the dominant demand is northbound towards the N40. Typically the morning peak hour journey time is circa one and a half minutes, which would equate to an average vehicle cruise speed of only 43kph in a section where the speed limit is 60kph. This is mainly due to traffic from Rochestown Road inter-weaving with northbound N28 traffic causing speeds to drop as traffic negotiate their journeys either eastbound or westbound on the N40. Delays arising can cause a build-up of congestion on the northbound single lane of the N28, with queues frequently extending back as far as the Carr's Hill junction.

Table 5.5 illustrates the traffic flows and average journey times from the 2014 Base Year Traffic Model for the N28 between the Rochestown Road and Bloomfield Interchange in the evening peak period.

Table 5.5: 2014 PM Base Year Model Traffic Flows and Journey Times between Rochestown Road and Bloomfield Interchange

N28 Rochestown Road – Bloomfield Interchange (Length 1km)	Traffic Flows (Veh/Hr)			Journey Times (minutes)		
	4-5 pm	5-6 pm	6-7 pm	4-5 pm	5-6 pm	6-7 pm
Northbound	1866	2002	1667	1.1	1.2	1.0
Southbound	2050	2732	2412	1.1	1.4	1.2

In the evening peak period the dominant flow of traffic occurs on the southbound carriageway of the N28 (though traffic demand northbound is also significant), where traffic is travelling onwards on the N28 from the N40 South Ring Road or diverging from the N28 to the R610 Rochestown Road. The short inter-weaving distance available can cause traffic delays and traffic can also back up on to the N28 from the existing roundabout junction on Rochestown Road.

5.4.5.3 Existing N28 – Between Carr's Hill and Rochestown Road

The current configuration for this section of the N28 is one lane for northbound traffic flow and two lanes for southbound traffic flow. There is an existing diverge slip road, which accesses the residential developments in the Mount Oval and Clarkes Wood areas and an existing merge from Maryborough Hill along this section of the road. **Table 5.6** shows the traffic flow and journey times from the 2014 Base Year Traffic Model for the N28 between Carr's Hill and Rochestown Road in the morning peak period.

Table 5.6: 2014 AM Base Year Model Traffic Flows and Journey Times between Carr's Hill and Rochestown Road

N28 Carr's Hill – Rochestown Road (Length 1.6km)	Traffic Flows (Veh/Hr)			Journey Times (minutes)		
	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am
Northbound	1427	1594	867	1.8	3.6	1.9
Southbound	1113	1009	491	1.5	1.4	1.1

Morning peak period traffic flows on this section of the N28 indicate a high demand northbound between 7:00am-9:00am but also a considerable demand southbound during the same time period. This is illustrative of the two-way peak hour demand typical of the traffic patterns on the N28. The traffic flows and journey times indicate that the peak traffic flow in the morning is northbound between 8:00am-9:00am and it can typically take nearly four minutes to complete a journey on the N28 between Carr's Hill and Rochestown Road, which is only a distance of 1.6km. This equates to an average speed of just 24kph in a section where the speed limit is 100kph. The reason for the extended journey times and slow vehicle speeds is the level of congestion on the single lane northbound. This congestion can be as a result of the delays joining the N40 at the Bloomfield Interchange and the inter-weaving of traffic from Rochestown Road. Weaving traffic from the Maryborough Hill merge is also a source of northbound traffic delay as this additional traffic has to merge with the single northbound carriageway, which also carries significant peak hour traffic volumes.

Table 5.7 shows the traffic flow and journey times from the 2014 Base Year Traffic Model for the N28 between Carr's Hill and Rochestown Road in the evening peak period.

Table 5.7: 2014 PM Base Year Model Traffic Flows and Journey Times between Carr's Hill and Rochestown Road

N28 Carr's Hill – Rochestown Road (Length 1.6km)	Traffic Flows (Veh/Hr)			Journey Times (minutes)		
	4-5 pm	5-6 pm	6-7 pm	4-5 pm	5-6 pm	6-7 pm
Northbound	1150	1296	957	1.5	1.7	1.3
Southbound	1020	1432	1228	1.3	1.5	1.4

In the evening peak, the typical pattern of considerable demand in both directions is again evident from the traffic data. From 5:00pm-6:00pm the journey times for traffic travelling northbound shows that vehicles are travelling at an average speed of 56kph in a section where the speed limit is 100kph, which indicates that congestion is still evident in the evening peak hour but not as significant as the morning peak hour. In the southbound direction, the journey times indicate an average travel speed of 64kph. This relatively low journey speed is attributed to delays arising from the reduction of the southbound N28 from 2 lanes to 1 lane and the effect of additional vehicles arriving onto the N28 from Douglas Village at the Carr's Hill junction.

5.4.5.4 Existing N28 – Between Shannonpark Roundabout and Carr's Hill

The N28 between Shannonpark Roundabout and Carr's Hill is predominately a single carriageway, with a climbing lane on the northbound carriageway for approximately 700m, north of the junction with the L6477. **Table 5.8** shows the traffic flow and journey times from the 2014 Base Year Traffic Model for the N28 between Shannonpark Roundabout and Carr's Hill in the morning peak period.

Table 5.8: 2014 AM Base Year Model Traffic Flows and Journey Times between Shannonpark Roundabout and Carr's Hill

N28 Shannonpark Roundabout – Carr's Hill (Length 4km)	Traffic Flows (Veh/Hr)			Journey Times (minutes)		
	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am
Northbound	1156	1109	967	4.3	4.1	3.8
Southbound	1176	1177	603	4.7	4.7	3.4

The pattern of traffic flow on this section is similar to the N28 between Rochestown and Carr's Hill except that the highest morning peak is southbound towards Ringaskiddy and its associated employment areas. Between 8:00am-9:00am the journey time information shows that it can take 4.7 minutes to complete a southbound journey between Carr's Hill and Shannonpark Roundabout. This equates to an average vehicle speed of 51kph on a section where the speed limit is 100kph. The reason for the extended journey times and slow vehicle speed is primarily due to lack of capacity of the single carriageway layout and delays at Shannonpark Roundabout.

The journey time information also shows that it can take 4.3 minutes to complete a journey on the N28 northbound between Shannonpark Roundabout and Carr's Hill. This equates to an average vehicle speed of 56kph. This extended journey time and slow vehicle speed can be attributed to the lack of capacity of a single carriageway and traffic flow slowing down on N28, north of Carr's Hill.

Table 5.9 shows the traffic flow and journey times from the 2014 Base Year Traffic Model for the N28 between Shannonpark Roundabout and Carr's Hill in the evening peak period.

Table 5.9: 2014 PM Base Year Model Traffic Flows and Journey Times between Shannonpark Roundabout and Carr's Hill

N28 Shannonpark Roundabout – Carr's Hill (Length 4km)	Traffic Flows (Veh/Hr)			Journey Times (minutes)		
	4-5 pm	5-6 pm	6-7 pm	4-5 pm	5-6 pm	6-7 pm
Northbound	1112	1147	1035	4.2	4.2	3.8
Southbound	1072	1239	1196	4.2	4.6	4.4

The traffic flows and journey times outline that the peak demand in the evening is between 5:00pm-6:00pm. Similarly to the morning peak, journey times are reduced due to lack of capacity and delays at the existing Shannonpark roundabout. A 4.6 minute journey time equates to an average vehicle speed of 52kph in a section where the speed limit is 100kph.

5.4.5.5 Existing N28 – Between Shanbally and Shannonpark Roundabout

The N28 between Shanbally and Shannonpark Roundabout is predominately a wide single carriageway with hard shoulders and dedicated right turn lanes at key junctions.

Table 5.10 shows the traffic flow and journey times from the 2014 Base Year Traffic Model for the N28 between Shanbally and Shannonpark Roundabout in the morning peak period.

Table 5.10: 2014 AM Base Year Model Traffic Flows and Journey Times between Shanbally and Shannonpark Roundabout

N28 Shanbally - Shannonpark Roundabout (Length 2.85km)	Traffic Flows (Veh/Hr)			Journey Times (minutes)		
	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am
Eastbound	1228	1258	378	4.0	3.9	2.8
Westbound	399	437	302	2.8	2.8	2.7

The traffic flows and journey times outline that the peak demand in the morning is eastbound between 8:00am-9:00am. The journey time information shows that it can take circa 4 minutes to complete a journey between Shannonpark Roundabout and Shanbally. This equates to an average vehicle speed of 43kph in a section where the speed limit is primarily 100kph. The reason for the extended journey times and slow vehicle speed is primarily due to the constraints at the existing roundabout junction in Shanbally Village (which has limited capacity), a reduced speed limit (50kph) through the village and the significant volume of traffic flow going towards Ringaskiddy.

Table 5.11 shows the traffic flow and journey times from the 2014 Base Year Traffic Model for the N28 between Shanbally and Shannonpark Roundabout in the evening peak period.

Table 5.11: 2014 PM Base Year Model Traffic Flows and Journey Times between Shanbally and Shannonpark Roundabout

N28 Shanbally - Shannonpark Roundabout (Length 2.85km)	Traffic Flows (Veh/Hr)			Journey Times (minutes)		
	4-5 pm	5-6 pm	6-7 pm	4-5 pm	5-6 pm	6-7 pm
Eastbound	352	458	497	2.8	3.0	2.8
Westbound	899	986	692	3.3	5.1	3.6

The traffic flows and journey times outline that the peak demand in the evening is westbound between 5:00pm-6:00pm. The journey time information shows that it can take five minutes to complete a journey between Shanbally and Shannonpark Roundabout. This equates to an average vehicle speed of 34kph in a section where the speed limit is primarily 100kph. The reason for the extended journey times and slow vehicle speed is primarily due to the constraints at the Shannonpark Roundabout where traffic flow coming from Ringaskiddy gives way to traffic going to Carrigaline from Cork City and the 50kph speed limit through the village.

5.4.5.6 Existing N28 – Between Ringaskiddy and Shanbally

The existing alignment of the N28 between Ringaskiddy and Shanbally is on an elongated curve along the boundary of the Pfizer site. It is a wide single carriageway with dedicated right-turn lanes at key junctions with a roundabout access to the Pfizer site.

Table 5.12 shows the traffic flow and journey times from the 2014 Base Year Traffic Model for the N28 between Ringaskiddy and Shanbally in the morning peak period.

Table 5.12: 2014 AM Base Year Model Traffic Flows and Journey Times between Ringaskiddy and Shanbally

N28 Ringaskiddy – Shanbally (Length 2.85km)	Traffic Flows (Veh/Hr)			Journey Times (minutes)		
	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am
Eastbound	955	1002	252	3.6	3.8	3.2
Westbound	215	149	117	3.3	3.2	3.2

Between 8:00am-9:00am the journey time information shows that it can take 3.8 minutes to complete an eastbound journey between Shanbally and Ringaskiddy. This equates to an average vehicle speed of 45kph in a section where the speed limit is 60kph. The reason for the extended journey times and slow vehicle speed is primarily due to the constraints of a variety of junctions along the route, vehicles reducing speed on approach to the village and the significant traffic flows towards Ringaskiddy and turning right onto the R613.

Table 5.13 shows the traffic flow and journey times from the 2014 Base Year Traffic Model for the N28 between Ringaskiddy and Shanbally in the evening peak period.

Table 5.13: 2014 PM Base Year Model Traffic Flows and Journey Times between Ringaskiddy and Shanbally

N28 Ringaskiddy - Shanbally Roundabout (Length 2.85km)	Traffic Flows (Veh/Hr)			Journey Times (minutes)		
	4-5 pm	5-6 pm	6-7 pm	4-5 pm	5-6 pm	6-7 pm
Eastbound	132	118	270	3.1	3.1	3.2
Westbound	662	741	556	3.4	3.5	3.3

Between 5:00pm-6:00pm the journey time information shows that it can take 3.5 minutes to complete a westbound journey between Ringaskiddy and Shanbally. This equates to an average vehicle speed of 49kph in a section where the speed limit is 60kph. The reason for the extended journey times and slow vehicle speed is primarily due to the constraints at the roundabout in Shanbally Village.

5.4.5.7 Existing Key Junctions

Shannonpark Roundabout

After the Bloomfield Interchange, which is discussed in **Section 5.4.5.2,** Shannonpark roundabout is the next key junction directly on the N28 corridor. This junction links the N28 to the R611, which is a key route connecting the Cork Metropolitan Area with the significant satellite town of Carrigaline. There is significant traffic demand to/from Carrigaline in the daily peak periods.

Existing traffic flows at Shannonpark roundabout in the morning peak are predominantly northbound from Carrigaline towards the Cork Metropolitan Area and southbound on the N28 towards Ringaskiddy. As the predominant flows do not conflict with each other, the delays experienced in the morning peak at the junction are not excessive with a typical average delay of 20 seconds per vehicle.

In the evening peak, the predominant traffic flows are the opposite from the morning peak with southbound traffic travelling towards Carrigaline and northbound traffic travelling towards both the Cork Metropolitan Area and Carrigaline. These traffic flows do conflict with each other and considerably higher delays are experienced.

Shanbally Roundabout

East of Shannonpark, the existing N28 travels through the village of Shanbally, where the speed limit reduces to 50kph and a roundabout junction which serves the local road network. At this location, the traffic demand is tidal with peak flows towards Ringaskiddy during the morning peak and towards Cork City during the evening peak.

The morning peak hour traffic flow travelling eastbound on the N28 is approximately 1,258 vehicles, which is a significant volume of traffic travelling through the village (especially as it coincides with school travel periods). The restricted geometric parameters of the roundabout cause delays at the junction for traffic travelling east on the N28. Extensive eastbound queues extending back from the Shanbally roundabout are common in the morning peak period.

Rochestown Road Interchange

The N28/R610 Rochestown Road Interchange provides access to and from the N40 South Ring Road from the R610 Rochestown Road, which is a key local route serving the urban residential areas of Douglas, Rochestown and Passage West. In peak periods there is considerable demand to/from the N40 and also east-west on the R610. Conflicting traffic movements and right turning demand causes considerable delay and disruption to traffic flow in the area. During the morning peak, the main demand is westbound on the R610 towards the N28 and Douglas Village. During the evening peak the highest demand is traffic exiting the N28 towards the R610, though there is also significant eastbound demand from Douglas village area.

Fingerpost Roundabout

Another key junction on the R610 Rochestown Road is the 'Fingerpost' roundabout in Douglas Village, where Maryborough Hill, R609 Carr's Hill (Carrigaline Road) join the R610, which continues around Douglas Village. This is a key local junction on the alternative route to and from the study area via the Douglas Road and the South Douglas Road.

This roundabout is subject to significant localised traffic flow but would also be on the route for traffic going to the N28 via Carr's Hill and coming from the N28 via the R610 Rochestown Road. The peak hour in the morning is between 8:00am-9:00am and significant traffic flow is entering the roundabout from R610 Rochestown Road and from the R609 Carr's Hill. As the traffic flow on the R610 Rochestown Road has priority over Maryborough Hill it generates delay and congestion on Maryborough Hill.

The peak hour in the evening is between 5:00pm-6:00pm, though congested conditions can result in delays persisting into the hour between 6:00pm-7:00pm. The highest traffic flow comes from the R610 Douglas Village and this traffic flow has to give way to traffic on the roundabout from the R609 Carr's Hill and Tramway Terrace, which generates significant delay and congestion on the R610 back towards Douglas Village. Traffic travelling from the R610 Douglas Village and Tramway Terrace going to R609 Carr's Hill or Maryborough Hill has priority over the traffic on the R610 Rochestown Road and this can also cause delays on this route.

5.5 ACCIDENT DATA ANALYSIS

A total of 26 accidents have been reported on the existing road between 2009 and 2013. The N28 has a poor record of collisions in recent years, relating to the combination of heavy traffic flows, a significant proportion of heavy goods vehicles and an inconsistent quality of route. **Section 1.3.4** of this EIS describes safety issues and collision data relating to the existing N28. Collision clusters have been noted at/adjacent to the Rochestown Road junction, at/adjacent to Shannonpark roundabout and at Raffeen Bridge.

Accidents at the Rochestown Road junction comprised single vehicle collisions, rear end straight collision and a collision between a car and cyclist on the roundabout. It is proposed to provide linked traffic light control for traffic on Rochestown Road between Clarke's Hill and the merge junction with the N28, including a dedicated right turn lane from the R610 Rochestown Road to Clarke's Hill. These provisions will provide improved control on traffic movements in the area which will have a positive impact on accidents occurrence by reducing the risk of congestion related minor collisions at the Rochestown Road junction.

South of the Rochestown Road, a taxi collided with a pedestrian in dark conditions, there was a rear end straight collision and accidents involving vehicles carrying out U-Turns. The development of a new motorway will eliminate the risk of U-turn accidents and will not permit pedestrian movement.

The single carriageway section between Rochestown and Shannonpark is subject to traffic volumes in excess of the capacity of the road. The risk of collision increases as Level of Service decreases. Also, vehicles seeking to access the N28 from side roads find fewer opportunities to do so safely and through frustration may take unnecessary risks. Recorded accidents on this stretch of road included a single vehicle collision and a rear end straight collision. The provision of rear end straight accidents could be attributed to excessive traffic flow operating in a congested environment and the upgrade to a motorway with greater capacity should reduce the potential for 'rear end' collisions.

At the Shannonpark roundabout one of the collisions was a rear end straight and two of the collisions were between cars and cyclists on the roundabout which could be attributed to the difficulty cyclists have interacting with high traffic flows. The M28 provides for reduced traffic volumes at Shannonpark roundabout so this should reduce the risk of this type of collision.

At Raffeen Bridge, the road cross section has a ghost island right turn lane for northbound vehicles and left turn deceleration and acceleration lanes on the southbound carriageway at the junction with the R610. There were three angle right turn collisions and a head on collision. These accidents could be attributed to a lack of opportunities to turn right from the N28 to the R610 and through frustration drivers may take unnecessary risks. The reassignment of traffic flow to the new motorway will significantly improve the operation of the junction at Raffeen Bridge.

5.6 DO MINIMUM SCENARIO

A Do-Minimum traffic model has been developed that includes the following future changes to the road network. These are considered to be 'committed' schemes to the extent that they will be implemented before the proposed M28 Road Project is built:-

- Proposed Dunkettle Interchange upgrade scheme.

- Douglas Land Use and Transportation Study proposals to:-
  - Remove through traffic from East Douglas St.
  - Replace the current roundabout at the Douglas West N40 off-slip with a signalised junction.
  - Replace the current roundabout at the entrance to Douglas Court Shopping Centre with a signalised junction.
- Roundabout on Maryborough Hill giving direct access to Maryborough Ridge development area.
- Improved western access to the port at Ringaskiddy to a signal controlled junction as per the proposed developments at the port.
- Improvements to Mahon Point access junction to increase capacity for through traffic.

In addition, the Do Minimum scenarios include for:-

- Medium growth scenario.
- Heavy Goods Vehicles (HGV) travelling (off-peak) to and from the expanded Port of Cork facility at Ringaskiddy as per Phases 1 and 2 of the proposed developments at the port. In line with An Bord Pleanála's conditions for the development of the Port, Phase 3, including the Ro-Ro facility and associated HGV movements are assumed to occur in the Do Scheme scenario but not in the Do Minimum. In the Do Minimum case there are no additional HGV movements in the peak periods 07:00-09:00 and 17:00-19:00. This is consistent with the Planning Permission granted in relation to the expansion of the port facilities at Ringaskiddy. In the absence of the proposed M28 road project, all HGV to and from the port will utilise the improved western access junction on the N28 and R613 routes. The future year Do Minimum scenarios are developed for the proposed Year of Opening 2020 and Design Year 2035. The Do Minimum scenarios provide for direct comparison between the Do Something scenarios in order to directly measure the likely impacts of the proposed development.

5.6.1 Do Minimum Traffic Flows

In a similar methodology to the Base Year assessment, the Do-Minimum traffic flows shown in the tables below are the predicted volumes of traffic that will get through each section in the particular hourly period. The level of congestion on the network has a direct impact on the actual traffic flow volumes and if the congestion levels are severe it can result in the traffic flows impacting on the following hourly and/or traffic re-routing to alternative routes.

Table 5.14 compares the highest traffic flows between the Base Year 2014, Do-Minimum 2020 and Do-Minimum 2035 on the existing N28 and sections of the N40 South Ring Road in the morning peak period.

Table 5.15 compares the highest traffic flows between the Base Year 2014, Do-Minimum 2020 and Do-Minimum 2035 on the existing N28 and sections of the N40 South Ring Road in the evening peak period.

Table 5.14: Comparison of Highest AM Traffic Flows for 2014, 2020 and 2035 on the N40 and N28

	2014 Base			2020 Do-Minimum			2035 Do-Minimum		
	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am
N40 (Kinsale Road Interchange – Bloomfield Interchange)									
Eastbound (Range in Traffic Flow)	1182-2267	1500-2949	925-2095	1436-3022	1922-3386	1201-2506	2130-3437	2777-3772	2024-2854
Westbound (Range in Traffic Flow)	1675-3250	1800-3871	1168-2528	1937-3637	2042-4301	1384-2886	3077-3779	3557-4212	2275-2775
N40 (Bloomfield Interchange – Mahon Interchange)									
Eastbound	2691	2952	1890	3022	3386	2198	3437	3772	2411
Westbound	2555	2729	1736	2861	3096	1928	3073	2861	2044
N40 (Mahon Interchange – Jack Lynch Tunnel)									
Eastbound	2475	2214	1439	2793	2498	1631	3211	2789	1859
Westbound	2655	3061	2017	2964	3509	2142	3157	3219	2352
Existing N28 (Rochestown Road – Bloomfield Interchange)									
Northbound	2611	2898	1709	2823	3169	1935	2920	3307	2090
Southbound	1413	1553	920	1589	1849	1223	1659	1832	1493
Existing N28 (Carr's Hill - Rochestown Road)									
Northbound	1427	1594	867	1446	1632	757	1349	1618	749
Southbound	1113	1009	491	1094	1000	567	1003	685	606
Existing N28 (Shannonpark Roundabout – Carr's Hill)									
Northbound	1156	1109	967	1075	966	952	1174	1050	967
Southbound	1176	1177	603	1168	1230	683	1096	960	664
Existing N28 (Shanbally – Shannonpark Roundabout)									
Eastbound	1228	1258	378	1267	1299	461	1196	1024	555
Westbound	399	437	302	423	451	272	459	461	283
Existing N28 (Ringaskiddy – Shanbally)									
Eastbound	955	1002	252	852	972	271	897	757	323
Westbound	215	149	117	225	170	125	239	197	145
Rochestown Road (East of the M28)									
Eastbound	207	492	389	256	562	450	321	670	618
Westbound	979	1283	857	1091	1340	946	1198	1310	981
Rochestown Road (West of the M28)									
Eastbound	355	602	482	391	734	549	508	955	713
Westbound	274	697	513	327	732	514	382	693	539
Maryborough Hill (west of the N28)									
Northbound	177	414	174	213	458	224	309	476	296
Southbound	365	577	260	414	573	246	513	633	308
Garryduff Road (across from Maryborough Ridge)									
Eastbound	66	161	108	72	141	115	77	188	125
Westbound	183	358	165	232	502	222	250	698	280
Clarkes Hill									
Northbound	335	542	305	336	412	263	372	341	259
Southbound	53	92	99	42	88	107	73	115	138

Table 5.15: Comparison of Highest PM Traffic Flows for 2014, 2020 and 2035 on the N40 and N28

	2014 Base			2020 Do-Minimum			2035 Do-Minimum		
	4-5 pm	5-6 pm	6-7 pm	4-5 pm	5-6 pm	6-7 pm	4-5 pm	5-6 pm	6-7 pm
N40 (Kinsale Road Interchange – Bloomfield Interchange)									
Eastbound (Range in Traffic Flow)	1850-3885	1919-4366	1775-3724	3203-4388	3547-4806	3021-4126	3298-4528	3558-4876	3126-4254
Westbound (Range in Traffic Flow)	1641-2958	1766-3245	1409-2724	2463-3066	2822-3224	2436-2905	2805-3459	2905-3372	3014-3488
N40 (Bloomfield Interchange – Mahon Interchange)									
Eastbound	3000	3039	2450	3456	3561	2863	3681	3460	3151
Westbound	2762	3299	2758	2954	3505	3004	3427	3881	3541
N40 (Mahon Interchange – Jack Lynch Tunnel)									
Eastbound	3020	3094	2573	3401	3601	2985	3333	3058	3146
Westbound	2297	2836	2396	2506	2931	2556	2978	3321	3008
Existing N28 (Rochestown Road – Bloomfield Interchange)									
Northbound	1866	2002	1667	2094	2185	1837	2376	2331	2161
Southbound	2050	2732	2412	2409	2872	2659	2689	2905	2760
Existing N28 (Carr's Hill - Rochestown Road)									
Northbound	1150	1296	957	1106	1308	1041	1120	1031	1084
Southbound	1020	1432	1228	1126	1502	1395	1284	1546	1641
Existing N28 (Shannonpark Roundabout – Carr's Hill)									
Northbound	1112	1147	1035	1096	1295	1118	1198	928	1144
Southbound	1072	1239	1196	1167	1292	1226	1249	1297	1231
Existing N28 (Shanbally – Shannonpark Roundabout)									
Eastbound	352	458	497	435	616	567	507	617	745
Westbound	899	986	692	983	1134	771	1108	1026	967
Existing N28 (Ringaskiddy – Shanbally)									
Eastbound	132	118	270	144	140	266	148	153	281
Westbound	662	741	556	671	741	521	728	685	616
Rochestown Road (East of the M28)									
Eastbound	954	1101	1056	1047	1172	1117	1118	1122	1033
Westbound	590	613	628	681	689	722	871	940	895
Rochestown Road (East of the M28)									
Eastbound	749	777	694	803	868	691	889	931	791
Westbound	676	796	733	775	837	777	900	976	743
Maryborough Hill (west of the N28)									
Northbound	228	322	265	225	263	292	272	315	367
Southbound	444	541	513	469	553	555	543	583	593
Garryduff Road (across from Maryborough Ridge)									
Eastbound	141	205	230	171	224	243	216	234	281
Westbound	165	220	218	208	259	259	240	255	324
Clarkes Hill (north of Mount Oval Village)									
Northbound	161	220	206	156	208	203	211	283	268
Southbound	216	181	273	187	196	230	212	163	172

Examination of the data in **Tables 5.14 and 5.15** demonstrates that traffic flows on the N40 South Ring Road, the existing N28 and local Douglas/Rochestown road network are predicted to increase between the Base Year 2014 and the 2020 Do-Minimum Year. This predicted growth will increase the current congestion occurring on the N40 and the N28, particularly between Bloomfield and Carr's Hill.

However it is also noted that on significant sections of the existing national and local road network in the 2035 Do-Minimum peak hours the predicted traffic flows are lower than the 2020 Do-Minimum traffic flows. This is due to increased congestion which has the effect of spreading the peak time of flows over longer periods, i.e., more traffic in the hour either side of the peak and/or traffic relocating to alternative routes in the local road network.

5.6.2 Do-Minimum Network Link Capacity

The N40 and the N28 are subject to existing high traffic demand, which is predicted to increase over time. To assess the capability of the network to cater for this demand, an indicative network link capacity has been carried out. The document "*Traffic Capacity of Urban Roads*" TA 79 provides guidance information on hourly link capacities and this has been used to establish indicative capacities of the road sections along the N40 and N28.

For an Urban Motorway (which has similar features to the N40) the theoretical link capacity is 4,000 vehicles per hour in each direction. With reference to Tables 5.14 and 5.15, the predicted Do-Minimum demand flows are predicted to exceed the capacity on the N40 between the Kinsale Road Interchange and Jack Lynch Tunnel during morning and evening peak periods.

For a UAP1 (Urban All-Purpose), which has similar features to the N28 between Rochestown and Carr's Hill, the theoretical capacity of a single lane is 1,400 vehicles per hour. Therefore during the morning peak hour the predicted Do-Minimum traffic flows will typically exceed the capacity on the northbound lane on this section of the N28.

The existing section of the N28 between Carr's Hill and Shannonpark is a reduced standard and would be categorised as a UAP2 in TA 79. The theoretical two-way link capacity of this section of the N28 is 2,450 vehicles per hour. Therefore during morning and evening peak periods the predicted Do-Minimum demand flows will be operating close to capacity on the N28 between Shannonpark and Carr's Hill.

East of Shannonpark, the existing N28 will retain some capacity under the Do Minimum scenario, though this is likely to be exceeded in the Design Year between Shannonpark and Shanbally.

5.6.3 Do-Minimum Journey Times

Table 5.16 compares the average journey times (in minutes) between the Base Year 2014, Do-Minimum 2020 and Do-Minimum 2035 on the existing N28 and sections of the N40 South Ring Road in the morning peak period.

Table 5.17 compares the average modelled journey times (in minutes) between the Base Year 2014, Do-Minimum 2020 and Do-Minimum 2035 on the existing N28 and sections of the N40 South Ring Road in the evening peak period.

Table 5.16: Comparison of AM Journey Times between 2014, 2020 and 2035 on the N40 and N28

Time in Minutes	2014 Base			2020 Do-Minimum			2035 Do-Minimum		
	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am
N40 (Kinsale Road Interchange – Jack Lynch Tunnel)									
Eastbound	5.8	6.0	5.2	6.9	7.4	6.0	8.5	9.2	7.3
Westbound	6.6	8.6	6.8	8.3	10.7	6.9	9.9	11.3	10.8
Existing N28 (Rochestown Road – Bloomfield Interchange)									
Northbound	1.4	1.4	1.1	1.5	1.5	1.2	2.0	1.8	1.5
Southbound	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1
Existing N28 (Carr's Hill - Rochestown Road)									
Northbound	1.8	3.6	1.9	1.7	5.0	3.0	2.2	6.2	4.7
Southbound	1.5	1.4	1.1	1.4	1.4	1.3	1.4	1.4	1.4
Existing N28 (Shannonpark Roundabout – Carr's Hill)									
Northbound	4.3	4.1	3.8	4.5	4.1	4.4	5.3	5.0	5.2
Southbound	4.7	4.7	3.4	5.3	5.5	3.9	6.1	9.9	5.6
Existing N28 (Shanbally – Shannonpark Roundabout)									
Eastbound	4.0	3.9	2.8	4.3	5.0	2.9	5.5	13.3	6.1
Westbound	2.8	2.8	2.7	3.0	3.0	3.0	3.1	3.5	3.2
Existing N28 (Ringaskiddy – Shanbally)									
Eastbound	3.6	3.8	3.2	4.0	4.3	3.5	4.3	5.6	5.6
Westbound	3.3	3.2	3.2	3.5	3.5	3.4	3.6	3.5	3.5

Table 5.17: Comparison of PM Journey Times between 2014, 2020 and 2035 on the N40 and N28

Time in Minutes	2014 Base			2020 Do-Minimum			2035 Do-Minimum		
	4-5 pm	5-6 pm	6-7 pm	4-5 pm	5-6 pm	6-7 pm	4-5 pm	5-6 pm	6-7 pm
N40 (Kinsale Road Interchange – Jack Lynch Tunnel)									
Eastbound	7.4	10.1	7.0	10.3	12.9	8.5	14.0	19.2	19.6
Westbound	6.0	6.8	5.8	7.1	8.7	6.9	9.5	12.6	11.7
Existing N28 (Rochestown Road – Bloomfield Interchange)									
Northbound	1.1	1.2	1.0	1.2	1.2	1.1	1.4	1.6	1.3
Southbound	1.1	1.4	1.2	1.4	1.7	1.7	1.6	2.0	2.3
Existing N28 (Carr's Hill - Rochestown Road)									
Northbound	1.5	1.7	1.3	1.4	1.6	1.4	1.6	2.2	1.6
Southbound	1.3	1.5	1.4	1.3	1.4	1.4	1.4	1.5	1.5
Existing N28 (Shannonpark Roundabout – Carr's Hill)									
Northbound	4.2	4.2	3.8	4.7	5.2	4.2	5.4	6.1	5.2
Southbound	4.2	4.6	4.4	4.9	5.2	5.0	5.8	5.9	6.1
Existing N28 (Shanbally – Shannonpark Roundabout)									
Eastbound	2.8	3.0	2.8	2.8	3.3	2.8	3.1	3.4	3.3
Westbound	3.3	5.1	3.6	3.6	4.0	3.3	4.2	5.9	4.5
Existing N28 (Ringaskiddy – Shanbally)									
Eastbound	3.1	3.1	3.2	3.4	3.4	3.6	3.6	3.5	3.7
Westbound	3.4	3.5	3.3	3.9	4.1	3.9	4.4	5.2	4.9

The data shows that the journey times on both the N40 and the N28 increase as traffic demand increases over time. There is also a notable spread of journey time delay to the hours either side of the peaks.

The N40 and northern sections of the N28 are at/close to their practical capacity, the peak flows are at their maximum and the peak periods extend in terms of length of time.

5.7 IMPACT OF THE PROPOSED M28 ROAD PROJECT

The description of the proposed M28 Road Project is contained in **Chapter 3** of this EIS. The following infrastructural improvements are added to the Do Minimum scenarios to construct the 2020 and 2035 Do-Something Traffic Models to represent the proposed M28 road project:-

- On-line dual carriageway motorway between the northern end of the M28 Road Project at the Bloomfield Interchange with N40 and the Carr's Hill interchange.
- Provision of a diverge slip road from the M28 to the westbound N40.
- Provision of an additional right turn lane at the Rochestown Road and Clarke's Hill junction, together with reconfiguration and linked traffic light control on Rochestown Road at the junctions with Clarke's Hill, St Patrick's roundabout (reconfigured junction) and the M28 merge.
- Upgrading of the existing sub-standard off-ramp to Mount Oval.
- Removal of the existing sub-standard northbound on-ramp at Maryborough Hill
- Provision of a new dual carriageway motorway to the west of the existing road, between Carr's Hill and Shannonpark.
- Provision of a full interchange at Carr's Hill and a new two-way link road, adjacent to Douglas Golf Club, to connect this new interchange with Maryborough Hill.
- Incorporation of the existing Shannonpark roundabout into a new grade-separated interchange, with north-facing slip roads.
- Provision of a new dual carriageway motorway to the south of the existing road, between Shannonpark and the proposed roundabout at Barnahely.
- Provision of a grade separated junction at Shanbally with west facing slip roads.
- A single-carriageway link road from the new roundabout at Barnahely to the proposed new Port of Cork entrance east of Ringaskiddy Village with a roundabout junction on the Loughbeg Road [protected road status].
- A shared use pedestrian and cyclist underpass at Old Post Office Road in Ringaskiddy.

In the following section, the Do Something traffic model outputs are compared to the Do Minimum traffic model outputs in order to assess the likely significant traffic effects of the proposed development. In a similar methodology to the Base Year assessment, the Do-Something traffic flows shown in the tables in **Sections 5.7.1** and 5**.7.2** are the predicted volume of actual traffic flows that will get through each section of road in an hourly period.

5.7.1 Morning Peak Conditions

Table 5.18 compares the highest traffic flows between the Do-Minimum and Do-Something scenarios for the Opening Year 2020 and Design Year 2035 morning peak period.

Table 5.19 compares the journey times between the Do-Minimum and Do-Something Scenarios for the Opening Year 2020 and Design Year 2035 morning peak period.

Table 5.18: Comparison of Highest Traffic Flows between the AM 2020 and 2035 Peak Periods

	2020 Do-Minimum			2020 Do-Something			*2020 Impact*		
	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am
N40 (Kinsale Road Interchange – Bloomfield Interchange)									
Eastbound	3022	3386	2506	3033	3458	2515	*0%*	*+2%*	*0%*
Westbound	3637	4301	2886	3608	4307	2937	*0%*	*0%*	*-1.8%*
N40 (Bloomfield Interchange – Mahon Interchange)									
Eastbound	3022	3386	2198	3030	3458	2257	*0%*	*+2.1%*	*+2.7%*
Westbound	2861	3096	1928	2851	3029	1928	*0%*	*-2.2%*	*0%*
N40 (Mahon Interchange – Jack Lynch Tunnel)									
Eastbound	2793	2498	1631	2792	2554	1639	*0%*	*2.2%*	*0%*
Westbound	2964	3509	2142	2971	3495	2143	*0%*	*0%*	*0%*
M28 (Rochestown Road – Bloomfield Interchange)									
Northbound	2823	3169	1935	2802	3587	2103	*0%*	*+13.2%*	*+8.7%*
Southbound	1589	1849	1223	1739	2039	1248	*+9.4%*	*+10.3%*	*+2.0%*
M28 (Carr's Hill - Rochestown Road)									
Northbound	1446	1632	757	1471	2250	1007	*+1.7%*	*+38%*	*+33%*
Southbound	1094	1000	567	1358	1468	637	*+24.1%*	*+46.8%*	*+12.3%*
Existing N28 (Shannonpark Roundabout – Carr's Hill)									
Northbound	1075	966	952	89	330	73	*-91.7%*	*-65.8%*	*-92.3%*
Southbound	1168	1230	683	251	217	156	*-78.5%*	*-82.4%*	*-77.2%*
Existing N28 (Shanbally – Shannonpark Roundabout)									
Eastbound	1267	1299	461	386	752	222	*-69.5%*	*-42.1%*	*-51.8%*
Westbound	423	451	272	234	391	226	*-44.7%*	*-13.3%*	*-16.9%*
Existing N28 (Ringaskiddy – Shanbally)									
Eastbound	852	972	271	582	754	143	*-31.7%*	*-22.4%*	*-47.2%*
Westbound	225	170	125	80	106	71	*-64.4%*	*-37.6%*	*-43.2%*
	2035 Do-Minimum			2035 Do-Something			*2035 Impact*		
	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am
N40 (Kinsale Road Interchange – Bloomfield Interchange)									
Eastbound	3437	3772	2854	3384	3810	2937	*-1.5%*	*+1.0%*	*+2.9%*
Westbound	3779	4212	2775	3772	4133	2772	*0%*	*-1.9%*	*0%*
N40 (Bloomfield Interchange – Mahon Interchange)									
Eastbound	3437	3772	2411	3384	3723	2376	*+1.5%*	*-1.3%*	*-1.5%*
Westbound	3073	2861	2044	3052	2751	2026	*0%*	*-3.8%*	*0%*
N40 (Mahon Interchange – Jack Lynch Tunnel)									
Eastbound	3211	2789	1859	3167	2785	1854	*-1.4%*	*0%*	*0%*
Westbound	3157	3019	2352	3159	3218	2370	*0%*	*+6.6%*	*0%*
M28 (Rochestown Road – Bloomfield Interchange)									
Northbound	2920	3307	2090	3020	3787	2263	*+3.4%*	*+14.5%*	*+8.3%*
Southbound	1659	1832	1493	1987	2177	1635	*+19.8%*	*+18.8%*	*+9.5%*
M28 (Carr's Hill - Rochestown Road)									
Northbound	1349	1618	749	1638	2345	1080	*+21.4%*	*+44.9%*	*+44.2%*
Southbound	1003	685	606	1474	1321	857	*+47.0%*	*+92.8%*	*+41.4%*

	2020 Do-Minimum			2020 Do-Something			*2020 Impact*		
	7-8 am	**8-9 am**	**9-10 am**	**7-8 am**	**8-9 am**	**9-10 am**	**7-8 am**	**8-9 am**	**9-10 am**
Existing N28 (Shannonpark Roundabout – Carr's Hill)									
Northbound	1174	1050	967	93	396	77	***-92.1%***	***-62.3%***	***-92.0%***
Southbound	1096	960	664	316	314	204	***-71.2%***	***-67.3%***	***-69.3%***
Existing N28 (Shanbally – Shannonpark Roundabout)									
Eastbound	1196	1024	555	440	820	295	***-63.2%***	***-20.0%***	***-46.8%***
Westbound	459	461	283	301	452	292	***-34.4%***	***-2%***	***+3.2%***
Existing N28 (Ringaskiddy – Shanbally)									
Eastbound	897	757	323	633	793	189	***-29.4%***	***+4.8%***	***-41.5%***
Westbound	239	197	145	92	122	85	***-61.5%***	***-38.1%***	***-41.4%***

Table 5.19: Comparison of Journey Times between the AM 2020 and 2035 Peak Periods

Journey Times in Minutes	2020 Do-Minimum			2020 Do-Something			2035 Do-Minimum			2035 Do-Something		
	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am	7-8 am	8-9 am	9-10 am
N40 (Kinsale Road Interchange – Jack Lynch Tunnel) – Length 6,125m												
Eastbound	6.9	7.4	6.0	7.0	7.5	6.0	8.5	9.2	7.3	8.5	9.7	7.3
Westbound	8.3	10.7	6.9	8.3	11.3	6.9	9.9	11.3	10.8	9.9	12.6	11.3
M28 (Rochestown Road – Bloomfield Interchange) – Length 550m												
Northbound	1.5	1.5	1.2	1.3	1.6	1.1	2.0	1.8	1.5	3.0	6.3	4.1
Southbound	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1
M28 (Carr's Hill - Rochestown Road) – Length 1,605m												
Northbound	1.7	5.0	3.0	1.2	1.2	1.1	2.2	6.2	4.7	1.2	1.3	1.2
Southbound	1.4	1.4	1.3	1.1	1.1	1.0	1.4	1.4	1.4	1.1	1.1	1.1
Existing N28 (Shannonpark Roundabout – Carr's Hill) – Length 4060m												
Northbound	4.5	4.1	4.4	3.0	3.0	3.0	5.3	5.0	5.2	3.2	3.2	3.2
Southbound	5.3	5.5	3.9	3.2	3.2	3.2	6.1	9.9	5.6	3.0	3.0	3.0
Existing N28 (Shanbally – Shannonpark Roundabout) – Length 2,845m												
Eastbound	4.3	5.0	2.9	2.7	2.8	2.6	5.5	13.4	6.1	2.7	3.0	2.7
Westbound	3.0	3.0	3.0	2.7	2.7	2.7	3.1	3.5	3.2	2.7	2.8	2.7
Existing N28 (Ringaskiddy – Shanbally) – Length 2,845m												
Eastbound	4.0	4.3	3.5	3.3	3.6	3.3	4.3	5.6	5.6	3.3	3.7	3.3
Westbound	3.5	3.5	3.4	3.4	3.4	3.4	3.6	3.5	3.5	3.4	3.4	3.4

A comparison of the traffic flows and journey times between the Do-Minimum and Do-Something scenarios for the **morning peak period** indicates the following:-

- The proposed M28 Road Project is predicted to have a negligible impact on the scale of traffic flows and the lengths of journey times in both directions on the N40 South Ring Road between Kinsale Road Interchange and the Jack Lynch Tunnel.
- The N28 corridor incorporating the proposed M28 Road Project is predicted to attract an increase in morning peak traffic volumes from the local road network, notably the existing N28. Traffic is also attracted to the proposed route from other local routes, such as the route via Douglas village, and the local road network which links to the south, i.e., the Ballinrea Road through Donnybrook Hill and the Moneygourney Road, L6477.
- Between Bloomfield Interchange and Rochestown Road, the proposed M28 Road Project is predicted to result in an increase in traffic flows travelling southbound during the peak hours but this increase in traffic flow will not have any significant impact on the journey times or average speeds.
- In the northbound direction between Rochestown Road and Bloomfield Interchange, there is predicted to be an increase in traffic flows in the morning peak, with a particular increase in the 8:00am to 9:00am period. An increase in average journey time of 4.5 minutes in the 08.00 to 09.00 period (1.8 minute average journey time without the road project in place to 6.3 minutes with the road project in place) is predicted in the 2035 scenario as the increased traffic volumes from the M28 Road Project will experience some delay accessing the N40.
- Between Carr's Hill and Rochestown Road, the proposed Road Project is predicted to result in a significant increase in traffic flow travelling both northbound and southbound during the peak hour 8.00am-9:00am but the predicted traffic flows are within the capacity of the motorway dual carriageway. There are predicted to be significant reductions in journey times travelling northbound from 5.0 to 1.2 minutes during the peak hour 8:00am-9:00am in 2020. It is predicted that the journey times travelling southbound will reduce also from 1.4 minutes to 1.1 minutes in 2020.
- Between Shannonpark and Carr's Hill, the M28 Road Project is predicted to result in a very significant reduction in northbound and southbound traffic flows on the existing N28 carriageway during the peak period. This is due to traffic travelling north to Cork City from Ringaskiddy and Carrigaline reassigning to the new motorway. The significant reduction in traffic flows also reduces the journey times along this section of the existing road.
- Between Shannonpark and Ringaskiddy, the new road is again predicted to result in significant reductions in the eastbound traffic flow along the existing N28 across the entire morning peak period (between 7am-10am) and will significantly reduce traffic volumes going through the village of Shanbally. The reduction in traffic flow also reduces traffic congestion on this section of the existing N28 with the journey times decreasing significantly. The new M28 road will also reduce traffic flows travelling westbound along the existing N28 between Ringaskiddy and Shannonpark.

5.7.2 Evening Peak Conditions

Table 5.20 compares the highest traffic flows between the Do-Minimum and Do-Something Scenarios for the Opening Year 2020 and Design Year 2035 evening peak period.

Table 5.21 compares the journey times between the Do-Minimum and Do-Something Scenarios for the Opening Year 2020 and Design Year 2035 evening peak period.

Table 5.20: Comparison of Highest Traffic Flows between the PM 2020 and 2035 Peak Periods

	2020 Do-Minimum			2020 Do-Something			*2020 Impact*		
	4-5 pm	5-6 pm	6-7 pm	4-5 pm	5-6 pm	6-7 pm	4-5 pm	5-6 pm	6-7 pm
N40 (Kinsale Road Interchange – Bloomfield Interchange)									
Eastbound	4388	4806	4126	4414	4809	4180	***0%***	***0%***	***+1.3%***
Westbound	3066	3224	2905	3134	3321	2968	***+2.2%***	***+3.0%***	***+2.2%***
N40 (Bloomfield Interchange – Mahon Interchange)									
Eastbound	3456	3561	2863	3460	3573	2892	***0%***	***0%***	***+1.0%***
Westbound	2954	3505	3004	2946	3507	3007	***0%***	***0%***	***0%***
N40 (Mahon Interchange – Jack Lynch Tunnel)									
Eastbound	3401	3601	2985	3405	3603	2989	***0%***	***0%***	***0%***
Westbound	2506	2931	2556	2503	2929	2553	***0%***	***0%***	***0%***
M28 (Rochestown Road – Bloomfield Interchange)									
Northbound	2094	2185	1837	2372	2442	2009	***+13.3%***	***+11.8%***	***+9.4%***
Southbound	2409	2872	2659	2506	3008	2861	***+4.0%***	***+4.7%***	***+7.6%***
M28 (Carr's Hill - Rochestown Road)									
Northbound	1106	1308	1041	1396	1583	1211	***+26.2%***	***+21%***	***+16.3%***
Southbound	1126	1502	1395	1311	1791	1853	***+16.4%***	***+19.2%***	***+32.8%***
Existing N28 (Shannonpark Roundabout – Carr's Hill)									
Northbound	1096	1295	1118	62	169	144	***-94.3%***	***-87.0%***	***-87.1%***
Southbound	1167	1292	1226	333	403	342	***-71.5%***	***-68.8%***	***-72.1%***
Existing N28 (Shanbally – Shannonpark Roundabout)									
Eastbound	435	616	567	324	614	422	***-25.5%***	***0%***	***-25.6%***
Westbound	983	1134	771	589	510	387	***-40.1%***	***-55.0%***	***-50.0%***
Existing N28 (Ringaskiddy – Shanbally)									
Eastbound	144	140	266	77	70	86	***-46.5%***	***-50%***	***-67.7%***
Westbound	671	741	521	522	374	292	***-22.2%***	***-50%***	***-44.1%***
	2035 Do-Minimum			**2035 Do-Something**			***2035 Impact***		
	4-5 pm	**5-6 pm**	**6-7 pm**	**4-5 pm**	**5-6 pm**	**6-7 pm**	**4-5 pm**	**5-6 pm**	**6-7 pm**
N40 (Kinsale Road Interchange– Bloomfield Interchange)									
Eastbound	4528	4876	4254	4541	4849	4267	***0%***	***0%***	***0%***
Westbound	3459	3372	3488	3506	3502	3506	***+1.4%***	***+3.9%***	***0%***
N40 (Bloomfield Interchange – Mahon Interchange)									
Eastbound	3681	3460	3151	3691	3509	3166	***0%***	***+1.6%***	***0%***
Westbound	3459	3372	3488	3423	3858	3560	***-1.0%***	***+14.4%***	***+2.1%***
N40 (Mahon Interchange – Jack Lynch Tunnel)									
Eastbound	3333	3058	3146	3331	3051	3167	***0%***	***0%***	***0%***
Westbound	2978	3321	3008	2978	3299	3030	***0%***	***0%***	***0%***
M28 (Rochestown Road – Bloomfield Interchange)									
Northbound	2376	2331	2161	2716	2829	2395	***+14.3%***	***+21.4%***	***+10.8%***
Southbound	2689	2905	2760	2803	2982	2903	***+4.2%***	***+2.7%***	***+5.2%***
M28 (Carr's Hill - Rochestown Road)									
Northbound	1120	1031	1084	1481	1610	1317	***+32.2%***	***+56.2%***	***+21.5%***

Southbound	1284	1546	1641	1510	1759	1917	***+17.6%***	***+13.8%***	***+16.8%***
Existing N28 (Shannonpark Roundabout – Carr's Hill)									
Northbound	1198	928	1144	145	271	211	***-87.9%***	***-70.8%***	***-81.6%***
Southbound	1294	1297	1231	393	459	432	***-69.6%***	***-64.6%***	***-65.0%***
Existing N28 (Shanbally – Shannonpark Roundabout)									
Eastbound	507	617	745	423	727	576	***-16.6%***	***+17.8%***	***-22.7%***
Westbound	1108	1026	967	682	633	502	***-38.5%***	***-38.3%***	***-48.1%***
Existing N28 (Ringaskiddy – Shanbally)									
Eastbound	148	153	281	95	90	98	***-35.8%***	***-41.2%***	***-65.1%***
Westbound	728	685	616	612	509	408	***-15.9%***	***-10.7%***	***-33.8%***

Table 5.21: Comparison of Journey Times between the PM 2020 and 2035 Peak Periods

Journey Times in Minutes	2020 Do-Minimum			2020 Do-Something				2035 Do-Minimum			2035 Do-Something		
	4-5 pm	5-6 pm	6-7 pm	4-5 pm	5-6 pm	6-7 pm		4-5 pm	5-6 pm	6-7 pm	4-5 pm	5-6 pm	6-7 pm
N40 (Kinsale Road Interchange – Jack Lynch Tunnel) – Length 6,125m													
Eastbound	10.3	12.9	8.5	10.3	13.1	8.7		14.0	19.2	19.6	14.1	19.8	20.0
Westbound	7.1	8.7	6.9	7.2	8.9	7.1		9.5	12.6	11.7	9.9	13.5	12.3
M28 (Rochestown Road – Bloomfield Interchange) – Length 550m													
Northbound	1.2	1.2	1.1	1.2	1.1	1.1		1.4	1.6	1.3	1.3	2.8	1.8
Southbound	1.4	1.7	1.7	1.2	1.3	1.2		1.6	2.0	2.3	1.3	1.3	1.4
M28 (Carr's Hill - Rochestown Road) – Length 1,605m													
Northbound	1.5	1.6	1.4	1.1	1.2	1.1		1.6	2.2	1.6	1.2	1.2	1.1
Southbound	1.3	1.4	1.4	1.1	1.1	1.1		1.4	1.5	1.5	1.1	1.1	1.1
Existing N28 (Shannonpark Roundabout – Carr's Hill) – Length 4,060m													
Northbound	4.7	5.2	4.2	3.2	3.2	3.2		5.4	6.1	5.2	3.2	3.2	3.3
Southbound	4.9	5.2	5.0	3.1	3.1	3.1		5.8	5.9	6.1	3.1	3.1	3.1
Existing N28 (Shanbally – Shannonpark Roundabout) – Length 2,845m													
Eastbound	2.8	3.3	2.8	2.7	2.8	2.7		3.1	3.4	3.3	2.7	2.9	2.8
Westbound	3.6	4.0	3.3	2.9	2.8	2.8		4.2	5.9	4.5	3.0	3.0	2.9
Existing N28 (Ringaskiddy – Shanbally) – Length 2,845m													
Eastbound	3.4	3.4	3.6	3.4	3.6	3.4		3.6	3.5	3.7	3.4	3.5	3.4
Westbound	3.9	4.1	3.9	3.5	3.8	3.5		4.4	5.2	4.9	3.6	3.8	3.6

A comparison of the demand flows and journey times between the Do-Minimum and Do-Something scenarios for the **evening peak period** indicates the following:-

- The proposed M28 Road Project is predicted to have an almost negligible impact on the scale of traffic flows and length of journey times in both directions on the N40 South Ring Road between Kinsale Road Interchange and the Jack Lynch Tunnel.
- The N28 corridor incorporating the proposed M28 Road Project is predicted to attract an increase in evening peak traffic volumes from the local road network, notably the existing N28.
- Between Bloomfield Interchange and Rochestown Road, the proposed M28 Road Project is predicted to result in increases in traffic flows travelling both northbound and southbound during the each of the evening peak hours. Although the traffic flow increases, the southbound journey times are predicted to reduce slightly. Modest increases in journey time are predicted for the northbound traffic flows in 2035, again due to delays experienced by the additional traffic volumes accessing onto the N40.
- Between Carr's Hill and Rochestown Road, the new M28 road is predicted to result an increase in traffic flow volumes in the evening peak hours, particularly travelling northbound during the peak hour 5:00pm-6:00pm. However the additional capacity of the proposed M28 Road Project will reduce the journey times.
- Between Shannonpark and Carr's Hill, the new Road Project is predicted to significantly reduce the northbound and southbound traffic flows on the existing N28 carriageway during each of the peak hours with consequent reductions in journey times on the existing N28. This is due to vehicles travelling north to Cork City from Ringaskiddy and Carrigaline reassigning to the new motorway.
- Between Ringaskiddy and Shannonpark, the new Road Project is predicted to result in significant reductions in westbound traffic flow (especially the section between Shanbally and Shannonpark) along the existing N28 across the entire evening peak period and will reduce traffic volumes going through the village of Shanbally. The reduction in westbound traffic flow also reduces the traffic congestion on this section of the existing N28 with the journey times decreasing between Shannonpark and Shanbally.

5.7.3 Impact on the Local Road Network

The proposed M28 Road Project has the effect of increasing traffic volumes using the proposed M28 corridor, particularly in the peak hours. This will result in significant relief to the existing N28 corridor south of Carr's Hill and also results in changes to the traffic patterns on the local road network north of Carr's Hill. The proposed Road Project includes a change in the way that local traffic in the greater Douglas area accesses the M28. The existing sub-standard merge from Maryborough Hill is proposed to be replaced with a new parallel link from Maryborough Hill to the interchange proposed at Carr's Hill. At Carr's Hill the existing interchange is proposed to be upgraded to include for full interchange with the M28 by providing slip roads for all traffic movements to and from the M28.

The key characteristic of traffic flow on the local road network in the Douglas/Rochestown areas is high peak hour demand and limited road network infrastructure to and from the area. The main routes are via the N28 corridor and via Douglas Village. This limited local road infrastructure suffers from peak hour congestion at critical local junctions. As traffic demand grows into the future years, the issue of local peak hour traffic congestion is expected to worsen as described in **Section 5.6**.

The impact of the M28 Road Project on the local road network north of Carr's Hill is described in more detail in the following sections. **Sections 5.7.3.1** and **5.7.3.2** describes the likely impact on the Douglas/Rochestown area. The proposal to replace the existing merge slip road at Maryborough Hill results in changes in local travel patterns and **Section 5.7.3.3** describes the impact of this proposal in particular. As there are key junctions where most of the peak hour delays occur, **Sections 5.7.3.4** to **5.7.3.6**, describe the impact at the Fingerpost Roundabout, the N28 junction on Rochestown Road and the proposed priority junction on Maryborough Hill, respectively.

5.7.3.1 Douglas/Rochestown Area

The existing Carr's Hill junction consists of a northbound diverge slip road and southbound merge slip road from the R609 to the existing N28. Existing slip roads exist at Mount Oval and Maryborough Hill, which are sub-standard for a motorway. As part of this road project it is proposed to upgrade the existing slip road at Mount Oval to motorway standards. The option to also upgrade the existing slip road at Maryborough Hill was considered but no feasible option was identified.

The M28 Road Project provides for the interchange at Carr's Hill to be upgraded to a full grade separated junction and to provide slip road access with the M28 for all traffic movements. The proposed interchange will link with the local road network via the existing R609 and by a proposed north-south link to Maryborough Hill running parallel to the proposed motorway on the east side of Douglas Golf Club. This link will provide full accessibility between Maryborough Hill and the M28. This new two-way link road will intersect the R609 via the northern roundabout of Carr's Hill Interchange and intersect Maryborough Hill via a new right turn lane priority junction. The proposed interchange will also provide a through local route via the existing N28 and the R609. The proposed Carr's Hill Interchange provides improved accessibility between the local area and the M28 corridor.

To establish the likely impact of the M28 Road Project including the new interchange and two-way link road on the local road network, a comparison of the traffic flows and journey times for the Do-Minimum Scenario and Do-Something Scenario was undertaken.

Table 5.22 and **Table 5.23** shows the traffic flows on the local road network in the vicinity of Carr's Hill Interchange for the Opening Year 2020 and Design Year 2035 peak periods Do-Minimum and Do-Something scenarios.

Table 5.22: Morning Peak 2-Way (Unless 1-Way Road) Traffic Flows on the Local Road Network in 2020 and 2035

	2020 Do-Minimum			2020 Do-Something			Percentage Impact		
	7-8	8-9	9-10	7-8	8-9	9-10	7-8	8-9	9-10
Maryborough Hill									
North of existing N28 Merge	**627**	**1031**	**470**	**758**	**1082**	**599**	*+20.8%*	*+4.9%*	*+27.4%*
Between Broadale and Maryborough Ridge	**857**	**1440**	**546**	**737**	**1414**	**680**	*-14.0%*	*-1.8%*	*-24.5%*
Adjacent to Douglas Golf Club	**546**	**881**	**485**	**657**	**879**	**607**	*+20.3%*	*0%*	*+25.2%*
Garryduff Road									
Opposite Maryborough Ridge	**304**	**643**	**336**	**399**	**901**	**456**	*-31.3%*	*+40.1%*	*+35.7%*
Adjacent to the Sports Centre	**148**	**394**	**204**	**177**	**508**	**291**	*+19.6%*	*+28.9%*	*+42.6%*

	2020 Do-Minimum			2020 Do-Something			Percentage Impact		
	7-8	8-9	9-10	7-8	8-9	9-10	7-8	8-9	9-10
Clarke's Hill									
North of Mount Oval Village	**378**	**499**	**370**	**269**	**259**	**258**	*-28.8%*	*-30.0%*	*-30.3%*
South of Mount Oval Village	**170**	**277**	**117**	**112**	**397**	**206**	*-34.1%*	*+43.3%*	*+76.1%*
Coach Hill	**105**	**342**	**174**	**196**	**357**	**204**	*+86.7%*	*+4.4%*	*+17.2%*
Slip Road into Mount Oval Village	**41**	**68**	**36**	**42**	**69**	**40**	*+2.4%*	*+1.5%*	*+11.1%*
R609 Carr's Hill									
R609 north of junction with M28	**211**	**643**	**401**	**329**	**804**	**294**	*+55.9%*	*+25.0%*	*-26.7%*
Two Way Link Road									
To/from the Carr's Hill Interchange	**-**	**-**	**-**	**572**	**1042**	**353**	-	-	-
R610 Rochestown Road									
West of the M28	**719**	**1466**	**1062**	**676**	**1115**	**952**	*-6.0%*	*-23.9%*	*-10.4%*
East of the M28	**1347**	**1901**	**1395**	**1213**	**1608**	**1269**	*-10.0%*	*-15.4%*	*-9.0%*

	2035 Do-Minimum			2035 Do-Something			Percentage Impact		
	7-8	8-9	9-10	7-8	8-9	9-10	7-8	8-9	9-10
Maryborough Hill									
North of existing N28 Merge	**823**	**1109**	**604**	**819**	**1264**	**727**	*0%*	*+14.0%*	*+20.4%*
Between Broadale and Maryborough Ridge	**1018**	**1654**	**675**	**829**	**1520**	**815**	*-18.6%*	*-8.1%*	*+20.7%*
Adjacent to Douglas Golf Club	**760**	**937**	**656**	**723**	**981**	**711**	*-4.9%*	*+4.7%*	*+8.4%*
Garryduff Road									
opposite Maryborough Ridge	**327**	**886**	**406**	**489**	**944**	**574**	*+49.5%*	*+6.5%*	*+41.4%*
adjacent to the Sports Centre	**175**	**548**	**267**	**236**	**605**	**371**	*+34.9%*	*+10.4%*	*+40.0%*
Clarke's Hill									
North of Mount Oval Village	**445**	**456**	**397**	**272**	**297**	**252**	*-38.9%*	*-34.9%*	*-36.5%*
South of Mount Oval Village	**210**	**315**	**341**	**210**	**353**	**302**	*0%*	*+12.1%*	*-11.4%*
Coach Hill	**98**	**269**	**136**	**223**	**306**	**240**	*127.6%*	*+13.8%*	*+76.5%*
Slip Road into Mount Oval Village	**51**	**84**	**43**	**50**	**69**	**50**	*-2.0%*	*-17.9%*	*-16.3%*
R609 Carr's Hill									
R609 north of junction with M28	**335**	**826**	**381**	**399**	**1034**	**432**	*+19.1%*	*+25.2%*	*+13.4%*
Two-way Link Road									
To/from the Carr's Hill Interchange	**-**	**-**	**-**	**644**	**1032**	**360**	-	-	-
R610 Rochestown Road									
West of the M28	**890**	**1648**	**1252**	**768**	**1221**	**1040**	*-13.7%*	*-25.9%*	*-16.9%*
East of the M28	**1519**	**1980**	**1599**	**1319**	**1757**	**1409**	*-13.2%*	*-11.3%*	*-11.9%*

Table 5.23: Evening Peak 2-Way (Unless 1-Way Road) Traffic Flows on the Local Road Network in 2020 and 2035

	2020 Do-Minimum			2020 Do-Something			Percentage Impact		
	4-5	5-6	6-7	4-5	5-6	6-7	4-5	5-6	6-7
Maryborough Hill									
North of existing N28 Merge	**694**	**816**	**846**	**732**	**901**	**755**	+5.5%	+10.4%	-10.8%
Between Broadale * Maryborough Ridge	**777**	**1044**	**932**	**787**	**977**	**1015**	+1.3%	-6.4%	+8.9%
Adjacent to Douglas Golf Club	**713**	**858**	**912**	**702**	**833**	**770**	-1.5%	-2.9%	-15.6%
Garryduff Road									
opposite Maryborough Ridge	**379**	**483**	**502**	**423**	**636**	**634**	+11.6%	+31.7%	+26.3%
adjacent to the Sports Centre	**292**	**422**	**426**	**298**	**458**	**342**	+2.1%	+8.5%	-19.7%
Clarkes Hill									
North of Mount Oval Village	**343**	**405**	**433**	**293**	**366**	**339**	-14.6%	-9.6%	-21.7%
South of Mount Oval Village	**113**	**372**	**173**	**147**	**424**	**258**	+30.1%	+14.0%	+49.1%
Coach Hill	**199**	**202**	**170**	**224**	**229**	**243**	+12.5%	+13.4%	+42.9%
Slip Road into Mount Oval Village	**206**	**339**	**379**	**215**	**303**	**319**	+4.4%	-10.6%	-15.8%
R609 Carr's Hill									
R609 north of junction with M28 (two-way)	**450**	**410**	**403**	**555**	**647**	**543**	+23.3%	+57.8%	+34.7%
Two Way Link Road									
To/from the Carr's Hill Interchange	**-**	**-**	**-**	**349**	**545**	**698**	-	-	-
R610 Rochestown Road									
West of the M28 (two-way)	**1577**	**1705**	**1468**	**1431**	**1489**	**1247**	-9.3%	-12.7%	-15.1%
East of the M28 (two-way)	**1727**	**1861**	**1838**	**1668**	**1801**	**1755**	-3.4%	-3.2%	-4.5%
	2035 Do-Minimum			**2035 Do-Something**			**Percentage Impact**		
	4-5	5-6	6-7	4-5	5-6	6-7	4-5	5-6	6-7
Maryborough Hill									
North of existing N28 Merge	**816**	**898**	**960**	**818**	**991**	**918**	0%	+10.4%	-4.4%
Between Broadale and Maryborough Ridge	**923**	**1247**	**1100**	**926**	**1070**	**1177**	0%	-14.2%	+7%
Adjacent to Douglas Golf Club	**833**	**938**	**1023**	**778**	**906**	**859**	-6.6%	-3.4%	-16.0%
Garryduff Road									
opposite Maryborough Ridge	**456**	**489**	**605**	**539**	**768**	**826**	+18.2%	+57.1%	+36.5%
adjacent to the Sports Centre	**355**	**521**	**540**	**373**	**561**	**445**	+5.1%	+7.7%	-17.6%
Clarkes Hill									
North of Mount Oval Village	**422**	**446**	**439**	**368**	**422**	**411**	-12.7%	-24.0%	-6.4%
South of Mount Oval Village	**330**	**487**	**494**	**269**	**414**	**354**	-18.5%	-15.0%	-28.3%
Coach Hill	**173**	**190**	**143**	**216**	**266**	**235**	+24.9%	+40.0%	+64.3%
Slip Road into Mount Oval Village	**256**	**380**	**562**	**216**	**261**	**297**	-15.6%	-31.3%	-47.2%
R609 Carr's Hill									
R609 north of junction with M28 (two-way)	**587**	**484**	**444**	**819**	**763**	**651**	+39.5%	+57.6%	+46.6%
Two-way Link Road									
To/from the Carr's Hill Interchange	**-**	**-**	**-**	**439**	**606**	**798**	-	-	-
R610 Rochestown Road									
West of the M28 (two-way)	**1788**	**1907**	**1534**	**1575**	**1718**	**1465**	-11.9%	-10.0%	-4.5%
East of the M28 (two-way)	**1989**	**2062**	**1927**	**1965**	**1980**	**1964**	-1.2%	-4.0%	+1.9%

The likely traffic impact of the proposed Road Project will principally be to change the existing traffic flow patterns in the Rochestown/Douglas area. Without the M28 Road Project in place there is a large peak hour demand on Rochestown Road/Clarkes Hill to and from the N28 corridor and Douglas Village. There is also a high morning peak demand towards the existing northbound merge on Maryborough Hill. Traffic also travels via Douglas village.

The proposed Road Project and the proposed full interchange at Carr's Hill with the link from Maryborough Hill, in particular will have an effect on the prominent routes in the area. The provision of the interchange provides additional accessibility to/from the M28. M28 southbound traffic can now access Maryborough Hill and avoid the need to go through Douglas village and/or Rochestown Road. This has the effect of attracting additional traffic onto Maryborough Hill and Garryduff Road. There is a corresponding modest decrease in traffic utilising Rochestown Road/Clarke's Hill route to/from the M28 and Douglas Village.

A comparison of the traffic flows between the Do-Minimum and Do-Something scenarios indicate the following direct impacts on the local road network:-

- The new Carr's Hill Interchange and two-way link road is predicted to increase the peak hour traffic flow on Maryborough Hill just northwest of the existing N28 merge but predicted to reduce the peak hour traffic flow between Broadale and Maryborough Ridge and have a negligible impact further north, adjacent to the Maryborough Hotel.
- The new Carr's Hill Interchange and two-way link road will generate additional peak hour traffic flow on Garryduff Road as traffic from the Landsborough/Garryduff area will utilise the new Carr's Hill Interchange as the primary route to and from the M28.
- The peak hour traffic flow on the R609 Carr's Hill will increase to/from Douglas and the new Interchange and M28 as traffic flow assigns to this road to access the proposed interchange and M28.
- The new Carr's Hill Interchange and two-way link road is predicted to generate additional traffic flow on Coach Hill during peak hours, particularly in the hours either side of the highest peak hour. However, the volumes are low with the highest traffic flow on Coach Hill with the M28 Road Project in place being 357 vehicles per hour (in the 2020 morning peak hour). This is only 15 vehicles higher than the flow predicted without the M28 Road Project in place.
- It is predicted that with the M28 Road Project with the proposed Carr's Hill Interchange in place, it will result in noticeable reductions in the traffic flow on the R610 Rochestown Road, east and west of the interchange with the M28 and on the northern section of Clarke's Hill. This is due to the rerouting of local traffic to the proposed Carr's Hill interchange instead of either to the M28 interchange on Rochestown Road or to the Fingerpost roundabout.

The introduction of the proposed full interchange and two-way link road results in a reassignment of local traffic during the peak hours. In this scenario, additional traffic is attracted to the main routes to/from the proposed interchange. The document "*Traffic Capacity of Urban Roads*" TA 79 provides guidance on hourly link capacities based on the characteristics and width of the road. **Table 5.24** and **Table 5.25** compares the total peak hour traffic flows for 2020 and 2035 to estimates of the theoretical hourly link capacity for the key routes in the local road network.

Table 5.24: Comparison of 2020 Peak Hour Traffic Flow and Link Capacity

	2020 Peak Hour Total Traffic Flow	Theoretical Capacity
Maryborough Hill (Urban All-Purpose Road (UAP) 3)*		
North of existing N28 Merge	1,082	1,850
Between Broadale and Maryborough Ridge	1,414	1,850
Adjacent to Douglas Golf Club	879	1,500
Garryduff Road (Urban All-Purpose Road (UAP) 3)*		
opposite Maryborough Ridge	901	1,500
adjacent to the Sports Centre	508	1,850
Clarkes Hill (Urban All-Purpose Road (UAP) 3)*		
North of Mount Oval Village	366	1,500
Coach Hill (Urban All-Purpose Road (UAP) 3)*	357	1,500
Slip Road into Mount Oval Village (Urban All-Purpose Road (UAP) 2)*	303	900
R609 Carr's Hill (Urban All-Purpose Road (UAP) 3)*		
R609 north of junction with M28 (two-way)	804	1,850
Two-way Link Road (Urban All-Purpose Road (UAP) 1)*		
To/from the Carr's Hill Interchange	1,042	1,850
R610 Rochestown Road (Urban All-Purpose Road (UAP) 3)*		
West of the M28 (two-way)	1,489	2,167
East of the M28 (two-way)	1,801	2,167

* Roads are categorised as Urban All-Purpose Roads (UAP) in Table 1 of TA 79

Table 5.25: Comparison of 2035 Peak Hour Traffic Flow and Link Capacity

	Peak Hour Total Traffic Flow	Theoretical Capacity
Maryborough Hill (Urban All-Purpose Road (UAP) 3)*		
North of existing N28 Merge	1,264	1,850
Between Broadale and Maryborough Ridge	1,520	1,850
Adjacent to Douglas Golf Club	981	1,500
Garryduff Road (Urban All-Purpose Road (UAP) 3)*		
opposite Maryborough Ridge	944	1,500
adjacent to the Sports Centre	605	1,850
Clarkes Hill (Urban All-Purpose Road (UAP) 3)*		
North of Mount Oval Village	422	1,500
Coach Hill (Urban All-Purpose Road (UAP) 3)*	306	1,500
Slip Road into Mount Oval Village (Urban Purpose Road (UAP) 2)*	261	900
R609 Carr's Hill (Urban All-Purpose Road (UAP) 3)*		
R609 north of junction with M28 (two-way)	1034	1,850
Two-way Link Road (Urban All-Purpose Road (UAP) 1)*		
To/from the Carr's Hill Interchange	1032	1,850
R610 Rochestown Road (Urban All-Purpose Road (UAP) 3)*		
West of the M28 (two-way)	1,719	2,167
East of the M28 (two-way)	1,980	2,167

* Roads are categorised as Urban Purpose Roads (UAP) in Table 1 of TA 79

A comparison of the 2020 and 2035 peak hour traffic flows to the link capacities of the key routes in the Douglas/Rochestown area show that although there is some increases in traffic flow due to the development of the new scheme all roads have sufficient capacity to cater for the increase in traffic flow.

5.7.3.2 Impact on Journey Times along Key Routes in the Douglas/Rochestown Area

Table 5.26 outlines the changes in journey times during the Design Year 2035 morning and evening peak hours for vehicles travelling on the key routes in the Douglas/Rochestown area. In order to compare the impact on journey times due to the proposed road project, the following sample routes were selected for assessment:-

- Coach Hill - Fingerpost Roundabout along Rochestown Road;
- Garryduff Road - N40 via Maryborough Hill;
- Maryborough Hill – Fingerpost Roundabout; and
- R609 Carr's Hill – Fingerpost Roundabout.

Table 5.26: Changes in Journey Times along route in Douglas/Rochestown during 2035 AM and PM Peak hours

Journey Times (minutes)	2035 Do Minimum	2035 Do Something	2035 Do Minimum	2035 Do Something
	8-9am	8-9am	5-6pm	5-6pm
Coach Hill - Fingerpost Roundabout along Rochestown Road (Wb)	4.3	4.3	4.5	4.1
Coach Hill - Fingerpost Roundabout along Rochestown Road (Eb)	4.4	3.6	4.5	4.5
Garryduff Road – N40 via Maryborough Hill (Nb)	19.2	12.3	6.0	5.4
Garryduff Road – N40 via Maryborough Hill (Sb)	5.3	5.2	7.4	6.0
Maryborough Hill – Fingerpost (Nb)	10.3	6.0	3.4	3.0
Maryborough Hill – Fingerpost (Sb)	2.9	2.7	3.3	3.1
R609 Carr's Hill – Fingerpost (Nb)	3.1	3.0	2.7	3.0
R609 Carr's Hill – Fingerpost (Sb)	2.4	3.1	2.4	3.0

A comparison of Do-Minimum and Do-Something scenarios for the 2035 Design year peak hours show that the M28 Road Project will have a predominantly positive impact on journey times on routes through the Douglas/Rochestown area, especially on routes approaching the Fingerpost Roundabout and Douglas Village. This is the case even though the traffic volumes are predicted to increase on some local roads. The proposed improvement in road infrastructure capacity has the effect of increased efficiency and reduction in travel delays.

5.7.3.3 Impact of Removing the Existing N28 Merge at Maryborough Hill

Although the new Carr's Hill Interchange will provide increased accessibility from the R609 and Maryborough Hill to the M28, it will increase the journey distance for trips that currently use the N28 merge from Maryborough Hill. The closure of the merge to the N28 would typically result in traffic travelling an additional 600m back along a new two-way link road to the northbound merge to

the M28 which results in a total of approximately 1.2km additional travel distance for vehicles travelling northbound on the M28.

Table 5.27 outlines the changes in journey times during the Design Year 2035 morning and evening peak hours for vehicles accessing to and from Maryborough Hill and the M28. In order to compare the impact on journey times due to the proposed road project and closure of the existing merge in particular, the following sample routes were selected for assessment:-

- Broadale Estate to M28 northbound carriageway in the AM Peak Hour (with and without the M28 Road Project in place).
- Bloomfield Interchange southbound to Broadale Estate in the PM Peak Hour (with and without the M28 Road Project in place).

Table 5.27: Changes in Journey Times to/from Maryborough Hill and the M28 during 2035 AM and PM Peak Hours

Journey Times (minutes)	2035 Do Minimum	2035 Do Something	2035 Do Minimum	2035 Do Something
	8-9am	8-9am	5-6pm	5-6pm
Broadale Estate to M28 Northbound Carriageway ▪ Do-Minimum Distance – 725m ▪ Do-Something Distance – 1995m	6.5	4.4	-	-
Bloomfield Interchange southbound to Broadale Estate ▪ Do-Minimum Distance – 3162m ▪ Do-Something Distance – 2970m	-	-	5.5	3.4

A comparison of Do-Minimum and Do-Something scenarios show that although the distance to travel from Broadale to the M28 northbound carriageway increases with the closing of the existing merge at Maryborough Hill the predicted journey times will decrease which is a positive impact on the traffic flow in the local area. This is primarily due to the alleviation of traffic congestion on the northbound carriageway.

A comparison of Do-Minimum and Do-Something models show that in the evening peak hour the new linkage between the M28 southbound and Maryborough Hill will reduce both the distance and the journey time for trips to Maryborough Hill from the M28. This decrease in journey time is due to less congestion at key junctions, allowing traffic to flow more freely and the addition of a southbound diverge at the Carr's Hill interchange.

5.7.3.4 Impact on the Fingerpost Roundabout

The 2020 and 2035 Do-Minimum traffic models show that the highest Volume of Flow to Capacity (V/C Ratio) at the Fingerpost exceeds capacity in both the morning and evening peak hours. The 2020 and 2035 Do-Something models show that the proposed road project will have negligible impact on the highest V/C ratios and hence have negligible impact on the operation of the roundabout.

5.7.3.5 Impact of Maryborough Hill/New Link Road Junction

The proposed Maryborough Hill/New Link Road junction will operate as a priority controlled junction so it will not impact on through traffic movement on Maryborough Hill. The junction will have a dedicated right turn lane for vehicles looking to access the new link road. The capacity assessment showed that there are sufficient gaps in traffic flow to allow both this right turning movement and also turning from the new link road onto Maryborough Hill without excessive delay. The option of traffic signal control at this junction was also considered. The assessment of this alternative concluded that there would be no additional benefit to the operation of the junction by the installation of traffic lights.

5.7.3.6 Impact on R610 Rochestown Road (including St. Patrick's Church Roundabout)

The assessment of the receiving environment and feedback received from the public consultation confirm that there are peak hour capacity and operational problems on the R610 in the vicinity of St. Patrick's Roundabout (extended queuing along the Rochestown Road and the N28 off-slip regularly occur). In addition, safety issues due to inadequate deflection, poor visibility and excessive gradients on the approach arm from St. Patrick's Church are present at the roundabout. The issues identified on Rochestown Road and at the existing roundabout have the potential to adversely impact on the operation of the M28, particularly queueing back on the exit ramp onto the M28 mainline and possibly the N40.

An improvement scheme for the Rochestown Road/M28 junction was developed to mitigate the negative effects described above. The proposed design includes removing the roundabout junction and providing a linked traffic signal control system on the section of Rochestown Road from the existing pedestrian crossing adjacent to Rochestown Rise to the proposed junction with Clarke's Hill. This involves re-configuration of the roundabout junction in conjunction with the signalisation of the adjacent Rochestown Road/M28 on-slip and Rochestown Road/Clarke's Hill junctions. This will provide an integrated linked traffic control mechanism for this section of the R610 Rochestown Road and would improve the operational performance of the junctions. In addition, under traffic signal control, the problems of entry deflection and entry visibility would be resolved. The problem of entry gradient would also be alleviated through the re-configuration and as the need to 'find a gap' in the traffic streams would not be necessary under traffic signal control.

Under the proposed traffic light control system, it will be possible to optimise traffic flows through the M28/Rochestown Road junction. The proposed traffic signalisation will also provide for enhanced pedestrian facilities. The M28 Road Project includes the linked signalisation of Rochestown. Therefore, the traffic impact assessment includes this element in the Do Scheme scenarios.

5.8 FUTURE DAILY TRAFFIC FLOWS

The key characteristic of the local road network north of Carr's Hill is peak hour congestion. The predicted impact of the M28 Road Project on this area is described in detail in the preceding sections. In order to assess the traffic impact on a wider basis, it is proposed to compare the estimated Annual Average Daily Traffic (AADT) flows on various links with and without the proposed road project in place. **Section 5.8.1** describes the impact along the M28 corridor and **Section 5.8.2** describes the impact on the local road network around the M28 corridor. In addition, **Figures 5.13** and **5.14** illustrate the impact of the proposed road project on traffic (AADT and HGV %) across the

road network for the Design Year 2035. **Table 5.28** summarises the daily traffic assignment to the proposed road project.

Table 5.28: Design Year Daily Traffic Assignment to the Proposed Road Project

Section of Proposed Road Project	2035 AADT	2035 % HGV
Bloomfield to Rochestown Road	64,760	10.1
Rochestown Road to Carr's Hill	38,260	14.5
Carr's Hill to Shannonpark	37,050	15.0
Shannonpark to Shanbally	12,780	32.9
Shanbally to Barnahely	11,410	35.7
Barnahely to Loughbeg	9,150	44.9
Loughbeg to East of Ringaskiddy	5,990	64.0

5.8.1 Design Year 2035 AADT (Do-Minimum v Do-Something) on N40/M28 Corridor

Table 5.29 shows the 2035 Do-Minimum and Do-Something AADT on the M28 corridor and the percentage differences.

A comparison between the Do-Minimum and Do-Something show a significant reduction in traffic flow (circa 85% reduction) on the existing N28 between Carr's Hill and Shannonpark Roundabout.

There will also be a reduction of traffic flow (circa 65% reduction, west of Shanbally) on the existing N28 between Shannonpark Roundabout and Ringaskiddy, which will have a positive impact on Shanbally Village and onwards through Ringaskiddy Village.

There will be marginal changes in the overall traffic volumes on the N40 with the M28 Road Project in place.

Table 5.29: Comparison between the 2035 AADT on the M28 Corridor

	2035 AADT Do-Minimum	2035 AADT Do-Something	Percentage Impact
N40 (west of Bloomfield)	79,600	82,140	**+3.2%**
N40 (east of Bloomfield)	87,140	86,650	**-0.6%**
Existing N28 (Bloomfield to Rochestown)	60,560	64,760	**+6.9%**
Existing N28 (Rochestown to Carr's Hill)	23,970	38,260	**+60.0%**
Existing N28 (Carr's Hill to L6477)	30,340	4,620	**-84.8%**
Existing N28 (L6477 to Shannonpark)	31,580	5,300	**-83.2%**
Existing N28 (Shannonpark to Raffeen)	17,990	11,130	**-38.1%**
Existing N28 (Raffeen to Shanbally)	17,270	5,600	**-67.6%**
Existing N28 (Shanbally to Ringaskiddy DWB)	10,860	3,750	**-65.5%**
Existing N28 (through Ringaskiddy)	9,040	3,630	**-59.8%**
R610 Rochestown Road (East)	25,660	23,820	**-7.2%**
R610 Rochestown Road (West)	22,010	19,180	**-12.9%**
R611 to Carrigaline	20,350	24,180	**+18.8%**
R610 Raffeen	5,650	5,440	**-3.7%**

	2035 AADT Do-Minimum	2035 AADT Do-Something	Percentage Impact
R613 Barnahely	3,650	2,590	**-29.0%**
L2492 at Shanbally	6,220	3,250	**-47.8%**
L2545 at Ringaskiddy	3,050	3,230	**+5.9%**
M28 (North of Shannonpark)	-	37,050	-
M28 (East of Shannonpark)	-	12,780	-
M28 (East of R613 Barnahely)	-	9,150	-

5.8.2 Design Year 2035 AADT (Do-Minimum v Do-Something) on Local Road Network

Table 5.30 shows the 2035 Do-Minimum and Do-Something AADT on the local road network and the percentage differences.

A comparison between the Do-Minimum and Do-Something show an increase in traffic on the R609, and on Garryduff Road. This is related to the proposal for a full access interchange at Carr's Hill, which provides increased accessibility to the M28 to/from Douglas.

There will be decreases in the overall traffic volumes on the R610 Rochestown Road, Clarke's Hill and Maryborough Hill (South of the M28) with the M28 road project in place. This is a result of the alternative of using the new interchange at Carr's Hill Interchange rather than the Rochestown Road Interchange.

Table 5.30: Comparison between the 2035 AADT on the Local Road Network

	2035 AADT Do-Minimum	2035 AADT Do-Something	Percentage Impact
Douglas Village	22,750	22,840	**+0.4%**
Clarke's Hill (North of Mount Oval Village)	5,550	4,260	**-23.2%**
Clarke's Hill (South of Mount Oval Village)	3,870	3,370	**-12.9%**
Maryborough Hill (Douglas Golf Club)	10,460	10,370	**-0.9%**
Maryborough Hill (South of the N28)	9,730	8,150	**-16.2%**
L6477 Maryborough Hill to Carrigaline	3,980	1,390	**-65.1%**
Moneygourney Road	1360	870	**-36.0%**
Ballinrea Road	6,390	8,040	**+25.8%**
R609 Carrigaline Road	6,530	7,740	**+18.5%**
Garryduff Road (adjacent to Maryborough Ridge)	6,270	8,040	**+28.2%**
Garryduff Road (adjacent to the Sports Centre)	4,560	4,660	**+2.2%**
Coach Hill	2,120	2,860	**+34.9%**
Church Road, Douglas	11,930	11,430	**-4.2%**
Grange Road	12,980	12,750	**-1.8%**
Donnybrook Hill	12,570	8,460	**-32.7%**
L2474 Towards Rochestown College	6,950	6,330	**-8.9%**

A comparison between the Do-Minimum and Do-Something AADT show a significant reduction in traffic flow on the existing N28 (between Shannonpark and Carr's Hill) and the remote wider local roads between Douglas and Carrigaline as traffic reassigns to the M28. This is evident on the L6477, Moneygourney Road which connects the existing N28 (north of Shannonpark) to Maryborough Hill and on Ballinrea Road to Donnybrook Hill, which is an alternative route to Douglas from Carrigaline.

Overall and in a similar conclusion to the peak hour assessment, the new road project has a significantly positive impact on the traffic flow along a sub-standard section of the existing N28 carriageway (between Shannonpark Roundabout and Carr's Hill) and through the villages of Ringaskiddy and Shanbally. The road project will have a varied but modest impact on the wider Douglas/Rochestown local road network.

Figure 5.13: Comparison of AADT and HGV% between the Do-Minimum and Do-Something Scenarios – Northern Section of the M28 Road Project

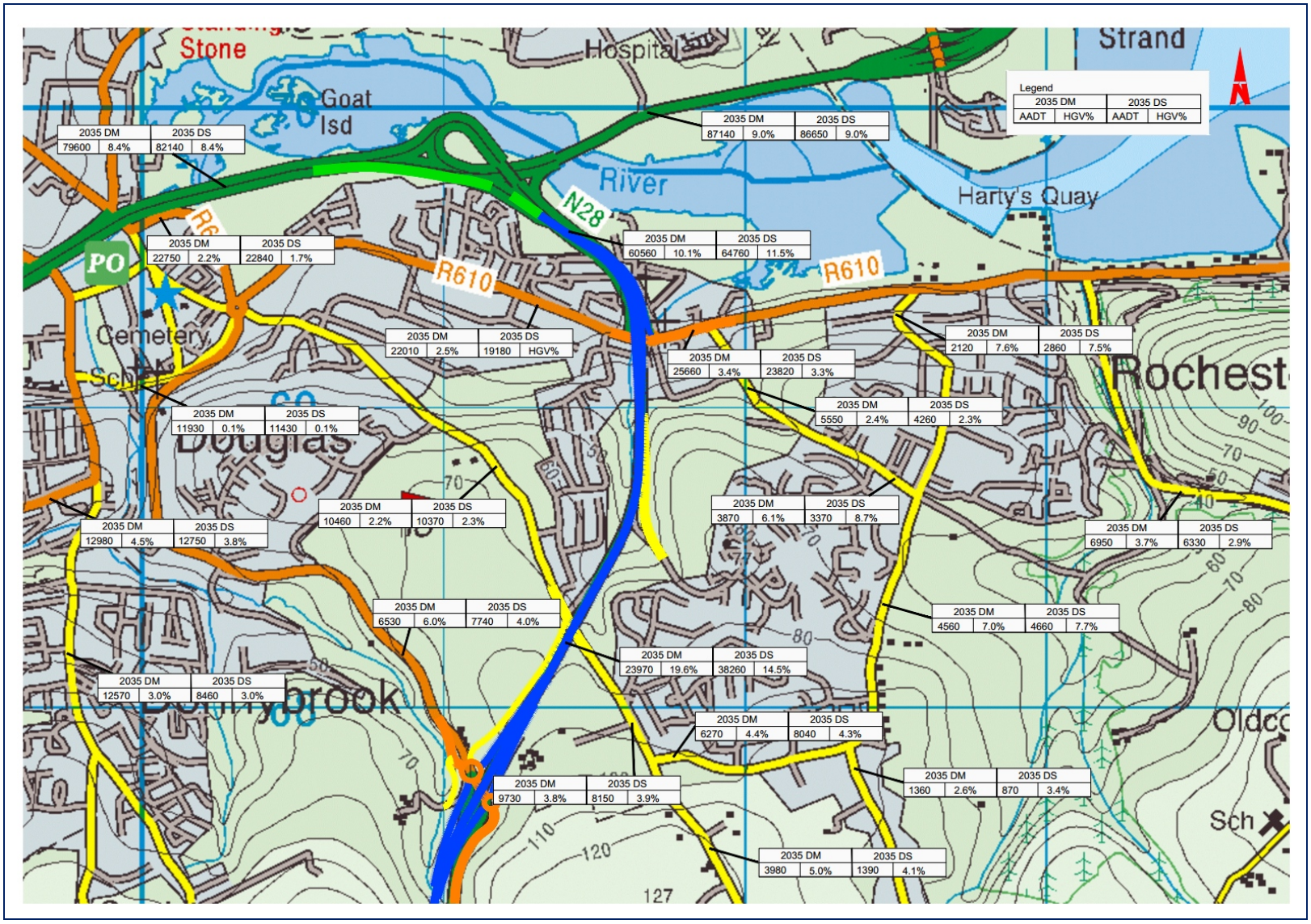
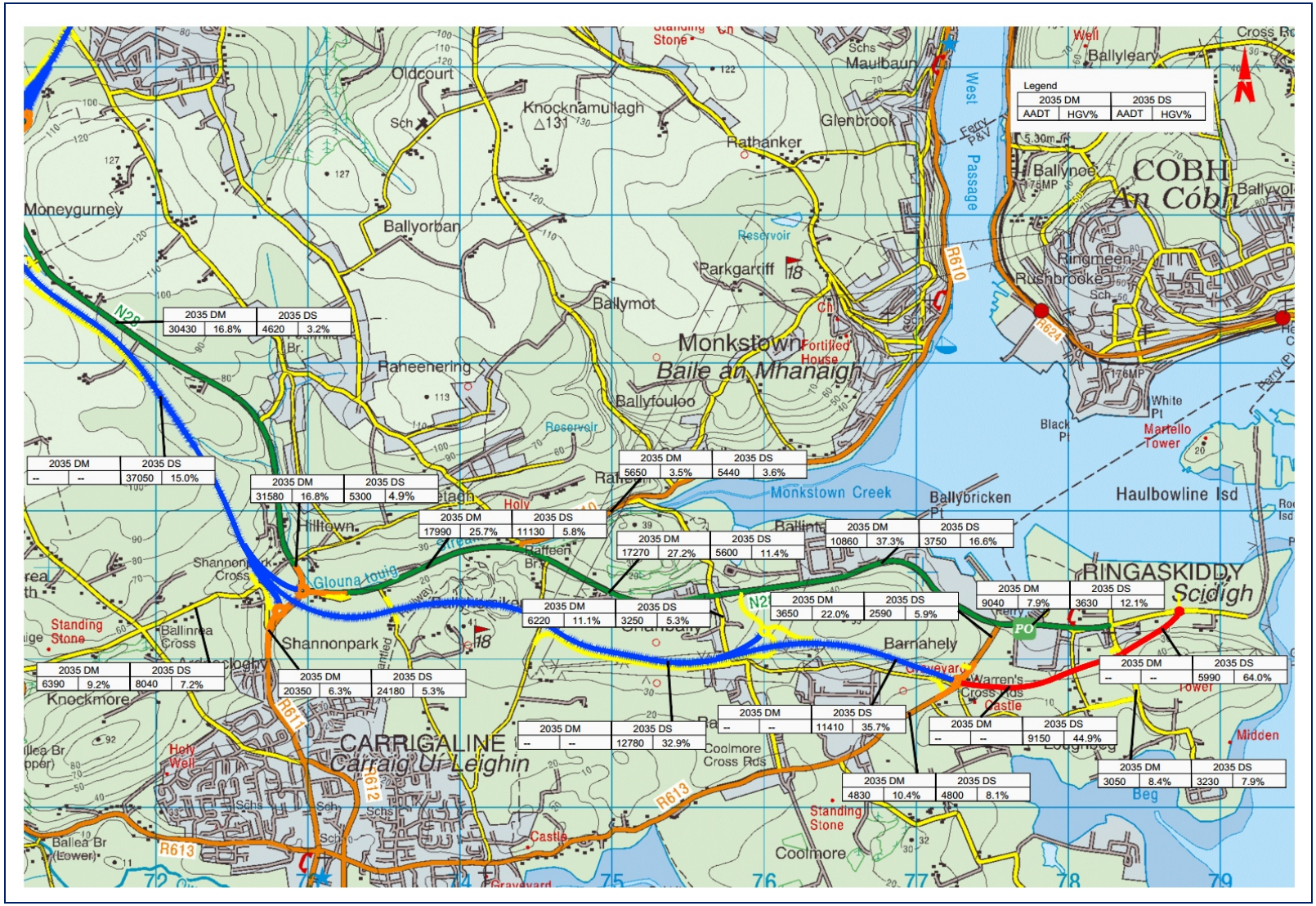


Figure 5.14: Comparison of AADT and HGV% between the Do-Minimum and Do-Something Scenarios – Southern Section of the M28 Road Project



5.9 BENEFIT OF THE M28 ROAD PROJECT FOR SUSTAINABLE TRANSPORT MODES

The policy document 'Smarter Travel – A Sustainable Transport future' sets out a blueprint for the delivery of more sustainable transport in Ireland. It includes for a broad suite of measures which aim to achieve a sustainable transport system. The development of targeted road schemes is part of this strategy. In particular, road schemes which provide environmental, social and economic benefits are envisaged in the strategy. Such road schemes would increase transport efficiency (reduce delay, congestion and bottleneck effects), benefit the efficient transport of freight particularly to/from maritime ports and facilitate the implementation of alternative transport modes.

The existing N28 corridor is the main route between Cork City and Carrigaline and Ringaskiddy. It is an essential route for travelling within the study area and is often congested, particularly in peak times. The level of existing congestion has significant implications for the implementation of other non-car based travel modes. Journey delays and congestion related road safety issues make the existing route unsuitable and/or unattractive for alternative modes. Many people would consider walking or cycling on the existing road unsafe and public transport in the form of bus services suffers the same journey delays as general traffic. As a result of these constraints, the favoured mode of transport in the area is by motorised vehicles. As noted in the Carrigaline Electoral Area Local Area Plan, the Central Statistics Office has identified Carrigaline as the most car dependent town in Ireland.

In order to provide viable alternative mode of transport choices for people, it is essential that there is increased capacity in the road network. The proposed road project provides increased capacity which reduces journey times and congestion in the local road network. The reassignment of significant volumes of traffic from the existing N28 to the proposed motorway/protected road will facilitate the reallocation of road space to other transport modes. With the reduction in traffic volumes, it will be possible to develop a walking/cycling route along the existing road. This provision will assist with providing alternative travel choices in the area and encourage modal change to more sustainable transport options.

Public Transport serving the area is currently by means of scheduled bus services. The provision of the road project has the potential to facilitate significantly improved bus services in the local area especially along the existing N28. Express bus services to/from Carrigaline and Cork City in particular, facilitated by the motorway would be a significant improvement in public transport services potentially leading to significant public transport mode shift in the area. Such improvements in service coupled with the reduction in journey times and implementation of bus priority measures locally has the potential to make public transport a more realistic choice for the local populations.

To further support the concept of sustainable transport, the M28 Road Project will include provision for pedestrian and cycle facilities on sections of the existing N28 by incorporating appropriate verge areas in the future scheme. At other side roads, provision for footways and cycleways are included to match existing facilities and/or to facilitate known future developments. In this way, the M28 Road Project will provide sufficient road space to accommodate the expansion of sustainable modes of travel in the area. The provision for pedestrian and cycling facilities along the M28 Road Project is illustrated on **Figure 1.4** of **Chapter 1: Introduction and Need for the Proposed Road Development** (contained in **Volume 5**) and as described below:-

- A segregated pedestrian/cycleway is proposed at Carr's Hill Interchange. The pedestrian/cycle facilities provided will link the R609 to the existing N28, either side of the proposed interchange, via a proposed underpass beneath the proposed motorway.
- Verge widths to accommodate cycle and pedestrian facilities through the interchange at Shannonpark. Cycle and pedestrian linkages are provided on the existing N28 and link through to the R611.
- The proposed underbridge at Ballyhemiken (Rock Road) Road includes sufficient span to accommodate future cycle and pedestrian linkage on both sides of the road. This provision facilitates the development of the proposed Passage West to Carrigaline Greenway.
- Existing pedestrian movements are retained at the proposed Shanbally Interchange. Provision for a footway is included on the proposed IDA Road Link. Also a footway is to be provided on the proposed L6472 Shanbally to Raffeen Link Road as far as the football pitch.
- It is anticipated that a future cycle route may be designated on the existing local road, L6472 between Shanbally and the R613 at Barnahely. To facilitate this, a cycle link is included onto the R613 at Barnahely. Provision is also included on the R613 North Link road and around the roundabout to link to the possible L6472 cycle link. Provision for pedestrian access is included on the R613 North and South Link Roads and the Janssen Access Spur to match existing facilities.
- A pedestrian/cyclist underpass is proposed along Old Post Office Road, principally to provide non-motorised access to the Ringaskiddy Lower Harbour National School.
- The realignment of Loughbeg Road is proposed to include a footway to match the existing facility.
- A 6.0m wide shared use cyclist/pedestrian facility is proposed along the northern side of the L2545 at the proposed Ringaskiddy Roundabout.
- The section of mainline from Barnahely to Ringaskiddy is proposed as a Protected Road and as such will not include facilities for pedestrians and cyclists. Non-motorised users will be directed to the existing road network.
- A new footway is proposed on the southern side of Rochestown Road to complete pedestrian accessibility through the proposed traffic light control system. An additional pedestrian crossing is also proposed on the eastern side of the M28 access junctions adjacent to The Ovals housing estate.
- The replacement Maryborough Hill Overbridge will include a 2.0m footway on the north side to tie-in to the existing footway. Provision for a future footway linkage will also be included on the south side of the proposed bridge. The existing cycle lane on Maryborough Hill is also proposed to be extended over the proposed overbridge.

The proposed road project will remove a significant volume of traffic flow from the existing carriageway through Shanbally and Ringaskiddy. This would provide scope for developing the public realm within the villages and improving facilities for walking/cycling in the area.

The impact of the proposed road project on the connectivity for other non-motorway users (NMUs) is described in **Section 3.3.1** of this EIS. The proposed mainline M28 diverges from the existing N28 at Carr's Hill. At this location, the existing N28 road will be diverted through the proposed Carr's Hill interchange and will be realigned to connect through to the existing R609. It is proposed to maintain the existing N28 carriageway from Carr's Hill to Ringaskiddy to act as a local access road for local traffic. This road will be reclassified to become a regional or local all-purpose road. Together with the R609, the route will provide the primary route in the area for non-motorway users.

An alternative route to the R609 for NMUs is the proposed Maryborough to Carr's Hill Link Road which links the proposed Carr's Hill Interchange to Maryborough Hill.

Other local roads are also present but may not be suitable routes for pedestrians, cyclists and other vulnerable road users but would be alternatives for motorised NMUs.

5.10 DEMAND MANAGEMENT

Demand management is a critical aspect to managing the way travel is carried out. This is an on-going transport management function to influence the need and way people travel, particularly in peak hours. It is an essential factor for the preservation of the value of the existing transport network assets over time.

In terms of this road project, the proposed demand management measures proposed for the port expansion in Ringaskiddy are accounted for in this traffic impact assessment. However, for the purposes of carrying out a robust traffic impact analysis, demand management measures have not generally been assumed in the analysis.

5.11 CONSTRUCTION STAGE TRAFFIC MANAGEMENT

5.11.1 General

Construction is predominantly offline. The traffic-related construction impacts of the offline sections are likely to be minimal, and there will be little disruption to existing flow of traffic on the existing N28. However, restrictions relating to traffic generated by the construction phase will apply as set out in the following sections.

However, as the section of the proposed M28 mainline from Carr's Hill to the existing Bloomfield Interchange is "online" i.e. the proposed upgrade will overlay the existing road as this section will in effect be widened, there will be construction related disruption to traffic in this section of the proposed road project. The local environment at the northern end of the proposed road project is very sensitive to traffic disruption. There is limited capacity in the local road network and high demand in peak hours. Peak hour delays frequently occur in the existing situation and further disruption to traffic flows would have a serious impact on the local travelling public. **Section 5.4 Receiving Environment** demonstrates the problems that exist at the northern end of the road project in the peak hours. Minimising the disruption to local traffic flow will be a key objective in the development of the temporary traffic management plans for the construction.

Effective traffic management plans will be required to minimise disruption during construction of this section of the M28. The successful Contractor will be required to submit a Construction Traffic Management Plan (CTMP) to be agreed with Cork County Council and appropriate emergency services, i.e., An Garda Síochána, ambulance services and fire services in order that potential road closures and restrictions and diversions are carried out safely and efficiently and to the satisfaction of the relevant stakeholders.

Except as specifically set out in the following section, it is a requirement that all local roads are maintained open to traffic at all times during the construction stage. This includes the existing N28 and other key routes in the area.

5.11.2 Traffic Management Requirements – Bloomfield Interchange to Carr's Hill

As outlined in **Section 3.13.1.3** of this EIS, a proposed set of restrictions in terms of traffic management and the order and sequencing of the proposed works at the northern end of the site are to apply to minimise the temporary traffic impacts on the travelling public during the construction phase. These measures are to be complied with during the construction and temporary traffic management planning for the project. They are repeated here for completeness:-

- The existing N28 will remain open to two-way traffic at all times, except for short term managed road closures for critical works, such as the proposed demolition of the Maryborough Hill overbridge. This will entail careful phasing and sequencing of the works along the N28 in order to maintain traffic flows.
- All traffic movements will be accommodated on the section of the works between Bloomfield Interchange and Rochestown Road. Phasing of the works will be carefully planned and sequenced to maintain traffic flows at all times. An illustrative outline of a possible construction sequence is described in **Section 5.11.6.2** below.
- Local road closures will not be permitted, except for critical works. Any road closures permitted will be for limited periods, e.g., night-time or weekend.
- Works on the local road network at the northern end of the road project will not coincide. This means that works, say on Rochestown Road will not coincide with works on Maryborough Hill or Carr's Hill and so on.

A designated construction order and sequence shall apply to the proposed works between Rochestown Road and Carr's Hill. This order and sequence is described in detail in **Section 5.11.6.4** below.

5.11.3 Other Construction Stage Traffic Management Requirements

5.11.3.1 Peak Hour Restriction on Construction Related Traffic

As noted in **Section 3.13.1.3** of this EIS, the study area is very sensitive to traffic delay and disruption during the peak hours. The preparation of the Construction Traffic Management Plan will include measures to ensure that construction related traffic is not going to contribute to the existing peak hour traffic congestion problems. There will be a requirement construction related traffic will be restricted from entering the local road network during the AM (07.45-09.00) and PM (17.00-18.00) commuter peak periods. The local road network as referred to in this requirement would encompass the network as illustrated in **Figure 3.1**. Any necessary exceptions to this to be agreed in writing with the Planning Authority and in advance as variations to the Construction Traffic Management Plan.

This restriction applies to construction related traffic travelling to and from the site and applies to both the workforce and material deliveries.

5.11.3.2 Road Closures and Temporary Diversions of Traffic

It may be critical from time to time to close parts of the local road network and implement temporary diversions of traffic. Such measures have the potential to cause serious delay and disruption to the local travelling public and will only be accepted for short term duration for critical works. A non-exhaustive list of critical works requiring road closures include:-

- Night time closures to place bridge beams over existing roads, e.g., Rochestown Road and R611 at Shannonpark.
- Weekend closures, e.g., for the demolition of the existing Maryborough Hill overbridge. Further night time closures will be necessary for bridge beam installation.

To facilitate these road closures, alternative routes will be required for the diverted traffic.

All plans prepared for road closures and temporary diversion of traffic will be subject to the approval of Cork County Council and will be prepared in consultation with the emergency services, e.g., An Garda Síochána, ambulance services and fire services. Any approval for night/weekend working will give consideration to the potential disruptive effects there may be on nearby residences and significant restrictions on noise and other adverse environmental emissions may be conditioned to any approval granted by Cork County Council.

5.11.3.3 Weekend and Night time Working

As noted above, weekend and night time working will be necessary for critical works involving road closures. In addition to this, it is likely there will be need for other works to be carried out at night time and weekends.

All plans prepared for night or weekend working will be subject to the approval of Cork County Council and will be prepared in consultation with the emergency services. e.g., An Garda Síochána, ambulance services and fire services. Any approval for night or weekend working will give consideration to the potential disruptive effects there may be on nearby residences and significant restrictions on noise and other adverse environmental emissions may be conditioned to any approval granted.

5.11.3.4 Construction Traffic Management Plans (CTMP)

In order to manage the likely construction related traffic movements and the normal traffic movements in the Ringaskiddy Area, the CTMP must incorporate the following controls:-

- **CTMP to be agreed** with Planning Authority before commencement of development. It shall be the responsibility of the Contractor to ensure that an agreed CTMP is in place before construction commences and that clear structures/arrangements are in place for full compliance during the course of construction.
- **No construction related traffic** to be permitted to use the road network in the area during the AM (07.45-09.00) and PM (17.00-18.00) commuter peak periods 2, on a 5 day week basis. Any necessary **exceptions** to this to be agreed in writing with the Planning Authority and in advance, as **variations** of the CTMP.

- Restrictions to apply to **all movements**; i.e. construction employees, supervisory staff and construction vehicles alike.
- If construction related employees are to access or leave construction sites during the specified peak traffic periods than they shall only do so by walking, cycling or bus.
- HGV movements to avoid school times and locations, insofar as possible.
- Other **roads related restrictions** such as:
  - Measures to prevent blocking of roads/inappropriate parking etc.
  - Truck wheel washing
  - Road soiling prevention/Road cleaning as required
  - Hours of operation
  - Pavement damage
  - Noise, dust and other nuisance issues
  - Advance signage
  - Miscellaneous matters bespoke to each individual site.
- Each CTMP to be dynamic in nature and **varied at regular intervals** in the light of conditions in the receiving environment.

5.11.4 Offline Section of the Road Project– Carr's Hill to Ringaskiddy

The construction of the offline sections will involve an element of interface with the existing road network during the construction of underbridges and at the L6465 Board of Works Link Road, R611/Shannonpark (also includes a new north roundabout), L2490 Rock Road, Shanbally and new roundabouts and realignments at R613 Barnahely, L6517 Loughbeg and at Ringaskiddy.

It is considered that the above works will cause some disruption to traffic but can be undertaken causing minimal traffic disruption during the construction. However, the proposed works at the Loughbeg Road are likely to require the construction of a temporary road and phased permanent road construction to complete the works whilst maintaining two-way traffic during the construction period.

For the off-line sections, it is anticipated that there will be two temporary slight negative impacts from the construction work:-

- An increase in off peak vehicle movements per day during the construction phase due to the delivery of building material and equipment and also due to workers commuting to/from the site,
- Traffic delays resulting from roadworks when constructing the M28 Road Project. For the off-line sections, these will mainly tie-ins to the local road network and a limited number of local roads which will be crossed by the proposed works.

5.11.5 Delivery of Materials to Site

The earthworks balance along the mainline is such that there will be a need for additional material.

It is anticipated that the majority of this deficit of material will be obtained from Raffeen Quarry. The route of the proposed road passes through the southern part of the quarry. The quarry has planning permission to resume material extraction, obtained on 16th July 2008 under Reg. Ref. 06/10037 and PL. 04.225610. This planning permission is valid for a 30 year period.

Material from the quarry can be transported along haul routes within the proposed site which will negate the need to access public roads. These measures will greatly reduce, but not completely eliminate, the need to import material from elsewhere.

Road pavement construction and the construction of bridges and other structural works (retaining walls, culverts, traffic sign gantries etc.) will generate HGV trips through delivery of asphalt, concrete, drainage pipework, steel and other construction materials. The timing of these trips will be irregular and spread out over time as required by the construction programme.

To minimise the impact of these additional HGV trips on the congested road network, the Contractor will be required to manage the deliveries so that:-

- Material will be transported along haul route through the site as much as possible.
- HGV drivers are instructed not to use unsuitable local roads.
- HGV trips will be scheduled to avoid peak traffic periods during the day.
- Deliveries will, for the most part will be confined to using the existing N28 route.

5.11.6 Online Works between Bloomfield Interchange and Carr's Hill

The on-line works proposed for the section of the road project between Bloomfield and Carr's Hill are complex. This section will require the careful consideration in terms of the phasing and sequencing of the works to minimise adverse impact on the travelling public. Critical areas of work along this section include:-

- Widening of the westbound M28 to N40 merge.
- On-line widening between Bloomfield and Rochestown Road, including the construction of large retaining walls and a new overbridge over Rochestown Road.
- Proposed works on Rochestown Road.
- On-line widening between Rochestown Road and Maryborough Hill, including the construction of large retaining walls.
- Proposed new bridge replacement at Maryborough Hill.
- On-line widening between Maryborough Hill and Carr's Hill, including the construction of large retaining walls.
- Widening of Carr's Hill Underbridge and construction of Carr's Hill Interchange.

It is intended that two-way traffic flow on the existing N28 will be maintained at all times during the construction period as will traffic interchanging with the N40 and Rochestown Road. Traffic will also be maintained on critical local roads including Rochestown Road, Maryborough Hill (though one-way eastbound for a period) and the R609. This will be achieved by careful temporary traffic management and works phasing as described in the following sections.

5.11.6.1 Widening for Construction of the Westbound M28 to N40 Merge

This element of the works comprises the reconfiguration of the westbound merge from the M28 to the N40. The construction of this element involves widening of the existing carriageway at the location of the existing westbound merge. In order to carry out the work safely, temporary traffic management plans will be required and it is envisaged that the existing two lane slip road will be reduced to one lane during the works, which are envisaged to be carried out during off peak periods

5.11.6.2 Bloomfield to Rochestown Road

The following outline of a construction sequence illustrates one potential way the works may be constructed whilst maintaining existing traffic flows. The **TM Series** of drawings in **Volume 5** provide an illustration of the proposals.

1. Phase 1

Isolate a construction site on the eastern side of the site to construct the proposed works in this area. During this phase it is proposed that the following works will be completed:-

- Construction of Retaining Wall – RW2, which is largely off-line from the existing road, (note, some excavation temporary supports are likely to be required to construct some sections of the proposed retaining wall, temporary sheet piles are illustrated).
- Bulk Earthworks and construction of embankment for the Southbound Diverge Slip Road and approaches,
- Construct temporary realignment of N28 diverge slip road.
- Construct permanent pavement, drainage, barriers and other finishes.

Access to the site will be primarily from the access road to St. Patricks Church and southbound on the N28. For safety reasons, temporary traffic management measures are likely to be required on the access road to St. Patrick's Church.

During this stage existing traffic on the N28 is largely unaffected, though local diversions will be required at tie-ins. Careful planning of the works will be necessary to minimise the impact on local traffic accessing St Patrick's church and the existing dwellings located adjacent to the proposed site.

Upon completion of this phase, the proposed road widening on the east side and the permanent southbound diverge slip lane will be available for diverted traffic.

2. Phase 2

Phase 2 is envisaged to be located on the east side between the newly constructed southbound diverge slip road and the existing road. Works constructed in Phase 1 will be used to accommodate traffic flows. During this phase it is proposed that the following works will be completed:-

- Construction of Retaining Wall – RW5. Temporary excavation supports will be required.
- Widening and surfacing to main southbound carriageway between southbound slip road and existing road.

- Partial construction of proposed median barrier.
- Construct pavement, drainage, parapets, barriers and other finishes to approach embankments.

Access to the proposed works area is likely to be from Rochestown Road and from the southbound N28 carriageway.

Upon completion of this phase, a significant section of the proposed southbound carriageway will be available for future temporary traffic management phases.

3. Phase 3

Phase 3 is located in the middle of the site. During this phase it is proposed that the following works will be completed:-

- Partially Construct Retaining Wall – RW4.
- Removal of the existing median and surfacing to main carriageway between northbound and southbound traffic.
- Partial construction of proposed median barrier and proposed road layout. This is likely to entail night working and the operation of a single southbound trafficked lane.

During this phase northbound traffic remains relatively unaffected. Southbound traffic is diverted onto the permanent layout for the mainline and southbound Rochestown Road diverge slip road completed in Phases 1 and 2. Access to the site will be via the southbound N28 and the northbound N28.

Upon completion of this phase, the full extent of the proposed southbound carriageway and some of the permanent northbound carriageway will be available for future temporary traffic management phases.

4. Phase 4

Phase 4 is located in the middle of the site. During this phase it is proposed that the following works will be completed:-

- Complete construction of Retaining Wall – RW4. Temporary excavation supports will be required.
- Complete surfacing to eastern side of RW4.
- Construct drainage, parapet and other finishes on approach embankments.
- Construct one lane of Rochestown Road merge.

In this phase it is proposed to divert northbound N28 traffic into the area constructed in Phase 3, adjacent to the southbound N28 traffic, which remains as per Phase 3. It is proposed to merge traffic travelling northbound on the main N28 road with traffic travelling from the existing northbound merge.

Access to the site is likely to be via Rochestown Road, the northbound merge and the northbound N28.

At the end of this phase one of the northbound merge lanes will be completed and available for temporary traffic management.

5. Phase 5

Phase 5 is located adjacent to the existing northbound merge from Rochestown Road. During this phase it is proposed that the following works will be completed:-

- Complete construction and surfacing on northbound merge in order to accommodate two lanes of traffic.
- Complete junction reconfiguration between the northbound merge and Rochestown Road.

Access to the site for this phase is likely to be via Rochestown Road and the northbound merge.

For this phase it is proposed to maintain two separate northbound merge lanes; one on the existing northbound merge to cater for Rochestown Road eastbound traffic and one on the proposed northbound merge lane to cater for westbound Rochestown Road traffic.

Once this phase is completed, construction space can be made available for the construction of the proposed M28 to N40 westbound interchange link road.

6. Phase 6

Phase 6 is located on the western side of the proposed road project. During this phase it is proposed that the following works will be completed:-

- Construction of RW1 & RW3.
- Construction of Structure S2 over Rochestown Road
- Bulk Earthworks to proposed Northbound M28 to N40 Westbound link road.
- Surfacing to Northbound N28 to N40 Westbound link road.
- Construct drainage, parapet, barriers and other finishes on approach embankments.

Access to the proposed site from Rochestown Road is envisaged.

5.11.6.3 Proposed Works on Rochestown Road

The proposed works on Rochestown Road include for widening of the existing road, new footway construction, new boundary wall construction and new traffic light control. Works to construct the junction with the northbound merge lanes and Structure S2 will be carried out in conjunction with the proposed phasing of the construction works between Rochestown Road and Bloomfield Interchange; Phase 6 as outlined above.

The remaining works on Rochestown Road will be carried out at a time when works to construct the section between Rochestown Road and Bloomfield are substantially complete and there are no restrictions to traffic on this section of the road project. Also, the works on Rochestown Road will not coincide with proposed works at either Maryborough Hill or Carr's Hill. This is to minimise disruption to local traffic flows.

When the works are carried out, it is envisaged that they will not take place during peak hours. Much of the works will be constructed utilising one-way shuttle systems though there may be need for short term temporary road closures for critical works.

5.11.6.4 Construction Phasing/Sequence – Rochestown Road to Carr's Hill

The new road layout between Rochestown Road and Carr's Hill involves the construction of road widening, new links, substantial retaining walls and a full interchange at Carr's Hill. This section also includes for the demolition of the existing Maryborough Hill overbridge and for widening of the existing bridge at Carr's Hill. These works will involve substantial construction activities in a constrained area where significant traffic volumes need to be catered for.

The proposed works will substantially comprise the construction of:-

- M28 to N40 Westbound Link.
- Mount Oval diverge.
- Bulk earthworks and road widening.
- Construction of 5 Retaining Walls.
- Demolition of the existing Maryborough Hill overbridge.
- Construction of a 2-span bridge (Structure S3) to accommodate Maryborough Hill.
- New link road between Maryborough Hill and Carr's Hill and closure of the existing merge from Maryborough to the N28.
- New full interchange at Carr's Hill, including the widening of the existing bridge at Carr's Hill (Structure S4).
- Temporary Traffic Management Schemes (TTMS) to direct traffic through or around the site to facilitate construction works.

During these works, traffic flow will be maintained in both directions on the N28. The works will be phased, balancing works operations and associated temporary traffic management with the need to maintain traffic flows. Traffic disruption on the existing road network will be minimised. Local roadworks will only take place on one local road at a time. To minimise disruption to traffic, the general sequence and order of working on this section of the M28 Road Project is illustrated in the **TM Series** of drawings contained in **Volume 5** and described below;

1. Construction of Carr's Hill Interchange and temporary tie-ins to the existing N28 and opening to traffic as described below. Existing south facing slip road are to be modified for this purpose.
2. Phased Retaining Wall construction adjacent to the existing N28, whilst maintaining traffic flow in both directions.
3. Phased bulk earthworks operations to widen the existing N28 road corridor.
4. Phased M28 road widening operations.
5. Prior to demolition of the existing bridge at Maryborough Hill, construction of the first phase of the proposed bridge at Maryborough Hill. Traffic flow on the N28 is to be maintained in both directions. A short-term road closure is likely to be required for the lifting in of precast bridge beams.

6. Prior to demolition of the existing bridge at Maryborough Hill, construction of the proposed link road between Maryborough Hill and Carr's Hill. Construction access is proposed via Carr's Hill only.
7. Prior to demolition of the existing bridge at Maryborough Hill, construction of the road widening works on the west side of Maryborough Hill.
8. Demolition of existing Maryborough Hill overbridge and opening of the partially constructed bridge to eastbound traffic one-way flow. A short-term N28 road closure will be needed to facilitate this operation. A week-end possession is envisaged. Open link road to Carr's Hill to traffic at this stage also.
9. Construction of proposed Maryborough Hill overbridge.
10. Existing merge to the N28 to be closed only after the proposed bridge and realignment on Maryborough Hill and the proposed link road to Carr's Hill are fully completed and open to traffic.
11. Completion of the full interchange construction at Carr's Hill.

Carr's Hill Interchange

The first phase will entail the construction of the off-line elements comprising the East and West roundabouts, the southbound diverge and the northbound merge. Local traffic management will be required to construct temporary tie-ins to the existing roads. It is envisaged that the construction sequence will comprise of:-

- Create working platform to construct portion of Retaining Wall RW-11A on the eastern side of the southbound diverge – existing N28 traffic located on western edge of existing road through the works area.
- Construct secant piled wall - existing N28 traffic located on western edge of existing road through the works area.
- Construct ground anchors, bulk earthworks and road construction for southbound diverge - existing N28 traffic located on western edge of existing road through the works area.
- Bulk earthworks and road construction for northbound merge - existing N28 traffic located on eastern edge of existing road through the works area.
- Construction roundabouts off-line.
- Complete temporary tie-ins.

This sequence of construction is illustrated in the **TM Series** of drawings contained in **Volume 5.**

Once this interchange is completed, local access from the R609 to the northern section of the N28 will improve local accessibility and mitigate against local traffic disruption when works take place elsewhere in the locality.

The full interchange at Carr's Hill will be completed later in the construction programme.

Carr's Hill Underbridge Widening

In order to accommodate the proposed 2 lane dual carriageway, the existing 3 span underbridge at Carr's Hill (S4) is required to be widened. This involves the demolition of the existing deck cantilever and parapet on the western side of the structure, the extension of the in-situ reinforced concrete deck and abutments and the construction of new piers and parapets. To accommodate this construction, it is likely to be a combination of traffic restrictions on the existing road and implementation of diversions for short-term critical works. The construction of the initial phase of the interchange as described above will facilitate local traffic diversions by utilising the existing and newly constructed slip roads.

Restricted single lane traffic can be accommodated in both directions of the N28 across Carr's Hill underbridge by taking advantage of the width available from the southbound carriageway, the climbing lane and the hard shoulder. However, traffic will be running quite close to demolition works. Speed reduction methods will need to be implemented to ensure traffic negotiates the work site safely during the demolition/construction period.

Temporary formwork must be provided to enable construction of the extended deck. Lane closures on the R609 may be required for the erection and dismantling of the temporary formwork for the deck. This may happen during a night time closure or during a temporary diversion to minimise disruption to traffic. Once temporary formwork is erected, the headroom at the bridge will be reduced. A height restriction of 4.65m will apply and this compares to the current vertical clearance of 5.4m. Adequate signage and approach goal posts will be required to ensure no vehicles higher than 4.65m approach the bridge widening works.

On-Line Widening between Rochestown Road and Carr's Hill

The proposed widening of the mainline between Maryborough Hill and Carr's Hill takes place on both sides of the existing road and substantial retaining walls are required in order to minimise adverse impacts on the existing residential estates and Douglas Golf Course. At this location the existing road consists of two lanes southbound and 1 lane northbound.

Traffic management will be required to allow a minimum of single lane traffic to flow in both directions through the construction site while these works are taking place. The existing carriageway is wide enough to leave adequate room for the provision of 1 no. 3m lane in each direction. The road widening is parallel to the existing carriageway so one side of the carriageway can be widened at a time with all traffic transferred to the opposite side of the road.

Where retaining walls are required, these shall be constructed in advance of road widening works in the particular areas. This will ensure that permanent widening works, when completed will be available for temporary traffic management purposes.

It is envisaged that these widening works will take place in phases without significant disruption to traffic.

The existing diverge at Mount Oval must remain open to traffic until the interchange at Carr's Hill is connected to the existing N28. The majority of the proposed diverge to Mount Oval can be constructed without disruption to the existing diverge. Temporary short term road closures may be necessary to complete tie-in works.

Maryborough Overbridge

The existing Maryborough Overbridge carrying L2470 Maryborough Hill over the existing N28 is required to be demolished and replaced with a wider and longer structure.

Prior to the demolition of the existing bridge, the existing traffic on Maryborough Hill will not be affected by the proposed works and the existing merge will remain open to access the existing N28 northbound. The works described in **Section 5.11.6.4** above will be completed before the demolition of the existing bridge.

Proposed roadworks on Maryborough Hill shall not coincide with roadworks on either Rochestown Road or the R609 at Carr's Hill. The existing northbound merge is to remain open to traffic until the final road layout is completed at Maryborough Hill. The proposed road layout which will operate on Maryborough Hill following the demolition of the existing bridge and during subsequent new bridge construction consists of a single lane access to the east and the operation of both the existing merge and link road to Carr's Hill for access to the N28

The demolition of the existing bridge will require temporary closure of both the N28 and Maryborough Hill. It is envisaged that the demolition would be completed over a long week-end. The demolition is envisaged to be a similar process to the concrete bridge demolition works undertaken as part of the adjacent N40 Bandon Road Sarsfield Road Scheme in 2013.

To construct the proposed overbridge, it is anticipated that discrete and phased work zones will be created to facilitate the works and that a minimum of two lanes of traffic (one in each direction) can be maintained on the N28. Temporary short term road closure of the N28 will be necessary for some essential works such as bridge beam installation. Overnight closures are envisaged for this work.

To facilitate closure of the N28 for bridge demolition/beam installation, alternative route diversions will be put into place. Southbound N28 traffic will be diverted onto Rochestown Road to Douglas and up L2464 Donnybrook Hill and back onto the N28 at Carr's Hill. Northbound traffic can be diverted onto Carr's Hill Road via L2464 Donnybrook Hill towards Douglas along the R610 back to the N28 merge onto the N28.

5.11.7 Mitigation Measures

The preceding sections of this Construction Stage Traffic Management section outline the measures to be implemented to ensure that the disruption to traffic is minimised during the construction. The measures can be summarised as follows:-

- Careful Temporary Traffic Management Planning to be prepared for the approval of Cork County Council;
- Maintenance of existing traffic capacity to the maximum extent possible;
- Restricting construction related traffic from the peak periods;
- Permitting off peak work, subject to the approval of Cork County Council to reduce the overall construction period within any particular area;
- Mandating the order and sequence of the works at the Northern end so that maximum local road capacity is maintained throughout the construction period;

- Strictly limiting road closures to critical works only; and
- Phasing of the works generally to ensure traffic capacity is maintained.

With the implementation of these mitigation measures, it is assessed that there will be a temporary slight negative traffic impact in the area between Carr's Hill and Ringaskiddy and that there will be a temporary moderate negative traffic impact in the area between Bloomfield and Carr's Hill.

6 NON-STATUTORY CONSULTATION

6.1 INTRODUCTION

A process of non-statutory public consultation has been undertaken since the inception of the proposed road project and has developed in line with the project progression, as is described in **Chapter 3: Description of the Proposed Road Development**. **Section 6.2** of this chapter sets out that process as it has been undertaken to date.

This chapter describes these different elements of consultation in three sections; **Section 6.3** describes consultation carried out prior to 2014 which relates to a slightly different scheme as described in **Chapter 4: Outline of Alternatives**. **Section 6.4** relates to the current project proposals and describes the most recent consultation since RPS was appointed in 2014. Ongoing consultation activities associated with the statutory processes for the proposed M28 Road Project are also outlined in **Section 6.4**. **Section 6.5** outlines the process undertaken during the informal EIS scoping.

Consultation forms an essential part in the preparation of an EIS. The early involvement of the public and other stakeholders helps to ensure that the views of various groups or individuals are taken into consideration throughout the preparation of this EIS. **Section 6.6** provides an overview of some of the key changes to the project which were influenced by the consultation process.

6.2 CONSULTATION PROCESS

The overall aim of the consultation process was to:-

- Engage stakeholders and the public as early as possible on the project and encourage feedback;
- Provide a process for members of the public to participate in the project;
- Seek input from the public and from relevant stakeholders with respect to the route options proposed;
- Identify alternative solutions where feasible;
- Identify measures to reduce impacts during the construction phase;
- Provide opportunities for the public and stakeholders to provide information with respect to the potential impacts that could arise as a result of implementing the project; and
- Keep the public informed of the project as it progresses throughout the different stages.

6.3 NON-STATUTORY CONSULTATION IN RELATION TO THE PREVIOUS SCHEME/PROJECT

Prior to 2014, a number of public consultations and exhibitions were held by Cork County Council and Halcrow Barry including consultation on constraints, route options and the preferred route at the time. Meetings were also held with individually affected landowners to keep them appraised and to involve them in the planning process. Public consultations were held at the following key stages:-

- Constraints Stage September 2002 - Rochestown Park Hotel, Carrigaline Court Hotel and Ringaskiddy Community Centre;

- Route Corridor Option Stage May 2003 - Carrigaline Court Hotel;
- Emerging Preferred Route Corridor December 2004 - Carrigaline Court Hotel; and
- Amended Emerging Preferred Route Corridor March 2008 - Carrigaline Court Hotel.

6.4 NON-STATUTORTY CONSULTATION FOR THE PROPOSED M28 ROAD PROJECT

6.4.1 Preferred Route Corridor Public Consultation, 2014

In 2014, RPS was commissioned by CCC to reassess all previous studies undertaken on the proposed M28 Road Project. As part of this, RPS identified and presented the proposed revised route which was considered the most suitable to meet the project objectives. A public exhibition (Preferred Route Corridor - Public Display) was undertaken on 15th December, 2014 in the Carrigaline Court Hotel to engage stakeholders in the area and inform them of the new alignment. One hundred and thirty seven stakeholders attended the open day and signed the attendance register, while additional stakeholders also attended but did not sign the register.

6.4.2 Public Consultation, Carr's Hill Interchange, 2015

In November 2015, a dedicated consultation day was organised by the Project Team to liaise with the public and, in particular, those affected by changes to the proposed road project in the vicinity of Bloomfield Interchange and Carr's Hill. The purpose of this public consultation was to inform local residents of proposed changes to the proposed road in the vicinity of Bloomfield Interchange and Carr's Hill in comparison to earlier published options. This open day took place on 9th November, 2015 in Maryborough House Hotel and was attended by over six hundred members of the public. A copy of the Consultation Report prepared following receipt of submissions is available on the project website http://www.n28cork-ringaskiddy.com/) (See **Section 6.4.7**). In advance of the open day, the Elected Representatives were briefed at a full Council Meeting in County Hall on 16th October 2015.

6.4.3 Preferred Route Alignment including Revised Junction Strategy, Public Consultation, 2016

The junction strategy was revisited as a result of the feedback received during the 2014 and 2015 consultation phase and the resulting *Preferred Route Alignment including Revised Junction Strategy* put on public display in April, 2016. As part of this public consultation, the Project Team also presented the location of the proposed Service Area (SA). Public consultation was held at the following locations between 2:00pm to 8:00pm:-

- Maryborough House Hotel on Monday, 4th April; and
- Carrigaline Court Hotel on Tuesday, 5th April.

A total of three hundred and fifty people signed-in on 4th April with a further three hundred and fifty eight signing-in on April 5th. **Plate 6.1** provides an illustration of the public consultation event in April, 2016.

6.4.4 Preferred Route Alignment including Draft CPO, Noise Barrier and proposed Landscaping

The study team presented the final route alignment including the CPO line, proposed noise barriers and landscaping to the public in the form of a Public Display at Carrigaline Court Hotel on 11th April 2017. Approximately four hundred and thirty people attended the event. The purpose of the public display was to inform the public of the proposals that would be included in the planning application/EIS and the timeframes and process for making submissions.

6.4.5 Summary of the Key Issues Raised

The issues raised through public consultation were recorded and are presented in Consultation Reports included in **Appendix 6A**. There are two consultation reports in total and these are also available on the project website. The concerns raised are summarised below in **Table 6.1** and are addressed throughout relevant chapters in the EIS. **Chapter 4: Outline of Alternatives** demonstrates how the public consultation influenced the design particularly in the areas of Carr's Hill, Mount Oval, Maryborough Ridge and the Old Post Office Road.

Table 6.1: Summary of Key Issues Raised

Issue	Chapter where Issue is Addressed
Capacity of the Bloomfield Interchange and N40	Chapter 5: Traffic and Transportation
Timeframe and funding	Chapter 1: Introduction and Need for the Proposed Road Development Chapter 3: Description of Proposed Road Development
Noise and air emissions	Chapter 13: Air and Climatic Factors Chapter 14: Noise and Vibration Health Study - Appendix 1C
Impacts to local communities	Chapter 7: Socio Economic and Community Chapter 13: Air and Climatic Factors Chapter 14: Noise and Vibration Health Study - Appendix 1C
Closure of existing on ramps and off ramps	Chapter 5: Traffic and Transportation Chapter 7: Socio Economic and Community
Construction impacts	All
Closure of existing on ramps and off ramps	Chapter 5: Traffic and Transportation Chapter 7: Socio Economic and Community
Capacity of the Bloomfield Interchange and N40	Chapter 5: Traffic and Transportation
Sustainable development and public transport catering for future growth	Chapter 1: Introduction and Need for the Proposed Road Development Chapter 3: Description of Proposed Road Development Chapter 5: Traffic and Transportation
Motorway designation and the Port at Ringaskiddy	Chapter 5: Traffic and Transportation
Non-motorway users and signage	Chapter 5: Traffic and Transportation

Issue	Chapter where Issue is Addressed
Port of Cork Relocation	Chapter 5: Traffic and Transportation
Safety Barriers and Speed limits	Chapter 5: Traffic and Transportation
Loss of trees in the Mulcon Valley	Chapter 12: Terrestrial Ecology Chapter 16: Landscape and Visual
Anti-Social Behaviour	Chapter 7: Socio Economic and Community
Ballinrea Road	Chapter 5: Traffic and Transportation
Barnahely, Shannonpark, Loughbeg and Shanbally Roundabouts	Chapter 4: Outline of Alternatives Chapter 5: Traffic and Transportation
Old Post Office Road and Ringaskiddy Lower Harbour National School	Chapter 7: Socio Economic and Community Chapter 5: Traffic and Transportation
Closure of Cogan's Road (L6472)	Chapter 5: Traffic and Transportation
Service Area	Chapter 5: Traffic and Transportation
The Need to upgrade the road to Motorway Standard	Chapter 1: Introduction and Need for the Proposed Road Development Chapter 5: Traffic and Transportation

Outside of the formal consultation period a number of meetings took place with the following groups as summarised in **Table 6.2**.

Table 6.2: Summary of Key Issues Raised

Interest Groups	Correspondence Type and Date	Summary of Key Issues
Raffeen Quarry Local Interest Group	Written correspondence 04.10.2016	Written correspondence received from group of individuals with an interest in Raffeen Quarry. The correspondence outline the ecological value of Raffeen Quarry which includes habitats and species of conservation concern in addition to Pennyroyal *Mentha pulegium* a species protected on the Flora Protection Order (2015). This group regard the quarry as a valuable educational and recreational asset.
Raffeen Quarry Local Interest Group	Meeting Carrigaline Court Hotel 15.03.2017	Members of the group met with the Project Team and provided an overview of ecological features of Raffeen Quarry and expressed a preference for routing the M28 through the Fernhill Golf & Country Club over the quarry. The group also noted that the quarry should be restored to provide a unique wildlife area for the Cork Region.
IDA	Meeting – Rossa Avenue on 13.06.14 Meeting – Rossa Avenue on 14.11.14 Meeting – Rossa Avenue on 19.03.15 Meeting – NRDO Office on 04.08.16 Meeting – IDA Dublin on 08.02.17	These meetings presented an opportunity for the Project Team to keep the IDA informed of project progress and programme to construction. This project is of vital importance to the IDA as they own a significant amount of land in the Shanbally & Ringaskiddy areas to which vehicular access is currently as issue for concern. The IDA sees the proposed road project as a vital piece of infrastructure to ensure continued investment by the pharmaceutical industry in the region.

Interest Groups	Correspondence Type and Date	Summary of Key Issues
Cork Chamber of Commerce	Meeting – Cork Chamber Offices, Summerhill North on 15.02.17	At this meeting the Cork Chamber were given an overview of the proposed road project and there was a discussion about the various concerns that residents at the northern end of the project have. Further to the meeting there was a written response in relation to queries about air quality, noise levels, traffic congestion, etc.
Biological and Life Science (pharma)	Meeting – Janssen Biologics on 15.01.15 Meeting – County Hall on 15.12.16 Meeting – DePuy Synthes on 28.02.17	These meetings presented an opportunity for the Project Team to keep the pharmaceutical companies in Shanbally & Ringaskiddy informed of progress and programme to construction. The issues that are of concern to the local community, with whom the pharmaceutical companies have a good relationship, were also discussed at length.

6.4.6 Public Awareness

CCC raised awareness of the Preferred Route Alignment including Junction Strategy Public Consultation in the following ways:-

- Inviting Elected Officials to a briefing on April 4th 2016 and April 11th 2017 immediately prior to the Public Consultation events;
- Publishing information on the dedicated project website (http://www.n28cork-ringaskiddy.com/);
- Advertising the public consultation on local newspapers and radio; and
- Sending emails to extensive contacts list of approximately one thousand and thirty six individuals, formed during previous consultations.

Plate 6.1: Public Display Board April, 2016

6.4.7 Website

Access to up-to-date, accurate and reliable information about the M28 Cork to Ringaskiddy Project is considered essential to ensuring good consultation can occur. To aid the consultation process a stand-alone website was set up:-

http://www.n28cork-ringaskiddy.com/

This website enables the public to access (at any time) up-to-date information on the consultation process, the proposed road project and the overall project programme. It has a facility allowing submissions to be made online as well as providing a postal address for anybody who wishes to submit a hard copy.

6.4.8 Consultation with Elected Members

Elected Representatives were invited to attend briefing sessions:-

- Monday, 15th December, 2014 at Carrigaline Court Hotel in advance of the Preferred Route Corridor Public Display later on the same day;
- Friday, 16th October, 2015 at County Hall in advance of the Carr's Hill Interchange Public Consultation on 9th November, 2015;
- Monday, 4th April, 2016 at Maryborough Hotel in advance of the Preferred Route Alignment Public Consultation on 4th and 5th April, 2016; and
- Tuesday, 11th April, 2017 at Carrigaline Court Hotel in advance of the Public Display of the proposed M28 Road Project and CPO.

6.4.9 Additional Consultations

A number of landowners, residents, residents groups, business groups and interested parties have met with CCC and their consultants to discuss the proposals as they pertain to their area of interest. The formal consultation questionnaires have also been supplemented by a number of additional submissions received by the Project Team from members of the public.

The majority of these submissions related to the potential impact on individual properties along its route and to the impact on communities and community facilities.

Members of the Project Team met with each landowner who was directly and significantly impacted where contactable, and the potential impact of landtake was discussed. Where feasible, adjustment of the alignment to minimise impact on landtake was accommodated within design development.

Following a request from the Maryborough Hill and Rochestown Residents Association, members of the Project Team attended a meeting with them on 10th August 2016 in County Hall. A number of Elected Representatives were also in attendance. Issues included:-

- Increase in traffic volume and congestion;
- Road safety;

- Noise pollution;
- Air pollution;
- Impact on health and quality of life;
- Stripping back of trees and woodland;
- Irreversible damage to current landscape;
- Devaluation of property; and
- Solutions to meet the needs of the Port of Cork and residents along the existing N28.

A Health Expert was appointed to address the potential health concerns raised.

On 4th April 2017, the Project Team met with and presented to the Maryborough Hill and Rochestown Residents Association and the Ringaskiddy Residents Group in the County Hall. The purpose of this meeting was to provide feedback to the groups on concerns raised to date and to provide an overview of the proposed M28 Road Project to be submitted for planning.

6.5 NON-STATUTORY/INFORMAL EIS SCOPING

6.5.1 Statutory Bodies and Non Statutory Organisations

Informal consultation with statutory and non-statutory organisations has taken place throughout the various project stages. Consultation with the various parties listed in **Table 6.3** (refer to **Appendix 6B** for responses) took the form of one or all of the following:-

- Letter and indicative mapping of route options at route selection stage;
- Letter and indicative mapping of the preferred alignment during preparation of the EIS;
- Letter and copy of Scoping Report (**Appendix 1B**) during preparation of EIS and;
- Consultative meetings.

Table 6.3: Responses to Informal EIS Scoping

M28 Cork to Ringaskiddy Project EIA Scoping Response Summary Table				
Organisation	**Date**	**Form of Consultation**	**Responses and Key Issues Raised by Consultees**	**Relevant Chapter**
Bat Conservation Ireland	04.03.2015	Email	▪ Highlight the seriousness of bat decline across Europe and resulting associated legislation and conservation programmes to stabilise population numbers. ▪ Note that consideration should be given to the following: protection of bats and bat roosts under the Wildlife Act 1976 and 2000, the Habitats Directive 1992 (EEC 92/43), the SEA Directive 2001/42/EC and the National Biodiversity Plan. ▪ Identify a number of pressures on Irish bat species i.e. removal of hedges and scrub, bridge repairs, water pollution, renovation of buildings, alterations to aquatic systems and bank vegetation, roads etc. ▪ Request to follow TII? NRA Guidelines in relation to a four season bat survey. ▪ Recommendation to apply for bat records from national database.	Chapter 12: Terrestrial Ecology
Cork County Council 1,200mm Harbour and City Watermain Other watermains	06.05.15, 09.06.15, 16.10.15, 24.11.16 and 08.05.17	Meetings	Meetings, to discuss conflicts with the 1,200mm Harbour and City watermain and agree mitigation measures, have taken place with CCC on 06.05.15, 09.06.15, 16.10.15 and 24.11.16. In addition, extensive liaison has taken place via email, phone etc. A meeting to discuss conflicts with watermains, other than the 1,200mm Harbour & City Watermain took place on 08.05.17	Chapter 17: Material Assets
Irish Water	13.04.17	Meeting	A meeting with Irish Water, to discuss conflicts and agree mitigation measures, took place on 13.04.17.	Chapter 17: Material Assets
	13.04.17	Email	Information, incl. geometric design drawings, site investigation data etc. was issued to Irish Water immediately after the meeting on 13.04.17	
Department of Communications, Energy and Natural Resources (DCENR)	23.02.2015	Email	Acknowledgement only.	

M28 Cork to Ringaskiddy Project EIA Scoping Response Summary Table				
Organisation	**Date**	**Form of Consultation**	**Responses and Key Issues Raised by Consultees**	**Relevant Chapter**
Department of Arts, Heritage and the Gaeltacht (DAHG)	17.02.2015	Email	Acknowledgement only.	Chapter 12: Terrestrial Ecology
	18.02.2015	Email	Acknowledgement only.	
	19.02.2015	Email	Acknowledgement and request to correspond by email only. Meetings took place with the NPWS Regional and local Ecologists as outlined below.	
	28.02.3017	Meeting	Meeting to present and discuss the findings of the archaeological and architectural heritage assessment. Items discussed included severance at Barnahely Castle and the structural integrity of the Castle. DAHG requested a structural assessment of Barnahely Castle to address potential vibration impacts and that the team undertake consultation with the local authority heritage department.	Chapter 15: Cultural Heritage (including Archaeology and Architectural Heritage)
	09.04.2015	Email	Requested the following key potential ecological factors which to be addressed in the NIS and EIS: (1) NIS: Effects on feeding Curlew and other waders (to which the conservation objectives of Cork Harbour SPA apply), including potential fragmentation of feeding habitats; (2) NIS: Effects of noise and disturbance on roosting birds in Lough Beg (to which the conservation objectives of Cork Harbour SPA apply), with an assessment of any necessary mitigation options, and including effects in-combination with the industrial zoning in the Carrigaline Electoral Area Local Area Plan, 2015 (Second Edition); (3) EIS: Direct effects on breeding sites and resting places of otters; (4) EIS: Effects of road fragmentation on otter territories, prey sources, traffic mortality and breeding success of otters; (5) EIS: Effects of construction disturbance and operational disturbance (including any cyclist and pedestrian use) on otter use of rivers; (6) EIS: Effects of felling of old trees on roosts (breeding sites and resting sites) of Leisler's bats; (7) EIS: Effects of fragmentation of bat foraging habitat; (8) EIS: Direct effects on badger breeding sites and resting places; (9) EIS: Effects of fragmentation on badgers, and an assessment of badger	Chapter 12: Terrestrial Ecology

M28 Cork to Ringaskiddy Project EIA Scoping Response Summary Table				
Organisation	**Date**	**Form of Consultation**	**Responses and Key Issues Raised by Consultees**	**Relevant Chapter**
			mortality including mitigation with underpasses, etc. (10) EIS: Effects on Peregrine Falcon breeding sites; (11) EIS: Effects on limestone flora and invertebrate fauna of conservation importance in limestone rock areas (a botanical survey during the flowering season is recommended); (12) EIS: Effects on Barn Owl traffic mortality; (13) EIS: Effects on habitat of red-listed bird species, in particular yellowhammer. (14) EIS: Likelihood of introduction of invasive plant species (especially Japanese knotweed and Himalayan balsam), and mitigation measures to avoid their establishment.	
NPWS	11.06.2014	Meeting	A meeting was held with the EIS Project Manager and members of the NPWS to discuss potential impacts on Ecological Receptors in the vicinity of the proposed route. NPWS requested the following:- ▪ A winter bird survey to determine Curlew feeding patters; ▪ EIS to address impacts to Peregrine Falcon at the Quarry; ▪ EIS to address impacts to Barn Owls; and ▪ EIS to address impacts due to habitat fragmentation. A copy of the wintering bird report was issued by RPS to the NPWS on the 18.05.2016.	Chapter 12: Terrestrial Ecology and NIS
	18.02.2015	Email	Based on the Carr's Hill Interchange proposals advise that it is likely that the Department (DAHG) will recommend otter and bat surveys of the entire Donnybrook Stream.	Chapter 10: Aquatic Ecology Chapter 12: Terrestrial Ecology
	16.01.2017	Meeting	A meeting was held with the EIS Project Manager, Cork County Council Representative and the Ecologist and members of the NPWS to discuss the route, results of surveys undertaken and the key findings. The following key items were raised by the NPWS:- ▪ EIS to ensure badger mitigation does not result in risk to badger population from TB;	Chapter 12: Terrestrial Ecology and NIS

M28 Cork to Ringaskiddy Project EIA Scoping Response Summary Table				
Organisation	**Date**	**Form of Consultation**	**Responses and Key Issues Raised by Consultees**	**Relevant Chapter**
			▪ EIS to ensure underpasses are provided at appropriate time (i.e., pre-main construction activity); ▪ EIS to address impacts to Barn Owls and Yellowhammer; ▪ EIS to address impacts to bats in all seasons; and ▪ EIS to provide mitigation for Peregrine Falcon at the Quarry. The meeting also discussed the previous route option and the ecological impacts of the new route v the previous route. NPWS noted that moving the route should not solely be based on ecological grounds. EIS Project Manager advised that the route was moved for a number of reasons as outlined in **Chapter 4: Outline of Alternatives**. The meeting also addressed issues at Raffeen Quarry under its current planning condition including the presence of Pennyroyal.	
Environmental Protection Agency (EPA)	23.02.2015	Email	Acknowledgement only.	
ESB International 110kV and 220kV	14.08.14, 29.01.15, 19.06.15, 04.03.16, 22.04.16, 23.11.16 15.02.17	Meetings	Meetings, to discuss conflicts and agree mitigation measures, have taken place with ESB International on 14.08.14, 29.01.15, 19.06.15, 04.03.16, 22.04.16, 23.11.16 and 15.02.17. In addition, extensive liaison has taken place via email, phone, etc.	Chapter 3: Description of the Proposed Road Development Chapter 17: Material Assets Chapter 16: Landscape and Visual Chapter 12: Terrestrial Ecology
EirGrid	14.07.16	Meetings	A meeting with EirGrid, to discuss conflicts and agree mitigation measures, took place on 14.07.16. In addition, extensive liaison has taken place via email, phone, etc.	Chapter 3: Description of the Proposed Road Development Chapter 17: Material Assets Chapter 16: Landscape and Visual Chapter 12: Terrestrial Ecology

M28 Cork to Ringaskiddy Project EIA Scoping Response Summary Table				
Organisation	**Date**	**Form of Consultation**	**Responses and Key Issues Raised by Consultees**	**Relevant Chapter**
Eir	27.04.2017 28.04.2017	Meetings	Meetings with Eir, to discuss conflicts and agree mitigation measures, took place on 27.04.17 and 28.04.17. In addition, extensive liaison has taken place via email, phone, etc.	Chapter 17: Material Assets
Electricity Supply Board (ESB) Networks 38kV, MV and LV	17.02.2015	Email	Acknowledgement only.	Chapter 17: Material Assets
	18.02.2015	Email	Acknowledgment only.	
	23.02.2015	Email	Request to make contact again later in the process when the Project Team is at detailed design stage. Attached a drawing of possible conflicts with MV/LV networks.	
	25.08.2015 19.10.2015 23.11.2016 08.03.2017	Meetings	Meetings, to discuss conflicts and agree mitigation measures, have taken place with ESB Networks on 25.08.15, 19.10.15, 23.11.16 and 08.03.17. In addition, extensive liaison has taken place via email, phone, etc.	
Fáilte Ireland	18.02.2015	Email	Impacts in respect to tourism should refer to the Fáilte Ireland Guidelines for the treatment of tourism in the EIS.	Chapter 7: Socio-Economic and Community
Gas Networks Ireland (GNI)	17.02.2015	Email	Acknowledgment only.	Chapter 17: Material Assets
	17.02.2015	Email	Acknowledgment only.	
	20.02.2015	Email	▪ Provided two attachments including a drawing of known gas lines in the study area, and the other a Gas Networks Safety Advice Booklet. ▪ Advised that the information provided in relation to the location of pipe lines cannot be relied upon as being accurate. Advised that trial holes should be undertaken before major excavations take place. ▪ Advised that all work must comply with the HSA publication '*Code of Practice for Avoiding Danger from Underground Services*'. ▪ Advised that where Aurora Telecom data is present, relevant contacts should be referred to. ▪ Advised that all Ordnance Survey Information should be obtained directly if required and not by GNI who have no right or entitlement to the information.	

M28 Cork to Ringaskiddy Project EIA Scoping Response Summary Table				
Organisation	**Date**	**Form of Consultation**	**Responses and Key Issues Raised by Consultees**	**Relevant Chapter**
	04.09.2014 30.01.2015 22.06.2015 19.10.2015 01.02.2017	Meetings	▪ Meetings, to discuss conflicts and agree mitigation measures, have taken place with GNI on 04.09.14, 30.01.15, 22.06.15, 19.10.15 and 01.02.17. In addition, extensive liaison has taken place via email, phone, etc.	Chapter 17: Material Assets
Enet	24.11.20160 03.03.2017	Meeting	▪ Meetings, to discuss conflicts and agree mitigation measures.	Chapter 17: Material Assets
Geological Survey of Ireland (GSI)	13.03.2015	Email	▪ Agree with the key issues and information sources referenced in the EIA scoping report. ▪ Recommend that reference should be made to the GSI website www.gsi.ie/mapping for information in relation to datasets across many related headings, specifically soils, geology, hydrogeology, hydrology, and geological heritage. ▪ Request that if any significant bedrock cuttings should be created, these should be designed to remain visible as rock exposure.	Chapter 9: Hydrology and Drainage Chapter 11: Soils, Geology and Hydrogeology Chapter 16: Landscape and Visual
South Lee Environment Health (HSE)	23.02.2015	Letter	▪ Recommend that the location of sensitive occupied premises are identified, that the impacts on persons within these premises, as well as mitigation measures to remedy any adverse effects are included in the Socio-economic and community. ▪ Recommended that an assessment of increased vibration levels on sensitive premises during the construction phase, predicted increased traffic levels, and construction mitigation measures to address adverse vibration impacts on sensitive locations all be included in the Noise and Vibration chapter. ▪ Recommended that the EIS should consider the impacts from construction activities on air quality and identify any mitigation measures to ensure that dust nuisance is avoided. ▪ Recommended that road run-off treatment is considered in the EIS and mitigation measures are in place to protect groundwater from contamination during construction and from traffic flow.	Chapter 7: Socio-Economic and Community. Chapter 13: Air and Climatic Factors Chapter 14: Noise and Vibration

M28 Cork to Ringaskiddy Project EIA Scoping Response Summary Table				
Organisation	**Date**	**Form of Consultation**	**Responses and Key Issues Raised by Consultees**	**Relevant Chapter**
Health Service Executive (HSE)	24.03.2017	Letter	Provided feedback on the scope of the health study as outlined in the Health Study Scoping Statement issued by RPS. The Health Study Scoping Statement is included in **Appendix 1B**. Key issues identified included air and noise pollution, quality of life, vibration, pollution of groundwater and surface water, quality of life, social interaction and community severance and employment.	Chapter 7: Socio-Economic and Community. Chapter 9: Hydrology and Drainage Chapter 13: Air and Climatic Factors Chapter 14: Noise and Vibration Appendix 1C: Health Study
Inland Fisheries Ireland (IFI)	19.02.2015	Email	Acknowledgement only.	Chapter 9: Hydrology and Drainage Chapter 10: Aquatic Ecology
	24.02.2015	Email	In relation to road proposals at Carr's Hill recommend conducting an electrofishing survey and asked to revert with the results. Advised that if fish are present in the stream the design as proposed in relation to the culverting is unsatisfactory and requested an alternative approach as per an attached sketch (diverting Donnybrook Stream to the west of proposed roadway and provision of one culvert to the south of the interchange) and having a meeting to discuss alternative design details.	
	02.03.2015	Email	▪ Advised that based on available information at the time, the preferred route option has potential to interfere with both the Donnybrook and Glounatouig streams and tributaries. ▪ Recommend electrofishing survey in both streams and to revert to IFI with survey results. ▪ In relation to the Donnybrook Stream advise that Carr's Hill Interchange proposals are far from satisfactory and if fish are deemed to be present suggests an alternative proposal (as per previous email) and requested a meeting to discuss detailed design and timing of works. ▪ In the case of the Glounatouig Stream and its tributaries, advise that the information as submitted is not detailed enough to assess impacts and therefore request to revert when greater footprint information is available. ▪ Recommended in all cases that any instream works or works liable to	

M28 Cork to Ringaskiddy Project EIA Scoping Response Summary Table				
Organisation	**Date**	**Form of Consultation**	**Responses and Key Issues Raised by Consultees**	**Relevant Chapter**
			increase the suspended solids level of a waterbody above ambient level should be limited to the period of May to September.	
	02.11.2015	Email	▪ Advised that the Donnybrook Stream upstream of "Carr's Hill Underbridge" should be diverted at a right angle and then carried in open channel (newly constructed to fishery design spec) to the west of the proposed new carriageway. This would minimise the impact. ▪ Noted that the new road appears to avoid the Glounatouig Stream with the exception of a crossing over a tributary (Site 4) which has limited fisheries potential upstream of the crossing point.	Chapter 9: Hydrology and Drainage Chapter 10: Aquatic Ecology
	03.05.2017	Meeting	▪ The meeting focused on the drainage design and further requirements for consultation with IFI in the event that planning is granted.	Chapter 9: Hydrology and Drainage Chapter 10: Aquatic Ecology
Office of Public Works (OPW)	17.02.2015	Email	Acknowledgement only.	
South West River Basin District (SWRBD)	20.02.2015	Email	Advised the EPA should be consulted in respect of the matter.	Chapter 10: Aquatic Ecology
Cork County Council Conservation and Heritage Officers	28.03.2017	Meeting	The meeting largely focussed on potential impacts to Castle Warren and the findings of the EIS. Mitigation measures and opportunities for the conservation of Castle Warren were also discussed.	Chapter 15: Cultural Heritage (including Archaeology and Architectural Heritage)

6.5.2 Consultation with An Bord Pleanála

A pre-application statutory process was held with An Bord Pleanála (ABP) relating to the proposed M28 Road Project. This occurred over a series of three pre-application consultation meetings between July 2015 and January 2017 on the dates listed below:-

- 24th of July 2015;
- 17th of November 2016; and
- 12th of January 2017.

Copies of the written records from the meetings are included in **Appendix 6C.**

6.6 SUMMARY OF HOW CONSULTATION INFLUENCED THE PROPOSED M28 ROAD PROJECT

The consultation process has helped shape the proposed M28 Road Project now being presented to ABP. Key changes to the project design that have resulted from the consultation process are summarised below:-

- Revised Junction Strategy at Carr's Hill Interchange;
- Upgrade of Mount Oval Diverge;
- Assessment of Strategic Alternatives in the wider area;
- Assessment of options at Old Post Office Road resulting in a revised vertical alignment at Old Post Office Road to accommodate pedestrian/cyclist underpass;
- Inclusion of a section of local road improvement in mitigation for vehicular closure of Old Post Office Road and resolution of local flooding issue;
- Engagement of a Human Health Expert to undertake a Health Study to address concerns of air pollutants and noise;
- Landscaping and planting to ensure provision of screening at appropriate locations;
- Development of landscape and planting proposals taking into account key areas of concern highlighted by the public;
- Revised design of culvert at Donnybrook Stream to accommodate fish passage;
- Signalised junction to address traffic issues on Rochestown Road;
- Proposal to improve Clarke's Hill by CCC as a separate project; and
- Revised horizontal alignment on approach to Shannonpark resulting in reduced severance impact to landowner and reduced earthwork requirements.

7. SOCIO-ECONOMIC AND COMMUNITY

7.1 INTRODUCTION

The community surrounding the proposed road project can be divided into three principal groups; the resident, working and visiting communities. This chapter assesses the socio-economic impacts of the population and employment, and community groupings of the area as a result of the proposed M28 Road Project. It also considers any potential impacts from the changes that are proposed to land uses in the area in which the proposed project is to be located. Impacts in relation to land take associated with the Compulsory Purchase Order (CPO) in relation to non-agricultural properties are also assessed.

This chapter considers information on the demographic and employment characteristics of the resident population within the catchment area. This information is sourced from the Census of Population from 2002, 2006 and 2011 and also from preliminary results from 2016[1]. A number of site visits were also undertaken between December 2014 and May 2017 to inform the content of this Chapter.

The proposed road project is described in detail in **Chapter 3: Description of the Proposed Road Development** of this EIS and is outlined in **Figure 3.1**. The subject site is located within a relatively urban context which includes the Ringaskiddy strategic employment area and is located in close proximity to residential and other sensitive land uses such as educational uses. The site's relatively urban location increases its potential to adversely impact on communities as a result. There are some tourist and recreation functions in the general area. Therefore, this chapter will examine the potential to impact on this range of population groupings and in particular will identify the various sensitive 'communities' within the vicinity of the site, and assesses the potential for impact on same.

Other environmental assessments undertaken as part of this EIS that have potential to have socio-economic and community impacts include; **Chapter 14: Noise and Vibration**, **Chapter 13: Air and Climatic Factors, Chapter 5: Traffic and Transportation**, **Chapter 16: Landscape and Visual Impact**, **Chapter 11: Soils, Geology, and Hydrogeology**, **Chapter 12: Terrestrial Ecology** and **Chapter 10: Aquatic Ecology**. Impacts from these sources are addressed in detail in these Chapters of the EIS.

The issue of agricultural severance and loss of agricultural land will be assessed within **Chapter 8**: **Agriculture Land Use** of this EIS. A Health Study was also prepared in respect of the proposed road project and is available in **Appendix 1C** in **Volume 4** of this EIS.

[1] Accessed January 2017.

7.2 METHODOLOGY

This socio-economic and community impact assessment is carried out by way of a combination of desk-based studies, consultation and site visits and investigations. The methodology and associated impact assessment had regard to the following guidelines and policy documents:-

- Environmental Impact Assessment of National Road Schemes, A Practical Guide (NRA, 2008);
- Guidelines on information to be contained in Environmental Impact Statements (EPA, 2002);
- Revised Guidelines on information to be contained in Environmental Impact Statements (EPA, draft 2015);
- Advice Notes on Current Practice (in preparation of Environmental Impact Statements) (EPA, 2003);
- Advice Notes for Preparing Environmental Impact Statements (EPA, draft 2015); and
- Service Area Policy (NRA, 2014).

The quality, significance, magnitude, probability and duration of effects outlined within this assessment are based on the definitions set out within section 3.7.7 of the 'Revised Guidelines on information to be contained in Environmental Impact Statements (EPA, draft 2015).

Demographic characteristics of the area are ascertained from the Census of Population data and other statistics released by the Central Statistics Office (CSO). The most recent census carried out by the CSO was taken on 24th April 2016 (Census 2016) however only preliminary results are currently available[2]. Therefore the 2011 Census which was taken on 10th April 2011 is the main source of Census data for the purposes of this assessment. The Census records demographic information at State, County and local levels. The 2011 Census results were also compared against the results of the 2006 Census and available results from the 2016 Census. Consideration of current unemployment patterns is based on up-to-date information available from the Live Register. Information on tourists visiting the area was obtained from Fáilte Ireland Annual Tourism Facts accessed via the Fáilte Ireland website.

Identification of sensitive communities and land uses in the vicinity of the site was undertaken by a mix of site visits, review of digital mapping, aerial photography and development plan and local area plan mapping. Socio-economic and community survey mapping identifying socio-economic points of interest including relevant schools, amenities, services and commercial premises is within **Appendix 7A** of this EIS. The location of commercial premises within the study area was obtained from the An Post Geodirectory which identified commercial premises to be mainly centred around the urban areas in the northern and southern portions of the study area. The southern portion of the study area contains a high density of industrial and pharmaceutical type developments. The majority of the land use within the central portion of the study area is in agricultural use. Both are assessed under community and employment within this chapter.

In addition, the Cork County Development Plan, 2014 - 2020, Carrigaline Electoral Area Local Area Plan, 2011 (as amended) and the draft Ballincollig-Carrigaline Municipal District Local Area Plan 2016 and the Cork County Council Planning Enquiry system were also consulted for details on existing and future planning trends with regard to the development site and surrounding area. Information was also obtained through public consultation.

[2] Accessed May 2017.

The focus of this chapter is to establish the potential for impact on population and employment in the area and impacts on the community, including the resident, working and visiting community. Agricultural lands are assessed in **Chapter 8: Agricultural Land Uses** of this EIS.

Land Take Assessment

A land take impact assessment in relation to non-agricultural properties is included within this chapter also. This assessment deals with any residential and commercial lands which will be included within the Compulsory Purchase Order (CPO) to facilitate the proposed project.

With regard to the land take assessment, each of the different levels of significance which an impact may have on residential properties along the route is provided in **Table 7.1** below. These are based on the EPA 'Guidelines on the Information to be contained in Environmental Impact Statements' (2002) and associated draft Guidelines (2015); and 'Advice notes on Current Practice (in the preparation of Environmental Impact Statements)' (2003) and associated draft Advice Notes (2015) with reference specifically to properties along the proposed road project.

Impacts in relation to commercial and community properties may vary and have been assessed individually reflective of the definitions of impacts based on the EPA 'Guidelines on the Information to be contained in Environmental Impact Statements' (2002) and associated draft Guidelines (2015).

Table 7.1: Assessment Criteria

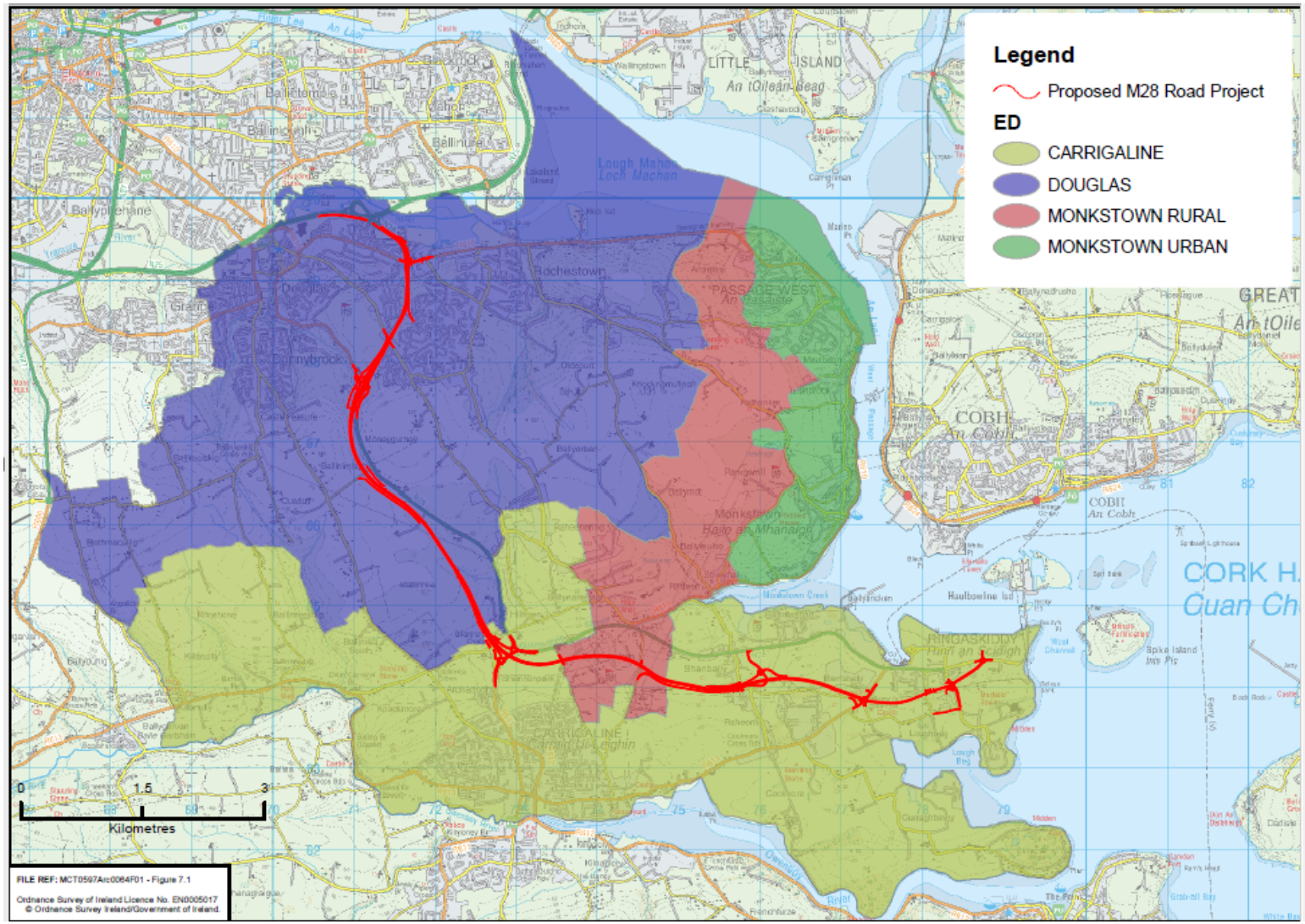
Significance of Impact	Criteria
Imperceptible	Property and curtilage is not affected by the project.
Not Significant	Development encroaches on landholding without encroaching on boundary or curtilage of property.
Slight	Development may encroach on a boundary causing a slight inconvenience but does not require a significant change to landholding or result in any reduction in residential amenity. Mitigation will overcome any problems.
Moderate	Development encroaches on more than one boundary of the site and/or encroaches on over 25% of the landholding/curtilage only and/or is likely to modestly reduce the residential amenity of the site. Mitigation measures should overcome most difficulties.
Significant	This impact will significantly reduce the size of the landholding by less than 40% and/or encroaches close to a sensitive building so as to substantially affect its residential amenities. This level of impact will require considerable mitigation measures and not all difficulties will be overcome.
Very Significant	This impact will significantly reduce the size of the landholding by over 40% and/or encroaches close to a sensitive building so as to significantly affect its residential amenities. This level of impact will require considerable mitigation measures and not all difficulties will be overcome.
Profound	The acquisition of an entire landholding to facilitate the proposed road project.

7.3 RECEIVING ENVIRONMENT

7.3.1 Population

The most recent census of population for which statistical results are widely available was in 2011. Although the 2016 Census was undertaken on 24th April 2016, to date only preliminary results are available. The smallest geographical units distinguished by the CSO are Electoral Divisions (EDs). In this case, demographic trends will be analysed at State, County and local level. The local level population of the area was examined and identified in the form of the four Electoral Divisions in which the proposed road development is located or closely adjoins and will be referred to as the 'study area' within this chapter. The proposed road project is primarily located within the ED of Carrigaline, while the western part of the site is located within the ED of Douglas and partly within the ED of Monkstown Rural as identified in **Figure 7.1 - Study Area Map including Electoral Divisions**. The ED of Monkstown Urban has also been included within the study area as the resident and working communities within this area are likely to use the existing N28 and proposed road. The proposed road project is considered to be at a suitable distance from other EDs so as not to directly impact on population elsewhere.

Figure 7.1: Study Area Map including Electoral Divisions



Source: CSO

7.3.1.1 Population Levels

Table 7.2 below summarises population trends within the study area between 2006, 2011 and 2016. For the purpose of comparison, population change within the State, Cork County and the relevant Electoral Divisions (EDs) including the overall study area are provided. **Figure 7.1** illustrates the study area and the relevant EDs.

Table 7.2: Population Change within State, Cork County and Relevant Electoral Divisions 2006, 2011 and 2016

Area	Population 2006	Population 2011	Population 2016	Change 2002-2006 (%)	Change 2006-2011 (%)	Change 2011-2016 (%)
State	4,239,848	4,588,252	4,757,976	+ 8%	+8%	+4%
County Cork	481,295	519,032	542,196	+8%	+8%	+5%
Study Area	34,801	38,344	39,341	+15%	+10%	+3%
Carrigaline ED	10,969	11,818	12,111	+17%	+8%	+3%
Douglas ED	18,182	20,397	20,913	+14%	+12%	+3%
Monkstown Rural ED	832	1,007	1,083	+7%	+21%	+8%
Monkstown Urban ED	4818	5,122	5,234	15%	6%	2%

Source: Census of Population 2006, 2011 and 2016

The population of the State increased at a rate of 8.2% between the period of 2006 to 2011, however this slowed to 4% in the 2011 to 2016 period. Rates of growth within Cork County were lower within the same periods at 8% and 5% respectively. There was a significantly high rate of growth within the study area between the period of 2006 to 2011 at just over 10%. In 2016 the study area experienced a much lower growth rate to previous years at a rate 3% which was even lower than the rates experienced at County and State levels. It is likely that these low growth rates were due to the economic downturn and reduction in new housing within the area during the inter-censal period.

Due to the urban nature of the project, the potential to affect settlements is higher. The nearest large settlements located in close proximity to the proposed project include Douglas and Carrigaline. However the wider Douglas and Rochestown suburban areas adjoin the northern section of the online section of the roadway which is proposed to be upgraded to motorway standard.

Douglas District Centre is located 1km to the west of the existing carriageway and has a population of 15,999 according to the 2011 Census. The town of Carrigaline is located 2km to the south of the new carriageway and had a population of 14,775 according to the 2011 Census. The villages of Shanbally and Ringaskiddy are located to the north of the proposed new carriageway and had populations of 337 and 478 respectively according to the 2011 census of population[3]. The settlements of Monkstown and Passage West combined (Monkstown Urban ED) had a population of 5,234 according to the 2011 Census.

[3] Data unavailable within Census 2016 Preliminary Results.

7.3.1.2 Population Age Cohorts

Table 7.3: Population Age Cohorts 2006

	Age Cohorts		
Area	**0-14**	**15-64**	**65+**
State	20%	69%	11%
County	20%	68%	11%
Study Area	23%	70%	7%
Carrigaline ED	24%	71%	5%
Douglas ED	23%	70%	7%
Monkstown Rural ED	22%	70%	8%
Monkstown Urban ED	22%	70%	8%

Source: CSO, 2006

Table 7.4: Population Age Cohorts 2011

	Age Cohorts		
Area	**0-14**	**15-64**	**65+**
State	21%	67%	12%
County	21%	67%	12%
Study Area	23%	69%	8%
Carrigaline ED	26%	68%	6%
Douglas ED	22%	70%	8%
Monkstown Rural ED	23%	69%	8%
Monkstown Urban ED	23%	67%	10%

Source: CSO, 2011

Dependent Age Cohorts (0-14 and 65+)

As shown on **Table 7.3** and **Table 7.4** above, the proportion of the population in the dependant age groups within the State and Cork County was 31% in 2006 increasing to 33% by 2011. In comparison the proportion of population within the dependant age groups within the study area was 30% in 2006 and rising slightly to 31% in 2011. There is a much higher percentage of the population within the young age dependant cohorts within all areas. However there appears to be a much higher ratio of the population within the young age cohorts within the study area in comparison with the State and County with a 2% increase experienced proportionately. In both 2006 and 2011 Carrigaline ED had the highest proportion of population within the young age dependant cohort within the study area. This is likely to be reflective of the substantial house building that had taken place in this area preceding this time. During the period between 2006 and 2011 the proportion of population within the older age dependant cohorts within the State and County was similar with rates of 11% in 2006 and 12% in 2011. In contrast the proportion of old age dependant cohorts within the study area was much lower during the same period with 7% and 8% in 2006 and 2011 respectively which is 4 % lower than the State and County. It is likely that the lower old age dependant cohort rates experienced within the study area are reflective of the relatively newer expansion of these areas in the last 20 to 30 years and, therefore, the population is likely to be younger within these areas than State and County averages.

Working Age Cohort (15-64)

In 2006, the percentage of population within the State in the working age cohort (15-64) was 69% decreasing to 67% in 2011 which was similar to County levels. The percentage of population within the working age cohort within the study area experienced a similar trend. The working age cohort within the study area decreased from 70% to 69% between 2006 and 2011. This trend is likely to be caused by an ageing population reflected in a slight increase in the old age dependant cohorts within the State and County during the same period. The number of people within the working age cohorts was slightly higher in the study area in comparison to the State and County in 2006 and 2011. Again this is likely to be reflective of the establishment/expansion of these settlements in more recent years and given their proximity to employment areas indicating a higher working population.

7.3.2 Employment

The Ringaskiddy area is designated as a Strategic Employment Area in the Cork County Development Plan, 2014 - 2020 (Objective EE 4-1) and is the main employment location within the study area. Ringaskiddy comprises of 344 acres of available IDA industrial zoned land according to the draft Ballincollig-Carrigaline Municipal District Local Area Plan, 2016.

Both Douglas and Carrigaline are also important employment areas. Douglas village is a district centre and comprises of two shopping centres, and contains various businesses and local services and is an important employment area in the study area particularly in relation to local services.

Carrigaline comprises of a large local centre serving the rural hinterland and comprises of a range of local services including retail, retail services, and offices and manufacturing type industries which also has an employment function within this area.

Outside of the Greater Dublin Area, Ringaskiddy has the largest foreign direct investment employment centre in Ireland. Many of the top world leading pharmaceutical companies are located here. Over 8,800 people are employed in the area[4]. Ringaskiddy has earned an international reputation as a location of choice for mobile pharmaceutical investment. These create high-quality employment opportunities while contributing to both the local and national economy. With market leaders such as Pfizer, Novartis, DePuy, Janssen Biologics (formerly Centocor Biogenics), Recordati, BioMarin, and GlaxoSmithKline, Moog and Carbon Group, the area is not only of national importance but of international significance as a pharmaceutical and manufacturing centre. These industries are also of regional importance as a centre of employment.

The Irish Navy headquarters is also located on Haulbowline Island within Ringaskiddy which provides employment within the area.

In addition to the pharma industry, the National Maritime College of Ireland (NMCI) was constructed in Ringaskiddy in 2004. Located near the bridge to Haulbowline Island on a Naval Service site, the college is one of the most sophisticated centres of its kind in the world. This facility can accommodate 750 full-time students through the Public Private Partnership of the Irish Naval Service, Cork Institute of Technology and the private partner FOCUS Education.

[4] Section 3.7.18, draft Carrigaline-Ballincollig Municipal District LAP, 2016

This is the first third level College to be delivered under the Public Private Partnership model. The National Maritime College offers naval training/education using Navy staff and Merchant Navy staff from the Cork Institute of Technology.

Work has recently been completed on expanding this educational campus eastwards, the new Beaufort building accommodates the Irish Maritime and Energy Cluster Ireland (IMERC) and includes facilities for UCC's Coastal and Marine Resources Centre (CMRC) and Hydraulics and Maritime Research Centre (HMRC), as well as maritime IT, incubator and marine business accommodation.

Port of Cork Operations at Ringaskiddy

The Port of Cork's deepwater berth at Ringaskiddy is of huge importance to the region both from a commercial and a tourism perspective. Current facilities at the deepwater berth can handle a range of cargo types, including roll-on roll-off, lift-on lift-off and dry bulk. Brittany Ferries sail from Ringaskiddy to Roscoff in France for six months of the year.

Cork Harbour is the second most significant port in the state. It is critical to the economic success of the South West Region. The port's activities are divided between several locations in the harbour, including traditional open wharves and container facilities on the eastern approaches to the City at Tivoli and a modern deep-water facility with 'Ro-Ro' facilities and car/passenger links to France at Ringaskiddy. There are a number of specialised facilities for oil and petroleum at Whitegate and general cargo at Passage West. Disused facilities at Marino Point have immediate potential to handle bulk cargo's transported to or from the port by rail. Handling non-rail cargo's at this location will require the upgrading of the R624 linking the site to the N25.

The Port of Cork proposes to expand its facilities in Ringaskiddy so that port centered operations and logistics can become more efficient through the accommodation of larger ships and so that port traffic can directly access the National Road network without passing through the City Centre. The planned expansion of Port facilities at Ringaskiddy will release dockland areas close to the City for planned redevelopment in line with proposals set out in the City Council's Development and Local Area Plans.

The Port at Ringaskiddy is currently undertaking a major expansion as permitted by An Bord Pleanála in 2015[5] which will see most of their city centre activities re-located to Ringaskiddy. As part of this planning permission phases one and two of the Port's development at Ringaskiddy can take place with demand management in place. However phase three of the Port's development which will enable RoRo freight traffic is not permitted to operate until the upgrade of the N28 is operational. Therefore, the M28 Cork to Ringaskiddy Project will provide a logistical support for the redevelopment of the Port of Cork's redevelopment, which in itself will create economic growth through the expansion and rationalisation of the port facilities.

Employment Statistics

The most recent information available from the CSO, in respect of the principal economic status of the area is from the 2011 Census of Population. The information from the 2011 Census is shown in **Table 7.5**. It is however likely that these figures are not entirely reflective of the current situation given that there has been a noteworthy turnaround in the economy with employment rising once

[5] An Bord Pleanála Reference No. PL04.PA003, granted 28/05/2015.

again. This information however gives an indication of how the local catchment area performed economically relative to the County or the State during the economic recession.

Unemployment levels as outlined in **Table 7.5** are generated purely from the principle economic status of persons over 15 years recorded in the 2011 Census of Population and as such are not a true reflection of real unemployment rates. However as noted above, they are useful for comparing the relative performance of an area compared with State or County averages.

It is likely that unemployment levels within the study area are lower than State and County averages given the areas designation as a Strategic Employment Area and the presence of large pharmaceutical and port-related industries within the general area.

Table 7.5: Labour Force and Unemployment Levels, 2011

Area	At Work	1st time Jobseeker	Unemployed	Work Force	Unemployment Level (%)
State	1,807,360	34,166	390,677	2,232,203	19%
Cork County	207,503	3,021	37,848	248,372	16.4%
Study Area	16,953	181	2,146	19,280	11.13%
Carrigaline ED	4,994	55	774	5,823	14.2%
Douglas ED	9,507	79	925	10,511	9.5%
Monkstown Rural ED	430	8	60	498	13.6%
Monkstown Urban ED	2,022	39	387	2448	15.80%

Source: CSO, 2011

A more accurate recording of unemployment rates can be obtained from live register figures recorded by the Central Statistics Office. Live register figures are seasonally adjusted and give a more up-to-date picture. Live register unemployment figures include all persons under 65 years of age who are claiming jobseekers benefit, jobseekers allowance and other registrants at local Department of Social Protection (DSP) offices in the reference week[6]. In this regard, it should be noted that the rate of unemployment recorded for the State as a whole in April 2011 was 14.4%. This rate has declined by over half since then to a rate of 6.2% in April 2017, which is the latest seasonally adjusted unemployment rate available. The number of people recorded on the Live Register at the Carrigaline Social Welfare Office has declined by over 50% in the same period, from 2,497 persons to 1,089 persons between April 2011 and 2017. This shows that there has been a substantial decrease in unemployment levels both nationally and locally between 2011 and 2017. This indicates that the economy is showing signs of recovery through a significant reduction in unemployment levels.

Information on 'population by socio-economic group' is available on a localised ED basis from the 2011 Census. By examining the current occupations of those at work, and the previous occupations of unemployed and retired persons, it is possible to categorise the relevant individuals by socio-economic group.

[6] First time job seekers are not included within unemployment levels as identified in Table 7.5.

Table 7.6 shows the proportion of the population by different socio-economic groupings in relation to the study area in which the site is located, Cork County and the State for comparative purposes.

Table 7.6: Proportion of Population by Socio-Economic Grouping, 2011

Area	Employers Managers	Higher Lower Profess'al	Non-Man & Man Skilled	Semi-Skilled & Unskilled	Own Account Workers	Farmers Agric. Workers	Unknown
State	16%	17%	27%	12%	6%	6%	16%
Cork County	15.5%	18%	26%	13%	6.5%	9%	12%
Study Area	22%	26%	26%	11%	6%	1%	10%

Source: CSO, 2011

The study area has a much higher proportion of persons in the higher socio-economic groupings such as 'Higher and Lower Professionals' (26%) and 'Manual and Non-Manual Skilled' groupings (26%) which reflect the groupings living within the area. While the proportion of 'Higher and Lower Professionals' within the study area is substantially higher than that of the State and Cork County areas, the result for the 'Manual and Non-Manual Skilled' grouping is on par with those for the State and Cork County.

In contrast the area has lower proportions of workers in the 'Farmers and Agricultural Workers' grouping with only 1% of workers in the study area employed in agriculture. These patterns are likely to arise due to the suburban nature of the area and the types of work available in this area largely being in pharmaceutical, industrial and port-related activity and educational and research within the National Maritime College and Beaufort Research Centre and Naval base. It is likely that these patterns are also due to the designation of the Ringaskiddy area as a Strategic Employment Area by Cork County Council.

According to the Preliminary Results of Census 2016, within Cork County approximately 76% of the population drive to work compared to the national average of 66%. This indicates that people residing in County Cork are much more dependent on private forms of transport than the state average and therefore on the national road network.

7.3.3 Community

7.3.3.1 Resident Community

As discussed above, the settlements of Douglas (including Rochestown), Carrigaline, Ringaskiddy and Shanbally are located within the study area. Other settlements within the study area include Passage West and Monkstown although these settlements are not located adjacent to or adjoining the proposed road. The receiving environment in respect of the resident community for each of these areas is set out below.

Douglas (including Rochestown)

Douglas is a suburb of Cork City which serves as a popular district centre serving the southern parts of the metropolitan area and is subject to heavy traffic congestion particularly at peak periods[7]. Douglas comprises of two shopping centres including Douglas Village and Douglas Court, numerous schools, hotels, bars, restaurants, sports facilities and community facilities. Rochestown directly adjoins the proposed route and comprises largely of suburban housing estates served by Douglas District Centre. There are small neighbourhood centres scattered throughout these areas.

Carrigaline

Carrigaline is a large satellite town located within the southern part of the study area and is also subject to significant traffic congestion at peak periods at the Shannonpark Roundabout[8]. It is located approximately 12km to the south of Cork City and 9.3km to the south east of Cork Airport. A new residential area is planned within the Shannonpark area to the north of Carrigaline and just south of the Shannonpark roundabout and construction of 200 new residential units recently commenced at this location. Carrigaline is a commuter town which caters for a large residential population with the work force travelling to and from locations such as the Airport Business Park, Cork City, Ringaskiddy and Little Island. It accommodates a range of important retail and retail service functions and business. It also contains a number of community facilities including schools and sports facilities.

Shanbally

Shanbally is a small residential village located between Carrigaline and Ringaskiddy with some community amenities including a church, shop, health centre, school and sports facilities. This village is subject to significant amounts of through traffic including large volumes of HCVs going to and from the port. The village is also subject to traffic congestion at peak periods particularly school related traffic.[9]

Ringaskiddy

Ringaskiddy comprises of a small village with a limited residential population but a large visiting and working population associated with its role as a strategic employment centre and the Port of Cork facilities. The N28 runs through the centre of Ringaskiddy Village with port related traffic traversing through the centre of the village along this roadway.

There are limited local services available within the village including a school and public house. As discussed above, the National Maritime College of Ireland/Irish Maritime and Energy Research Centre and the University College Cork Beaufort Laboratory are located in Ringaskiddy.

Although it is largely an industrial zone, the Ringaskiddy area also accommodates a resident population. A number of Navy recruits are also accommodated on Haulbowline Island during their training. Approximately 120 recruits can be in residence at the Naval Base at any one time; however, this level is not continuous and is dependent on the recruitment process.

[7] Section 5.4.2, Chapter 5 Traffic and Transportation
[8] Section 5.4.2, Chapter 5 Traffic and Transportation
[9] Section 5.4.2 and 5.4.5.7, Chapter 5 Traffic and Transportation

There is limited opportunity for substantial levels of residential expansion in Ringaskiddy or Shanbally in the future given the importance of the area for future industrial development. Development boundaries around the villages are also restricted from future growth by open space zoned lands which provide some buffering between the villages and industrial land as appropriate.

Passage West and Monkstown

Passage West and Monkstown both front onto inner parts of Cork Harbour and comprise of largely residential commuter settlements. Passage West comprises of expansive residential estates and comprises of a number of local services including a Garda station, churches, playground, sporting facilities, smaller shops and local services. It also contains both primary and secondary level education. Passage West also contains some small scale port facilities. Glenbrook car and passenger ferry which crosses to Cobh is located between Passage West and Monkstown.

Monkstown is a much smaller settlement with more established residential areas and comprises of a small number of local services including a café and a small number of public houses / restaurants, primary school and churches. A marina and sailing club is also located within Monkstown.

Community Facilities

There are a large number of community facilities within the study area. A survey of community facilities located within 1 km of the proposed road is documented in **Appendix 7A**. This survey is based on review of the available mapping of the area and site visits undertaken within the area. There are a number of recreational facilities within the study area in the vicinity of the proposed M28 road project. Sports facilities within the study area include the Garryduff Sports Centre, Raffeen Creek Sports Club, Carrigaline RFC, Douglas RFC, the sports complex utilised by Scoil Phádraig Naofa / Douglas Hall AFC and Hibernian FC (Shanbally), golf courses at Douglas, Fernhill and Raffeen Creek and three Pitch and Putt courses located in Douglas, Raffeen Creek and Garryduff Sports Centre.

Several churches and graveyards have been identified within the study area particularly within the Rochestown, Shanbally, Barnahely and Ringaskiddy areas and these have been identified in the figures as illustrated in **Appendix 7A**.

There are a number of primary and secondary educational facilities within the study area which are primarily concentrated in the Douglas, Rochestown, Shanbally, Passage West, Monkstown and Carrigaline urban areas. There are also plans for a new school site to the south west of the Shannonpark Roundabout in Carrigaline and for a new national school to serve Ringaskiddy and Shanbally.

Ringaskiddy is also home to the National Maritime College of Ireland (NMCI) which is a third level college which has capacity to accommodate 750 full time students. Work has recently been completed on expanding this educational campus eastwards, the new Beaufort building accommodates the Irish Maritime and Energy Resource Cluster Ireland (IMERC).

7.3.3.2 Working Community

As indicated within **Section 7.3.2** which refers to Employment, within the study area the main employment area is Ringaskiddy. Both Douglas and Carrigaline are also important centres for employment as they include a range of businesses, retail, services and local amenities.

Most of the employment and economic activities within the study area are located within the Ringaskiddy area between Carrigaline and Ringaskiddy which is home to the largest concentration of pharmaceutical companies in the country.

While there are inevitably local residents employed in local industries, the majority of the workforce commutes into the Ringaskiddy area from various locations around the Cork City Region resulting in traffic congestion to and from the Ringaskiddy area along the exiting N28 during peak periods. It is likely that the remainder of the workforce commute to neighbouring Cork City and suburbs, as well as Little Island for employment as these are the other main employment areas within the metropolitan area.

As indicated in **Section 7.3.2** which refers to the Port of Cork's operations in Ringaskiddy, phase three of the Port's development requires the M28 road to be in place before coming into operation. Once operational this will result in an increased working population within the area.

The Irish Navy headquarters contains approximately 200 core personnel on any given day. This number will vary depending on whether any Navy vessels are tied-up at the base. Proposals are underway to remediate the former Irish Steel, East Tip site located on Haulbowline Island into a large public park. Minor works have been completed and remediation works are expected to commence on the capping process in mid to late 2017 which will result in further employment within the area.

The UCC Beaufort Laboratory which was recently constructed and opened on the mainland adjacent to Haulbowline Bridge houses the Centre for Marine and Renewable Energy (MaERI) which has over 30 employees as well as the Lir National Ocean Test Facility (Lir-NOTF) which has 135 employees.

The National Maritime College of Ireland has the capacity to offer training to some 750 full-time students through the partnership of the Navy/Cork Institute of Technology/FOCUS Education. Currently the National Maritime College of Ireland has approximately 300 full time students and in the region of 80 staff.

The college, along with the Beaufort Laboratory will be subsumed in due course into a larger planned campus development – the Irish Maritime and Energy Resource Cluster (IMERC). IMERC aims to develop an educational, research and commercial cluster for the maritime and energy industry which will result in an increased working population within the area.

There are also some warehousing and other industrial uses in the area which would involve a small number of employees at the respective sites including those at both Portgate and Ringport Business Parks.

Other than the industrial and pharmaceutical industries and port facilities, there are few other employment creating activities in Ringaskiddy. Given their proximity to the main centre of Carrigaline the villages of Shanbally and Ringaskiddy contain few services.

Agriculture is also an employment source in the area, particularly within the central parts of the road development.

Outside of the main centres as described above employment is gained at facilities such as local amenities including hotels, golf courses, sports facilities and also in schools, crematorium and commercial premises.

7.3.3.3 Visiting Community

Fáilte Ireland recommends that the treatment of tourism in an EIS should consider impacts caused by tourism projects or impacts affecting tourism, e.g., the quality of a destination or tourism activity. Overall the study area is not a tourist destination other than tourists that travel through the area by ferry.

Brittany Ferries runs a Cork to Roscoff service with sailings once a week from March to the beginning of November from Ringaskiddy port. The ship arrives into port at 10:00 Saturday and departs at 16:00 the same day. The current service caters for a maximum of 2,400 passengers and 650 cars.

Fáilte Ireland published 'Tourism Facts 2015' in September 2016. The report evaluates Irish tourism and its value to the Irish economy for the 2015 period. According to Fáilte Ireland, overseas tourist visits to Ireland in 2015 grew by 13.1% resulting in 8 billion to the exchequer. Visitor numbers from Britain, Mainland Europe, North America and the rest of the world all experienced growth and the trend for overseas visitor numbers has now been increasing since 2010.

Britain accounts for 41.6% of overseas tourists, followed by the rest of Europe at 35.8%. Just over 16.1% of overseas tourists come from North America. In 2015, out-of-state tourist expenditure, including spending by visitors from Northern Ireland, amounted to €4.6 billion. With a further €1.3 billion spent by overseas visitors on fares to Irish carriers, total foreign exchange earnings were €6 billion. The port at Ringaskiddy contributes to the tourism market by accommodating passengers to travel into the country by ferry.

Visitor Attractions

Built Heritage

Visitor attractions within the area include the Martello Tower and Spike Island. The Martello Tower, built in 1804 by the British Defence Forces as a defensive fort, is located to the South of Ringaskiddy village. This tower is one of five in Cork Harbour, built as a line of defence to withstand an invasion from the continent. A similar one also exists on Haulbowline Island. There are no published visitors' numbers relating to this fort however numbers are thought to be low.

The 103 acre Spike Island located in Cork Harbour to the East of Ringaskiddy Village. Originally the home to a monastic settlement in the 7th century, the Island was used in the 17th century as a centre for convicts sentenced to transportation. This began the Islands long history with imprisonment, which saw purpose built prisons constructed in the 19th century and which were in use until the 1980s. Today, tours of the fortress, as well as an outdoor adventure centre on the Island provide popular days out. Spike Island is accessed via Cobh and therefore visitors are unlikely to be affected by the M28 project.

Walking and Cycling

There are a number of signposted walking and cycling routes traversing the area in the form of trails and along local roads. For example the old railway line which runs from Crosshaven to Passage West via Carrigaline and is now a planned greenway for walking and cycling. The section from Crosshaven to Carrigaline is in operation. The section between Passage and Raffeen is going through planning while the remainder of this route between Raffeen and Carrigaline is still at concept stage. The greenway will provide shared walking and cycling facilities. This will allow for a continuous public walkway between Cork City and Crosshaven. There are also marked Slí na Sláinte Routes at Ringaskiddy and Monkstown as shown in **Appendix 7B**.

In addition, the Fáilte Ireland[10] and Coillte[11] websites were accessed to identify any attractions within the area. Oldcourt / Garryduff woodland near Rochestown is the nearest woodland amenity to the proposed project and consists of 26 hectares of mixed woodland, however, given its distance from the project is unlikely to be affected.

Currently, at the end of the L2545 at the access road to Haulbowline there is a car park with beach access and seating and this local beach is known as Gobby Beach. This serves as a small local amenity area which is not widely used for bathing purposes. There is also a small publicly accessible amenity area adjacent to the crematorium on Rocky Island which has views to the Harbour.

Angling

There are three watercourses running through the area, the Woodbrook Stream, Donnybrook Stream and Glounatouig Stream. Brown trout is present in both the Donnybrook and Glounatouig streams.

There are a number of local angling points around the Ringaskiddy area. The most popular of these is at Paddy's Point which lies just to the east of the Haulbowline Bridge on the mainland in Ringaskiddy. None of these angling points are considered to generate significant visiting populations and are largely used by local anglers.

Equine

There are a number of small scale equine establishments within the area comprising of livery, training schools and sport horse facilities which attract the visiting community to the region.

Golf

Douglas Golf Club, Fernhill Golf & Country Club and Douglas, Raffeen Creek, Garryduff and Carrigaline Pitch and Putt Clubs are all located within the study area and are important amenities for the local communities.

[10] www.failteireland.ie
[11] www.coillte.com

Sailing

Cork Harbour is home to a number of sailing clubs including the Royal Cork Yacht Club in Crosshaven, the Cobh Sailing Club, Cobh Sea Scouts, Monkstown Bay Sailing Club and Sail Cork, (East Ferry). In addition there are other berthing facilities available around the harbour for pleasure craft. A number of tourist operators use the waters around Haulbowline Island in Ringaskiddy, for example, the ferry from Cobh to Spike Island as well as some established harbour tour operators. The channel between Haulbowline Island and Cobh, and the harbour waters generally in this area are therefore regularly used for leisure and tourism purposes as well as commercial fishing and shipping.

Other water based leisure events which pass the harbour area in Ringaskiddy include the Ocean to City Race (rowing event from Crosshaven to Cork City quays); the Spike to Cobh swim; Cobh Traditional Sail Regatta; Cobh Triathlon, Cobh People's Regatta; and Cork Week in Crosshaven. These events attract rowers and sailors from other parts of Ireland as well as international visitors.

As part of the Port of Ringaskiddy Upgrade, a section of the waterfront to the north of the Beaufort Laboratory will be upgraded to provide a new public pier, slipway and pontoon which will replace those currently located within the Port campus. This new facility will include improved tidal accessibility and provide boat storage as well as landscaped trailer parking areas with a pedestrian route connecting the site to Ringaskiddy village.

7.3.3.4 Land Use

The existing N28 national road provides access to a large number of diverse strategic land uses in Cork; namely the metropolitan town of Carrigaline; the Ringaskiddy Strategic Employment Area; the Irish Naval Service on Haulbowline; the National Maritime College of Ireland (NMCI) and associated technology campus; the Port of Cork complex; existing large scale biological and life sciences companies and the two villages of Shanbally and Ringaskiddy.

The main settlements along the proposed route are Ringaskiddy and Shanbally in the south east, Carrigaline to the south and Douglas/Rochestown to the north. Other settlements within the study area include Passage West and Monkstown although these settlements are not located adjacent to or adjoining the proposed project.

Community facilities within the study area have been identified from review of available mapping, public consultation, site visits and local knowledge of the area. In relation to amenity facilities there are a number of golf and pitch and putt courses located within the area. There are also a number of sports facilities within the study area including the Garryduff Sports centre, Carrigaline RFC, Douglas RFC, the sports complex utilised by Scoil Phádraig Naofa/Douglas Hall AFC, Hibernians AFC and Shamrocks GAA at Shanbally.

There is a proposal for the development of the dismantled railway line between Carrigaline and Raffeen Bridge as part of the Passage West to Carrigaline Greenway which will be considered with respect to amenities within the area.

Land Take Assessment

A land take impact assessment in respect of non-agricultural land uses has been undertaken in respect of the proposed project. This impact assessment assesses the level of impact associated with land take requirements required to facilitate the project in respect of residential, community and commercial premises. The Agricultural land use assessment is detailed in **Chapter 8** of this EIS.

The non-agricultural land use assessment is detailed in **Appendix 7C** of this report.

Each of the different levels of significance which an impact may have on residential properties along the route is provided in **Table 7.1** in the methodology section of this chapter. These are based on the EPA 'Guidelines on the Information to be contained in Environmental Impact Statements' (2002) and associated draft Guidelines (2015); and 'Advice notes on Current Practice (in the preparation of Environmental Impact Statements)' (2003) and associated draft Advice Notes (2015) with reference specifically to properties along the proposed M28 Road Project.

Impacts in relation to commercial and community properties will vary and have been assessed individually reflective of the definitions of impacts based on the EPA 'Guidelines on the Information to be contained in Environmental Impact Statements' (2002) and associated draft Guidelines (2015).

There is no difference between the temporary (construction phase) and permanent (operational phase) CPO land take requirements as accommodation works will generally take place within the proposed alignment of the existing and proposed roadway. Lands will be acquired as part of the CPO in advance of construction and therefore impacts are assessed in detail under the construction phase of this impact assessment (i.e. **Sections 7.4.1.4** and **7.6.1.4**).

7.4 POTENTIAL IMPACTS

7.4.1 Construction Phase

Construction phase impacts that have potential to impact on the socio-economic groupings within the study area include impacts associated with construction works including dust, noise, vibration, visual impacts and overall impacts to amenity. Other construction phase impacts include traffic diversions, road closures, traffic congestion and land take.

Chapter 3 of the EIS describes the proposed road project including the construction methods proposed.

The following section identifies potential construction phase impacts on population, employment, socio-economic groupings and land use **without mitigation in place.**

7.4.1.1 Population

It is envisaged that overall there will be approximately 430 people employed during the 30 to 36 month construction period[12]. Some of these people may move to the area temporarily during the construction period increasing population on a short term basis. This will have potential for positive short term impacts in terms of population.

As identified in the land use section below (**Section 7.4.1.4**) four occupied properties will be acquired as part of the CPO to facilitate the project. Two properties will need to be demolished to facilitate the proposed project. This will have a slight negative impact on population levels within the area in the short term.

It is likely that any short term disruption experienced will not be so significant as to result in changes to the population levels, demographic profile or trends in measures such as household size in the surrounding areas. Overall impacts on population levels during construction are likely to be neutral / slight positive in the short term overall.

No impacts on population are likely as a result of the construction of the proposed service area other than the potential for an increase in population levels as a result of construction activity. Impacts are likely to be neutral and short term with respect to population levels.

7.4.1.2 Employment

The construction phase of the proposed M28 Road Project will result in a significant short term positive increase in the working community at the site. It is estimated that there will be in the range of 430 people employed during the construction period over the 30-36 month construction period. It is expected that 30 of these jobs will relate to the construction of the service area.

There is also potential for indirect employment to be created as a knock on effect of increased spend within the local economy. Indirect expenditure (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 which has an estimated construction cost of €122 million.

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 and around Cork. Any indirect income generated locally through increased employment will have a knock-on positive effect on the local economy, in the form of increased trade in local shops, petrol stations, restaurants and temporary accommodation.

Overall there is potential for a short term significant positive impact as a result of the increase in direct and indirect employment within the area. This is likely to have associated positive economic impacts on the area as a result.

[12] Chapter 3, Description of Development

There is potential for short term disruption to road users along the existing route particularly between the Bloomfield interchange and Carr's Hill Interchange during construction. This will have the greatest impact to those travelling to and from work during peak periods due to delays and diversions while works are being undertaken.

Based on the extent of agricultural land take requirements to facilitate the proposed road project as per **Chapter 8** which deals with agricultural land uses, it is unlikely that there will be significant disruption to agricultural activities in the area during the construction phase.

Construction phase impacts are unlikely to be so significant that they will impede people from getting to and from places of employment. Overall construction phase impacts in terms of employment are likely to have significant positive short term direct and indirect impacts in relation to the proposed road. Impacts in relation to the service area on employment during the construction phase are likely to be moderate positive direct and indirect in the short term.

7.4.1.3 Community

Resident Community

During the construction phase there is potential for negative impacts to the general amenity of the resident community as a result of road works, traffic diversions, noise, visual and dust impacts. Widening of the roadway along the route is likely to affect entrances to homes within the land take area which is described in more detail in **Section 7.4.1.4** below. The main potential impact to those living within the area will be the disruption to local traffic due to diversions and delays associated with road works to facilitate the construction of the road project. Full construction stage impacts are described in **Chapter 5** of this EIS which refers to Traffic and Transportation.

As identified in the land use section below (**Section 7.4.1.4**) one property will be demolished and one permanently acquired to facilitate the proposed road project. At worst this will have a profound negative impact on the residents of these properties. The extent of impact maybe lessened depending on the personal reaction of the residents to the principle of relocation.

Where widening of the roadway along the route is likely to affect entrances to homes within the land take area, entrances will be reinstated if practical at the same location and will be maintained during construction, otherwise reasonable temporary access will be provided. However this will only be required in a limited number of areas including a limited section of roadway on the southern extent of Maryborough Hill to facilitate the new link road to the Carr's Hill Interchange. Widening of the Rochestown Road will also be required on approach to Clarke's Hill to the west and to improve a section of roadway (Tower Road) to the east of Ringaskiddy Lower Harbour National School which is located within the southern section of the proposed road project. The land take assessment identifies and assesses potential impacts to properties resulting from such works as detailed in **Section 7.3.3.4** and **Appendix 7C**.

During the construction phase of the proposed road there is potential for significant short term impacts on the residential amenities of communities residing in dwellings located closest to the proposed road project in Wainsfort, Newlyn Vale, Rochestown Rise, Mount Oval, Delfern Grove and Maryborough Heights as the existing tree belt along the N28 will be removed. There is potential for short term negative visual and noise impacts as a result during the construction phase.

There is potential for significant short term negative impacts to the residents within the Fairways on Maryborough Hill and other residents living within the Maryborough Hill area while the Maryborough Hill Overbridge is being replaced due to noise, vibration, dust, visual impacts and traffic diversions and congestion.

There is potential for significant short term impacts on residential amenities of those living within Rowan Hill in Mount Oval and The Close and Edgewood in Maryborough Ridge during the construction of the retaining wall to the south of these properties due to the associated noise and dust generation.

During the construction phase there is potential for slight short term impacts on the residential amenities of communities residing in dwellings to the south of the Bloomfield interchange at Kiltegan Park and Delford Drive due to construction impacts associated with the construction of the N40 Westbound Merge.

There is potential for significant short term negative impacts as a result of construction work to residents living within the Maryborough Hill area particularly those living in close proximity to the Maryborough Hill Overbridge during the construction of the replacement bridge due to noise and vibration, dust and visual impacts and traffic diversions and congestion.

There is potential for moderate short term negative impacts on the residential amenities of those living in The Downs in Mount Oval during the construction phase due to the generation of noise and dust.

A construction compound will be located to the east of Shanbally village during the construction phase of the road project. The site will be located within the proposed lands that will form part of the CPO and direct access for construction workers will be available from the existing N28. There may be slight impacts as a result of the location of the site compound at this location however these will be minor in nature and will largely relate to increased traffic associated with construction workers on the local road network.

There is potential for moderate negative short term impacts on the residential amenities of the residents living in the three properties located to the north and west of the proposed Carr's Hill Interchange on the Carrigaline Road during the construction phase of Carr's Hill Interchange as a result of construction traffic, noise, dust and visual impacts.

There is potential for significant short term impacts to the residential amenities of those living within the cluster of dwellings to the south east of the Shannonpark roundabout due to visual, noise and dust impacts associated with the construction of the M28 to the south and construction of improvements to the existing roadway to the north.

There is potential for significant temporary negative impacts to residents living at the start of the Ballinrea access road during the construction phase of the Shannonpark Interchange due to road diversions and construction work impacts (dust, noise, and visual impacts).

Part of the 3km Sli na Slainte walking route located along the R619 and along the Loughbeg Road will be closed to pedestrians during the construction phase of this part of the road project and,

therefore, only part of this walking route will be open. This will have a significant short term negative impact on the local community that use this walking route.

The traditional funeral route between Shanbally Church and Barnahely Graveyard utilises both the L2492 and L6472 before entering the graveyard via Warren's Cross. This funeral route will need to be diverted via the existing N28 during the construction phase. This will have a slight short term impact on the local community.

There is potential for significant short term impacts to those living and working in the Shanbally area as a result of the construction of the roadway within the built up area of the settlement. The road will sever the community to the north and south of the road project with potential for access issues including access to services and separation between parts of the community. During the construction phase there is potential for significant negative short term visual, noise and dust impacts and traffic delays as a result of road works and diversions.

Four properties will be acquired as part of the CPO in order to facilitate the road project and as a result residents of these properties will be required to relocate. As identified within the land take assessment profound impacts are likely as a result.

Overall construction phase impacts on the resident community are expected to be profound long term and significant negative and short term with regard to the proposed M28 road. Impacts in respect of the service area are expected to be slight negative and short term.

Working Community

Impacts on the resident community as a result of the proposed road during the construction phase will be similar to that of the working community. There is potential for negative impacts to the working community within the area as a result of road works due to traffic diversions, noise, dust and visual impacts. The main potential impact to those working within the area will be the disruption to traffic due to diversions and delays associated with road works to facilitate the construction of the road project.

There is a significant working community living within the study area travelling along the existing N28 on a daily basis to places of employment. There is also a significant number of people living outside of the study area that travel along the N28 to employment areas i.e. to Ringaskiddy and Carrigaline and travel to other employment areas via the N28 i.e. Carrigaline to the City, Little Island and Ballincollig. There is potential for significant negative short term impacts to the working community that use the proposed road as a result of diversions and traffic delays during the construction period.

Impacts to the working community in respect of the service area are expected to be slight negative and short term.

Visiting Community

The short term construction period of the proposed road project will not stimulate or suppress demand for tourism development in the area or affect tourism developments or attractions as roads will still be in use for vehicular traffic. Therefore the construction phase impacts of the road project are likely to be 'not significant' and short term in relation to the visiting community.

The proposed service area will be located to the east of Ringaskiddy village and will be accessed via a separate entrance to the Port of Cork. There is potential for slight negative short term impacts.

7.4.1.4 Land Use

Overall there will not be a significant change in land use during the construction stage of the proposed project as works will take place largely on line within the northern part of the road project. Within the central and southern parts of the road project construction works will take place largely within lands in agricultural use which is described in **Chapter 8** of the EIS.

During the construction stage there will be impacts on residential, commercial and community land use types as a result of the proposed land take proposed to facilitate the road project. Impacts are described below in relation to land take respective of land use types.

Land Take Assessment

There is no difference between the temporary (construction phase) and permanent (operational phase) CPO land take requirements as accommodation works will generally take place within the proposed alignment of the existing and proposed roadway.

Results of this Impact assessment are outlined in **Table 7.7** and in **Figure 7.2** below. The detailed impact assessment results and associated mapping is provided in **Appendix 7C**.

Table 7.7: Land Take Impact Assessment Results

Significance of Impact	CPO – No. of Properties
Not Significant	20
Slight	10
Moderate	7
Significant	2
Very Significant	3
Profound (entire property)	4

Based on the non-agricultural land take impact assessment as outlined in **Appendix 7C** of this EIS most of the impacts associated with the proposed land required to be compulsorily purchased will be either 'slight' or 'not significant'. Many of the 'not significant' impacts relate to lands that will need to be acquired for accommodation works outside the property boundary and therefore no boundary walls / hedging will need to be removed. Slight impacts are identified where the proposed development encroaches on a boundary causing a slight inconvenience but does not require a significant change to landholding or result in any reduction in residential amenity.

Land take will be required at Douglas Golf Course (Landholder No. LH0095) and Fernhill Golf and Country Club (LH0081) however land take will not interfere with the layout of either of the courses. Land take relates to peripheral areas of the overall development in consultation with landowners and impacts will be not significant in both cases.

There will however be some moderate impacts associated with the take required to facilitate the development. Moderate impacts have been identified in relation to residential properties where the development encroaches on more than one boundary of the site and/or encroaches on over 25% of the landholding/curtilage only and/or is likely to modestly reduce the residential amenity of the site.

A number of commercial facilities have been identified as having moderate impacts in terms of land take. Impacts relate to the level of land take required and impediments to the use of the site going forward. It is not proposed to demolish any business premises, however, permanent acquisition of areas of lands zoned for commercial/industrial uses will be required to facilitate the proposed road project. In some cases land take is required in respect of sites which contain operating commercial/ industrial premises. However the road has been designed to minimise land take and associated impacts on land uses within the area.

Significant effects are identified in relation to the land take required at Raffeen Quarry (LH0044) and in relation to one of IDA's sites (LH0093B) due to a reduction in the site's useable area.

There will be a small number of very significant impacts in relation to land take and these relate to the acquisition of lands in Shanbally within industrial zoned lands and at Shanbally Hibernian AFC (LH0066). In the case of Shanbally Hibernian AFC, the site comprises of one pitch used by the club and a second pitch which is leased to Carrigaline Soccer Club. The pitch which is currently being leased will be required to facilitate the road at this location. Very significant impacts have also been identified in relation to a commercial site in Shanbally (LH0075) whereby over 65% of the site will be included within the CPO. A very significant impact is also identified in relation to a vacant site located Ringaskiddy due to the quantum of land take required at this location (LH0052).

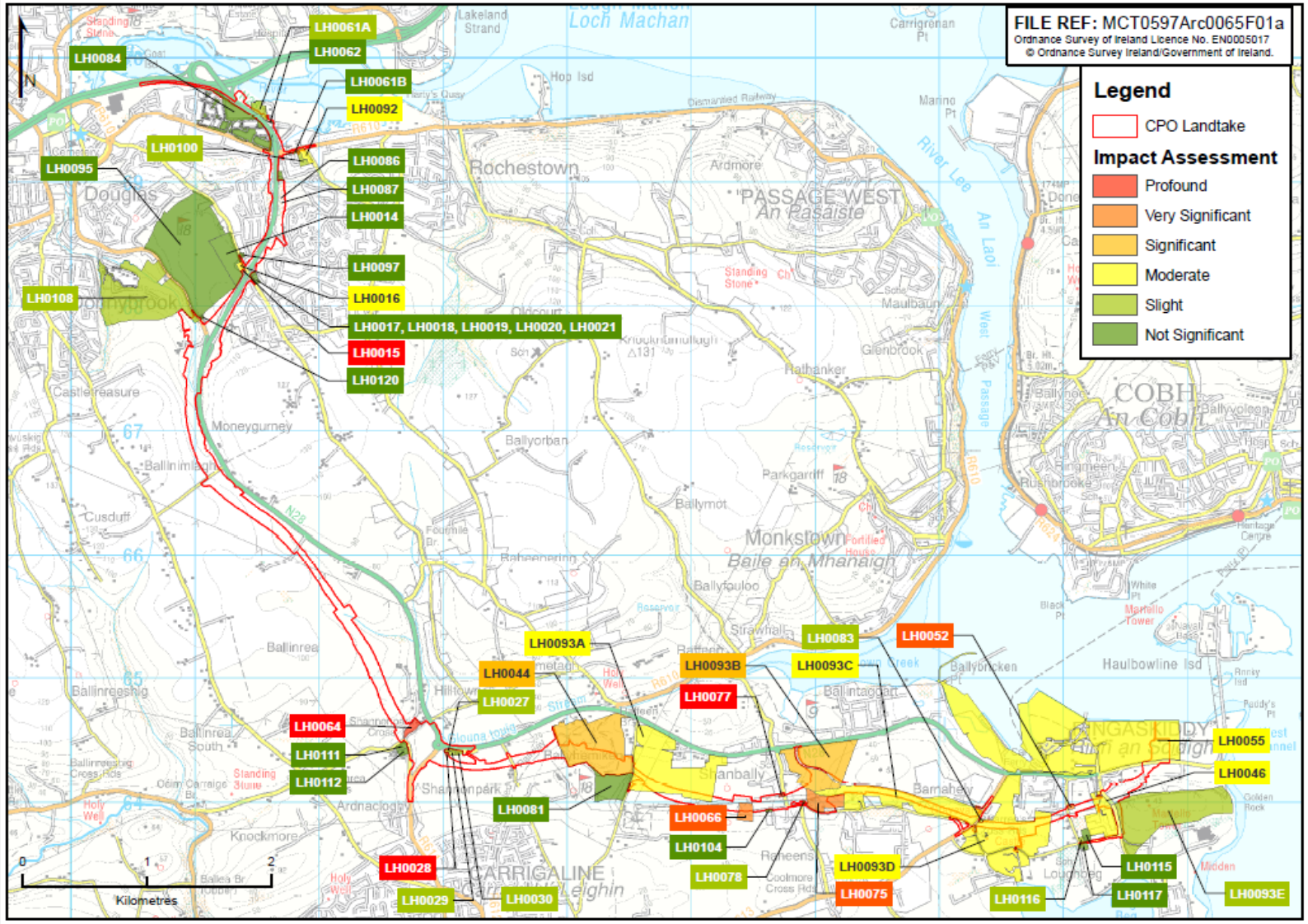
Profound negative impacts have been identified in relation to four properties which will be acquired as part of the CPO in relation to the proposed road project.

One of these properties is located on Maryborough Hill and will need to be demolished to facilitate the proposed Carr's Hill interchange link road from Maryborough Hill (LH0015). A second property located within Shanbally will also need to be demolished in order to facilitate the road project and associated accommodation works.

According to the Health Study in **Appendix 1C**, a Brothers of Charity property located to the north west of Shannon Park roundabout is a particularly sensitive land use. This property is therefore proposed to be acquired as a result of consultation with the landholders (LH0064). A further property to the south of Shannon Park roundabout will also be acquired as an outcome of consultation with the landholders (LH0028) given the loss of amenity as a result of the proposed road project.

The service area is zoned for Industrial uses under Objective I-I8 of the Carrigaline EALAP, 2015 which is for 'Port facilitates and Port Related Activities'. The site is owned by the Port of Cork and part of the site is currently in use for vehicle storage. There will be a moderate impact in relation to land take relating to the acquisition of lands to facilitate the service area in Ringaskiddy.

Figure 7.2: Non Agricultural Land Take Impact Assessment Map



7.4.2 Operational Phase

The following section identifies potential operational phase impacts on population, employment, socio-economic groupings and land use **without mitigation in place**.

7.4.2.1 Population

As identified in the land use section above (**Section 7.4.1.4**) four occupied properties will be acquired as part of the CPO to facilitate the M28 Cork to Ringaskiddy Project. Two properties will need to be demolished to facilitate the proposed road project. This will have a slight negative impact on population levels within the area in the short term.

With the road in place there is potential for increased capacity on the road network within the area. This may result in an increase in residential development within the area. This will be particularly positive for the Shannonpark Masterplan area within Carrigaline which is zoned for 1,200 new units and for currently undeveloped zoned lands within the Douglas and Rochestown areas. There is therefore potential for significant positive long term impacts on population within the area once the road is operational.

There is potential for significant increases in population within Cork City as a result of the relocation of the Port of Cork to Ringaskiddy Port in line with the objectives and residential and population targets set within the Cork City Development Plan. This is a potentially significant positive indirect long term impact which is of importance as a result of the proposed road project

Once the service area is operational no impacts on population are considered likely with a neutral impact.

7.4.2.2 Employment

The Proposed M28 Road Project will cater for port related traffic, providing priority access and increased capacity between the Port, bypassing the villages of Shanbally and Ringaskiddy. It is estimated that there will be a 4 – 5 minute interpeak time saving for HGVs between the Port of Cork at Ringaskiddy and the Mahon Interchange[13].

The upgraded road network will improve access and journey time to and from the Ringaskiddy area and as a result will make the zoned lands within this area more attractive to investors. It is likely that this will result in an increase in employment opportunities within the area. This will support the role of Ringaskiddy as a Strategic Employment Area. As a result the proposed road project has the potential to have significant positive long term impacts on employment and the economy of the County and region as a whole.

The proposed M28 road project has the potential to have significant positive indirect long term impacts with regard to employment opportunities created as a result of the relocation of the Port to Ringaskiddy and the opening up of new strategic land banks within the Cork City Docklands area also. This helps to achieve national, regional and local planning policy objectives as outlined in **Chapter 2** of this EIS which refers to the Planning and Policy Context of the M28 project.

[13] M28 Cork to Ringaskiddy Road Project Business Case, May 2017.

With respect to impacts on economic activities and consequently on employment, the proposed road project is not considered to have a significant built footprint particularly in the northern section of the road project where works are largely on-line. Therefore the permanent loss of land from other economic activities such as agriculture is proportionately low when considered in the context of the overall site.

Some businesses along the route may experience levels of diminution/severance as a result of the proposed road project. These include local services primarily located on the main street in Shanbally which will be by-passed as a result of the proposed development. The greatest loss in passing trade will be experienced by those businesses that have frontage onto the existing N28. Certain businesses such as filling stations are more dependent on passing trade. While some passing trade may be lost on the completion of the M28, the existing roads will remain open to traffic and much of the hinterland passing trade will remain.

It is likely that there will be opportunities for an increase in spend within the village of Ringaskiddy given the likely increase in visiting numbers to the area as a result of the proposed road project. On this basis impacts to businesses such as the Ferryboat Inn and Bed and Breakfast's in the area will be positive in the long term.

Once the M28 road project is operational there is likely to be both significant positive direct and indirect long term impacts in terms of employment within the area.

It is proposed that the service area will employ approximately 6 no. employees which will have a moderate positive direct and indirect long term impact in respect of employment within the area once operational.

7.4.2.3 Community

Resident and Working Community

There is potential for a combination of positive and negative impacts on the resident community within the area. There will be an overall reduction in traffic along the existing N28 roadway within the Raffeen, Shanbally and Ringaskiddy areas which will result in movement of traffic and HCVs away from local traffic, schools, community facilities and other properties adjacent to the existing N28. This will have a significant positive long term impact on the local community as a result.

Overall, access to community, recreational and employment facilities in Cork City, Douglas, Carrigaline and Ringaskiddy will be significantly improved as a result of the proposed road project which will benefit communities located throughout this area. These communities will also benefit from any improvements resulting from economic growth in the local area.

The Ringaskiddy and Shanbally communities will benefit from a cleaner, safer and quieter environment as these communities will be bypassed as a result of the construction of the proposed M28 route. The main impacts on the social interaction between neighbours and on their accessibility to community facilities are discussed below.

With the proposed road project in place there will be a separation of local and strategic traffic which will result in safer journeys for both categories of user. Primary local users of the existing road will experience a substantial reduction in frustration currently associated with difficulties in gaining safe access onto the busy road and will also experience much improved local journey times as a result of the substantial decrease in traffic volumes. There will be significant positive long term impacts as a result as described below:-

- It is proposed to maintain the existing N28 carriageway from Carr's Hill to Ringaskiddy village to act as a local access road for local traffic. This road will be reclassified to become a regional / local road. Together with the R609, the re-classified N28 will provide the primary route in the area for non-motorway users. Non-motorway users will be classified as pedestrians, cyclists, equestrians, learner drivers and certain classes of motorised vehicles which are not permitted on motorways.
- Once the M28 is operational the exiting N28 route will be downgraded to a regional / local road as outlined above and will provide a valuable local recreational amenity in terms of walking and cycling to serve the local community, which will have positive long term impacts on the quality of life. The proposed road project makes provision for pedestrian and cycle connections between Carrigaline and Raffeen to accommodate the proposed greenway walking and cycling route between the City and Crosshaven. There is potential for indirect positive health benefits as a result due to improvements in opportunities for use of sustainable modes of transport.
- Existing Bus Éireann routes will remain unaffected when the road is constructed. Parts of the proposed roadway between Carrigaline and Douglas will form part of the Carrigaline 'Green Route' high quality bus corridor. The proposed roadway will improve travel times along this route which will improve this service.

The project includes the relocation of the northbound on-ramp to the M28 from Maryborough Hill and the replacement of the overbridge at Maryborough Hill. The relocation of this direct access point to the M28 is likely to make journey distances slightly longer (approx. 1.2km) for people living adjacent to these areas. However the proposed Carr's Hill Interchange will provide an alternative access route onto the M28 and will have an overall improvement on travel times for those travelling to and from this area by 2.1 minutes on average during peak periods[14]. Furthermore it will allow a full suite of on and off movements between the M28, N28, R609 and Maryborough Hill. There is potential for significant positive long term impacts as a result due to improvements in accessibility overall and travel times.

The proposed road project provides for continued access upon completion of construction by way of underbridges or overbridges for all but two of the 16 roads directly affected. The creation of cul-de-sacs has been kept to a minimum.

At Raffeen, the existing L6472 will be severed and a crossing will not be provided at this point. There are a limited number of properties located along this roadway and no pedestrian facilitates. It is proposed that a cul-de-sac and turning head will be provided to the north of the M28 on the L6472. No alternative route will be required to the north as traffic will be able to turn and travel along the existing N28, however some inconvenience may be experienced. To the south of the M28 the L6472 will be accessed via the proposed new Shanbally to Raffeen slip road which will run adjacent to the southern boundary of the M28. Again some inconvenience may be caused to local road users at this point as they will be required to re-route their journey through the Shanbally to Raffeen Link Road.

[14] Table 5.27: Changes in Journey Times to/from Maryborough Hill and the M28 during 2035 AM and PM Peak Hours, Chapter 5 Traffic and Transportation.

These journeys are unlikely to be made on foot given the poor pedestrian environment and limited number of properties located along this route, therefore, impacts are unlikely to be significant as a result.

It is proposed to close Old Post Office road to through vehicular traffic. Old Post Office Road itself will however be accessible to pedestrians and cyclists as an underbridge is proposed. Tower Road which is located between Old Post Office Road and the Loughbeg Road (L6507) will be upgraded to a higher standard in order to cater for additional traffic as well as alleviating flooding currently experienced which will have a positive impact. This arrangement will still allow for pedestrian and cycle trips to Ringaskiddy Lower Harbour National School, with some inconvenience caused for vehicular movements resulting in a slightly longer route. However this is identified as a slight negative impact only.

The existing access to the Ringaskiddy Lower Harbour National School via the R613 and L6518 will remain in place when the proposed Barnahely Roundabout replaces Warren's Cross. A minor road between Warren's Cross and the L6518 will be severed and a turning head constructed, however this road is quite narrow and has incomplete surfacing resulting in the majority of school traffic currently utilising the L6518. Therefore a slight negative impact is expected as a result of this severance.

It is a local objective of the Ringaskiddy community to relocate the Ringaskiddy Lower Harbour National School to a new facility. The local community purchased a site to the east of Ringaskiddy village to relocate the school. No planning permission has been secured for this proposed school. This site is now however located within the land take of the proposed road and therefore this site is no longer feasible as a relocation site for the Ringaskiddy Lower Harbour National School which has potential to have a significant negative impact on the local community.

Four properties will be acquired as part of the CPO in order to facilitate the road project and as a result residents of these properties will be required to relocate. As identified within the land take assessment (**Appendix 7C**) profound impacts are likely as a result.

The traditional funeral route between Shanbally Church and Barnahely Graveyard utilises both the L2492 and L6472 before entering the graveyard via Warren's Cross. This funeral route will be maintained once the road is operational however the route will be required to go through the new Barnahely roundabout in lieu of Warren's Cross. This will have a not significant impact in the medium to long term.

The proposed road project will be located along parts of the Ringaskiddy Slí na Sláinte route along the L6517 Loughbeg Road (south) and along the R613 at Barnahely. This walking route will need to cross the proposed protected roadway and associated traffic on both of the above mentioned roads. This walking route will be significantly impacted as a result.

Local diversions to overhead electricity lines are required at Shanbally that will result in existing separate overhead lines on steel pylons and wooden poles being relocated. As outlined in **Chapter 16** which details the landscape and visual impact assessment, these features exist already in the landscape and as a result there will be no change in landscape resource. (**Section 16.4.2**) The proposed pylon masts will however be located closer to properties at Coolmore Close which will have a moderate negative impact as a result.

In summary, while the proposed road project will have both positive and negative impacts on resident and working communities, the impacts will predominantly be positive due to reduced journey times, improved accessibility and access to sustainable modes of transport resulting in an overall significant positive long term impact.

Once the service area is operational, there is potential for an increase in employment in the area as a result of the 6 no. direct jobs that will be generated within the service area resulting in moderate positive direct long term impacts. There will be moderate positive indirect long term impacts through increased spend in the area as a result of increased employment associated with the service area also.

Visiting Community

The proposed road project will allow for increased shipping traffic through the Port of Ringaskiddy in the form of transportation vehicles and ferry traffic. As a result there is potential for an increase in visiting community travelling through the area resulting in both significant positive direct and indirect impacts due to generation of services, increased spend within the local economy and will have a slight positive indirect impact on the economy as a result.

The service area will offer a facility to the HGV drivers via the Port of Ringaskiddy, improving the overall visitor experience. It will be beneficial to the already important function of the port by providing a secure parking area, rest and washing facilities to HGV drivers utilising the Port. There is potential for significant positive long term impacts as a result.

7.4.2.4 Land Use

With respect to land use, the proposed road is not considered to have a significant built footprint particularly in the northern section of the road project where works are largely on-line. Therefore the permanent loss of land use types including agriculture, commercial, residential and community is proportionately low when considered in the context of the overall site.

Two dwellings will be demolished to facilitate this road project which will have a profound impact (as identified in **Appendix 7C**). There has been a limited number of planning applications within the vicinity of the overall route alignment over the last number of years given the designation of these lands as greenbelt. Therefore the proposed route will not have a significant impact on any new land uses within this area. However, further south, the proposed route and service area will be located on lands which are currently zoned for industrial uses which will result in the loss of these lands as a result.

The proposed road is likely to have a significant positive long term impact on land use within the area. This area will be more attractive to investors due to improvements in access, sustainable modes of transport and improved travel times.

Land Take Assessment

No additional lands will be acquired as part of the CPO/landtake other than those identified under the construction phase impacts described in **Section 7.4.1.4**.

7.4.3 'Do-Nothing' Scenario

The do-nothing scenario will result in increased traffic delays and backlogs and associated increased air and noise pollution in an already congested area. A strict interpretation of the Spatial Planning and National Roads Guidelines would suggest that strategic port traffic should take precedence over the commuter function of the N28. This will cause a negative impact in terms of frustration and longer travel times for residents in the area who use the local road network as well as commuters travelling to work; both from residential areas such as Carrigaline to Cork City as well as the workforce travelling in the opposite direction from the N40 towards the many pharm-chem and manufacturing facilities in Shanbally and Ringaskiddy (refer to **Chapter 5**: **Traffic and Transportation** for further details). This is likely to have a long term negative impact.

The do-nothing scenario will also result in the Port of Ringaskiddy being unable to fully utilise its planned expansion, which may affect the economy in the region as well as failing to implement the TEN-T status of the Port.

Under the do-nothing scenario the project will not be advanced. Travel times along the existing route will greatly increase over time and the attractiveness of employment areas such as Ringaskiddy and residential areas such as Carrigaline and Rochestown will be reduced as a result. This will have significant long term negative impacts on population levels, employment, communities and the economy.

The do-nothing scenario will result in no road and no service area. Without the motorway being in place there will be no requirement for the service area in any case therefore no impacts in relation to the service area will take place as a result. There will be a neutral impact as a result.

7.5 MITIGATION MEASURES

7.5.1 Construction Phase

Construction phase impacts on socio-economic groupings relate to air, noise, dust, traffic and visual impacts associated with construction works, traffic and diversions. Mitigation associated with each of these impacts is detailed in the relevant chapters of this EIS.

7.5.1.1 Population

The project as proposed incorporates financial compensation for land acquisition along with boundary entrance relocation and/or reinstatement as necessary.

No other specific remedial measures in relation to demographics are proposed. Relevant mitigation measures with respect to air and noise to ensure minimal disruption to the population of the area are set out elsewhere in this EIS in **Chapter 13**: **Air and Climatic Factors** and **Chapters 14**: **Noise and Vibration**.

7.5.1.2 Employment

There is potential for roadworks along parts of the route to facilitate the proposed road. Best practice management will be put in place to minimise disruption to those working in the area or passing through to workplaces elsewhere. Traffic management measures have been outlined in **Chapter 5: Traffic and Transportation** including measures to be included in the Construction Traffic Management Plan (CTMP) to ensure minimum disruption at any one time. This traffic management measures has been prepared to ensure the successful implementation of any approval/consent as may be granted in any EIA Approval including any conditions/restrictions/ mitigation measures imposed. No further remedial or reductive measures are considered necessary in relation to impacts on employment.

7.5.1.3 Community

Resident Community, Working Community and Visiting Community

Impacts on the resident, working and visiting community as a result of the proposed road project at construction phase will all be similar. There is potential for an impact to the general amenity of the area as a result of road works, noise, dust, impacts. Widening of the roadway along the route is likely to affect entrances to homes. There will also be a disruption to local traffic and visiting traffic due to delays associated with road works however these will be minimised as outlined above in **Section 7.5.1.2.**

Where widening of the roadway along the route is likely to affect entrances to homes and farms within the land take area, entrances will be reinstated if practical at the same location and will be maintained during construction. Otherwise, reasonable temporary access will be provided.

A CTMP has been prepared which shall minimise construction phase impacts associated with in-combination effects with other developments which are planned for the area. The traffic management measures as outlined in **Chapter 5** which sets out the Traffic and Transportation Assessment has been prepared to ensure the successful implementation of any approval/consent as may be granted in any EIA Approval and/or Habitats Consent including any conditions/restrictions/ mitigation measures imposed.

7.5.1.4 Land Use

The route alignment and land take requirements have been carefully selected to ensure the minimum land take is required to facilitate the road project. Beyond the financial compensation as per the Compulsory Purchase Order, no further mitigation measures are proposed in relation to land use.

7.5.2 Operational Phase

7.5.2.1 Population

The road project as proposed incorporates financial compensation for land acquisition along with boundary entrance relocation and/or reinstatement as necessary.

No other specific remedial measures in relation to demographics are proposed.

7.5.2.2 Employment

Measures to reduce adverse impacts on businesses within the area have been incorporated into the design of the proposed road project at the outset. Businesses have been avoided where possible.

Some businesses along the route may experience levels of diminution/severance as a result of the proposed road scheme. These include local services primarily located on the main street in Shanbally and Ringaskiddy which will be by-passed as a result of the proposed road. The greatest loss in passing trade will be experienced by those businesses that have frontage onto the existing N28. Certain businesses such as filling stations are more dependent on passing trade and are likely to be affected. As a result it is proposed to provide measures to retain the attractiveness for stop over traffic including the provision of directional signage to by-passed settlements such as Shanbally in line with TII signage policy.

To minimise long-term severance, overbridges or underbridges have been included within the design to allow the regional/local road network to cross over or under the proposed road project. This will maintain the present continuous access where possible. Footpaths have been included within the design of the overbridges or through the underbridges. However through traffic will be closed to residents/ businesses on Old Post Office Road. Pedestrian and cycle access will continue to travel along this route. Traffic will be re-directed via the Tower Road and improvements will be made to this road.

As outlined in **Chapter 5** which refers to Traffic and Transportation, temporary connection with the N28 prior to replacement of the Maryborough Hill overbridge will be required as part of the construction of the Carr's Hill Interchange. This will reduce disruption to businesses in the area.

7.5.2.3 Community

Effort has been made during the design phase of the proposals to minimise community severance and to maintain access to community facilities, amenities and the existing N28. Where this has not been possible, alternative access will be provided. This may result in inconvenience in terms of localised increased travel distances but it is expected that improved access onto the existing N28 and reduced levels of traffic may serve to compensate for travel time lost. Any additional distances encountered should not affect to any great extent the use of community facilities, amenities or the existing N28. Rural communities will be sustained in the long term as existing routes, or suitable alternatives, linking communities and parishes will be maintained.

An alternative site for a primary school within the Barnahely area in Ringaskiddy has been identified within the proposed amendments to the draft Ballincollig-Carrigaline Municipal District Local Area Plan, 2016 which was published in May 2017.

The proposed road project will be located along parts of the Ringaskiddy Slí na Sláinte route along the L6517 Loughbeg Road (south) and along the R613 at Barnahely. A pedestrian crossing is proposed to improve the walking environment along the Loughbeg Road and R613 Road[15].

There is an objective in the Carrigaline Electoral Area LAP 2015 and draft Carrigaline-Ballincollig MDLAP 2016 to provide a pedestrian walkway along the old railway line between the City and Crosshaven. Objective CL-U-13 Carrigaline-Ballincollig MDLAP 2016 and associated amendments (May 2017) seek the 'Implementation of the Greenway project (disused railway line to Carrigaline) where practicable.' The proposed design of the road project makes provisions to link this greenway by way of a walking and cycling route along the underbridge at Ballyhemiken (Rock Road) Road which includes sufficient span to accommodate future cycle and pedestrian linkage on both sides of the roadway.

Prior to the commencement of works the contractor will be required to develop the mitigation measures proposed as part of this EIS to form a Construction Environmental Management Plan. This will ensure the successful implementation of any approval/consent as may be granted in any EIA Approval including any conditions/restrictions/ mitigation measures imposed to facilitate the proposal.

7.5.2.4 Land Use

The alignment of the road has been identified to avoid impacts to residential, commercial and community based land uses as far as possible from the outset as described in **Chapter 5: Traffic and Transportation** which outlines the alternatives considered in relation to the proposed road project. Mitigation measures to minimise adverse impacts on agricultural land uses are outlined in **Chapter 8**: **Agricultural Land Uses**.

A detailed alternatives assessment was carried out from the outset to determine the location of the service area in order to reduce potential impacts and associated mitigation measures. No mitigation is required in relation to the service area as a result.

The two properties proposed to be acquired in their entirety at Shannon Park Roundabout currently in the ownership of Brothers of Charity (LH0064) and a private landowner (Landowner Reference LH0028) can be put back into residential use once the road project has been constructed.

7.6 RESIDUAL IMPACTS

7.6.1 Construction Phase

7.6.1.1 Population

Overall impacts are considered to be neutral / slight positive and short term in nature from the construction phase of the road.

[15] Section 3.7.9, Chapter 3 Description of Development.

Given the nature of the construction phase, the proposed service area will not generate population increases or decreases. The construction phase of the service area will not cause any significant and likely adverse impacts on the population of the area. Impacts to population are considered to be neutral and short term in nature with respect to the service area.

7.6.1.2 Employment

The proposed M28 Road Project will cater for port related traffic, providing priority access and increased capacity between the Port, as well as other major employers in Ringaskiddy, and the National Road Network, bypassing the villages of Shanbally and Ringaskiddy. It is estimated that there will be a 4 – 5 minute interpeak time saving for HGVs between the Port of Cork at Ringaskiddy and the Mahon Interchange[16].

Based on the extent of agricultural land take requirements to facilitate the proposed road project as per **Chapter 8** which deals with agricultural land uses, it is unlikely that there will be significant disruption to agricultural activities in the area during the construction phase.

Construction phase impacts are unlikely to be so significant that they will impede people from getting to and from places of employment. Overall construction phase impacts in terms of employment are likely to have significant positive short term direct and indirect impacts as a result of the road. Moderate positive direct and indirect impacts with regard to the service area are likely during the construction phase.

7.6.1.3 Community

Resident and Working Community

There will be unavoidable short term impacts on the resident and working community during the construction phase of the proposed project. Such impacts will include negative impacts on residential amenity due to road works associated with the construction process, impact on properties (as described above) increased levels of noise and dust associated with the construction process and visual impacts. Some diversions and delays to road users will occur during the construction period along the route as a result of the construction of the proposed road project as detailed in the Traffic and Transportation Chapter (**Chapter 5**).

As outlined within the Health Study prepared in respect of the M28 road project presented in **Appendix 1C** of this EIS, the risk to community health as a result of air and noise emissions during the construction phase of the road project is not at a level to quantify any meaningful adverse health outcome.

There will be moderate residual impacts in Shanbally as the community will be severed north and south of the proposed M28 road project even with improved connectivity in place. A construction compound will also be located to the east of the village during the construction phase of the road project. The site will be located within the proposed lands that will form part of the CPO and direct access for construction workers will be available from the existing N28. There may be slight impacts as a result of the location of the site compound at this location however these will be minor in nature and will largely relate to increased traffic associated with construction workers.

[16] M28 Cork to Ringaskiddy Road Project Business Case, May 2017.

As outlined in **Chapter 19** of this EIS which sets out the proposed mitigation measures of the road project, the contractor will be required to develop the mitigation measures proposed as part of this EIS to form a CEMP. This will help to ameliorate construction impacts and will ensure the successful implementation of any approval/consent as may be granted in any EIA Approval including any conditions/restrictions/ mitigation measures imposed to facilitate the proposal. Furthermore, appropriate mitigation measures to address potential impacts on the Community are set out elsewhere in this EIS, i.e., **Chapter 14: Noise and Vibration**, **Chapter 16: Landscape and Visual Impact** and **Chapter 5**: **Traffic and Transportation** chapters.

In terms of land take there will approximately 142 hectares of land included within the CPO to accommodate the scheme. There will not be a substantial amount of land lost as a result of the proposed road widening at the northern end of the route. Greenfield lands will however be lost in the central and southern parts of the route. However, any loss of land will be addressed through agreements between Cork County Council and relevant landowners. Two dwellings will need to be demolished and an additional two dwellings will be permanently acquired to facilitate the proposed road project. There will be a profound long term impact on the residents living within these dwellings.

There will otherwise be moderate / significant negative short term impacts during the construction phase as a result of the proposed road during the construction phase.

The proposed service area will be located to the east of Ringaskiddy village and will be accessed via the existing N28 roadway which is widely used by residents and the working community. There is potential for slight short term impacts.

Visiting Community

The short term construction period of the proposed road will not stimulate or suppress demand for tourism development in the area or affect tourism developments or attractions as roads will still be in use for vehicular traffic. Therefore the construction phase impacts will be 'not significant' in relation to the visiting community.

During the construction phase of the service area there is potential for some disturbance to the visiting community as a result of the proposed construction works in the form of noise, dust and visual impacts. There will be slight negative short term effects on the visiting community during the construction phase.

7.6.1.4 Land Use

Overall there will not be a significant change in land use during the construction stage of the project as works will take place largely on line within the northern part of the road project. Within the central and southern parts of the project construction works will take place largely within lands in agricultural use which is described in **Chapter 8: Agricultural Land Uses** of the EIS.

Land Take Assessment

There is no difference between the temporary (construction phase) and permanent (operational phase) CPO land take requirements as accommodation works will generally take place within the proposed alignment of the existing and proposed roadway. Therefore, construction stage and operational stage impacts relative to the land take proposed will be very similar and are described under the construction stage land take impact assessment in **Section 7.6.1.4**.

7.6.2 Operational Phase

Overall, with mitigation measures in place, the advantages of the proposed road project considerably outweigh the disadvantages and the sub-regional and local community, as a whole, will benefit from the construction of the proposed road project.

7.6.2.1 Population

Overall there is a potential for significant positive indirect long term impact as a result of the proposed road. Once the service area is operational no impacts on population are considered likely with a neutral impact.

7.6.2.2 Employment

Accessibility and travel times to and from the Ringaskiddy Strategic Employment Area will be greatly improved. The upgraded road network will improve access and journey time to and from the Ringaskiddy area and as a result will make the zoned lands within this area more attractive to investors. It is likely that this will result in an increase in employment opportunities within the area. This will support the role of Ringaskiddy as a Strategic Employment Area. As a result the proposed road project has the potential to have significant positive long term impacts on employment and the economy of the County and region as a whole.

The proposed M28 Road Project has the potential to have significant positive indirect long term impacts with regard to employment opportunities created as a result of the relocation of the Port to Ringaskiddy and the opening up of new strategic land banks within the Cork City Docklands area also. This helps to achieve national, regional and local planning policy objectives.

Some businesses along the route may experience levels of diminution/severance as a result of the proposed road project. These include local services primarily located on the main street in Shanbally which will be by-passed as a result of the proposed development. The greatest loss in passing trade will be experienced by those businesses that have frontage onto the existing N28. Certain businesses such as filling stations, restaurants and bed and breakfast/ accommodation establishments are more dependent on passing trade and are likely to be affected particularly to those within the Shanbally and Raffeen areas. While some passing trade may be lost on the completion of the M28 road project, the existing roads will remain open to traffic and much of the hinterland passing trade will remain.

It is likely that there will be opportunities for an increase in spend within the village of Ringaskiddy given the likely increase in visiting numbers to the area as a result of the proposed road project. On this basis impacts to businesses such as the Ferryboat Inn and Bed and Breakfast's in the area will be positive in the long term.

Once the M28 Road Project is operational there is likely to be both significant direct and indirect positive long term impacts in terms of employment.

7.6.2.3 Community

Overall it will result in improved urban and village environments, particularly in Shanbally and Ringaskiddy which will be bypassed and may be more conducive to visiting and shopping and therefore likely to support local businesses with reductions in traffic of up to 69%[17]. There is potential for increased tourist numbers and the associated economic benefits, improved parking and the reduction of HCVs travelling through built-up areas. Although the village of Shanbally will experience severance as a result of the proposed road project it is considered that proposed mitigation measures in the form of new local access roads will reduce associated impacts in the medium to long term once the road project is in operation.

There will also be opportunities for more sustainable forms of transport along parts of the existing N28 route including bus routes, walking and cycling which will be positive for the local community. It will provide opportunities for connectivity with various locations including Cork City, Carrigaline, Crosshaven Douglas, Rochestown, Passage West, Monkstown and Ringaskiddy aligning with the following plans and initiatives:-

- Cork Cycle Network Plan (Cork City and County Councils);
- Greenway Link from Ringaskiddy and Shanbally to the Cork Harbour Greenway at Raffeen for connectivity to Carrigaline, Crosshaven, Passage West and Cork City; and
- Verge areas and suitable side roads for walking and cycling provision.

This will have particular benefits for the local community living and working in Shanbally and Ringaskiddy due to the improvised walking and cycling environments within these areas which the existing N28 currently runs through.

Overall, there is potential for neutral impacts on the resident community as the service area will not serve a local function. There will be a moderate positive direct and indirect impact on the working community as a result of increased employment generated by the service area.

There will be significant positive long term impacts with respect to the visiting community arriving and departing via the port as they will have the benefit of the facilities of the service area as a place to rest and refuel as part of their journey.

[17] Table 5.18: Comparison of Highest Traffic Flows between the AM 2020 and 2035 Peak Periods Chapter 5 Traffic and Transportation.

7.6.2.4 Land Use

With respect to land use, the proposed road is not considered to have a significant built footprint particularly in the northern section of the road project where works are largely on-line. Therefore the permanent loss of land use types including agriculture, commercial, residential and community is proportionately low when considered in the context of the overall site.

Land Take Assessment

There is no difference between the temporary (construction phase) and permanent (operational phase) CPO land take requirements as accommodation works will generally take place within the proposed alignment of the existing and proposed roadway. Therefore, construction stage and operational stage impacts relative to the land take proposed will be very similar to the residual land take impacts identified in **Section 7.6.1.4** which refers to the construction stage impacts.

Furthermore, the two properties proposed to be acquired in their entirety at Shannon Park Roundabout currently in the ownership of Brothers of Charity (LH0064) and a private landowner (Landowner Reference LH0028) can be put back into residential use once the road project has been constructed.

7.6.3 Residual Impacts Summary

A summary table identifying the potential socio-economic and community impacts of the project from construction phase through to residual impacts is presented in **Table 7.8** below for ease of reference.

Table 7.8: Socio-Economic and Community Impact Assessment Summary

	Potential Impacts		Residual Impacts	
Phase	**Construction Phase**	**Operational Phase**	**Construction Phase**	**Operational Phase**
Population				
Road	Neutral /Slight Positive Short Term	Significant Positive Indirect Long Term	Neutral / Slight Positive Short Term	Significant Positive Indirect Long Term
Service Area	Not Significant Short Term	Neutral	Neutral Short Term	Neutral
Employment				
M28 Road	Significant Positive Direct and Indirect Short Term	Significant Positive Direct and Indirect Long Term	Significant Positive Direct and Indirect Short Term	Significant Positive Indirect Long Term
Service Area	Moderate Positive Direct And Indirect Short Term	Moderate Positive Direct and Indirect Long Term	Moderate Positive Direct and Indirect Short Term	Moderate Positive Direct and Indirect Long Term
Resident Community				
M28 Road	Profound Long Term / Significant Negative Short Term	Significant Positive Long Term	Profound Long Term / Moderate to Significant Negative Short Term	Significant Positive Long Term
Service Area	Slight Negative Short Term	Neutral	Slight Negative Short Term	Neutral

	Potential Impacts		Residual Impacts	
Phase	**Construction Phase**	**Operational Phase**	**Construction Phase**	**Operational Phase**
Working Community				
M28 Road	Significant Negative Short Term	Significant Positive Long Term	Moderate / Significant Negative Short Term	Significant Positive Long Term
Service Area	Slight Negative Short Term	Moderate Positive Direct and Indirect Long Term	Slight Negative Short Term	Moderate Positive Long Term
Visiting Community				
M28 Road	Not Significant Short Term	Significant Positive Direct and Indirect Long Term	Not Significant Short Term	Significant Positive Long Term
Service Area	Slight Negative Short Term	Significant Positive Long Term	Slight Negative Short Term	Significant Positive Long Term

7.7 MONITORING

No monitoring measures are recommended.

8 AGRICULTURAL LAND USES

8.1 INTRODUCTION

The impacts that the proposed M28 Road Project may have on agriculture are a function of the following factors:-

- Area of lands acquired (temporary and permanent) for the construction, operation and maintenance;
- The length of time until lands temporarily acquired for construction return to, or succeed post-construction production levels;
- Area and orientation of lands severed;
- Farm enterprises; and
- Intensity of farming practices.

8.2 ASSESSMENT METHODOLOGY

The following publications and documents were considered in undertaking this assessment:-

- Revised Guidelines on the Information to be Contained in Environmental Impact Statements (Draft), EPA, September 2015;
- Guidelines on the Information to be Contained in Environmental Impact Statements, EPA, 2002;
- Guide to Process and Code of Practice for National Road Project Planning and Acquisition of Property for National Roads, March 2003 (revised 2005);
- EPA/ Teagasc/ GSI GIS Map of National Soil Types, 2006;
- Census of Agriculture 2010, final results;
- Environmental Impact Assessment of National Road Schemes – A Practical Guide, November 2008; and
- Aerial Photography.

Desktop surveys, field surveys, public consultation and discussions with landowners[1] were carried out to assess the potential impact on agriculture in the area. The surveys and discussions assessed a number of factors including:-

- The current agricultural practice taking place on the lands in and around the proposed M28 Road Project;
- Concerns and issues landowners may have; and
- Level of management currently practiced.

[1] All agricultural landowners affected by the scheme were met by the Project Team.

The potential impacts that the proposed M28 Road Project may have on agriculture are primarily related to the type of farming practised in the area and the intensity with which the enterprise is farmed.

The proposed road project may affect different farm enterprises as follows:-

- **Drystock:** Drystock farming (sheep, beef and sucklers) is the most common farm enterprise in the vicinity of the proposed road project. The animals, particularly the beef and sucklers, associated with this enterprise type are generally of a quiet disposition. These animals normally do not require moving on a daily basis but will require daily access and water, and facilities affected by the proposed road project would have to be re-instated, even temporarily, as soon as is practicable unless otherwise agreed with the landowner.
- **Dairy:** Dairy farming is one of the more profitable farming enterprises in this country. These farms require stock to be moved to and from the place of milking to the grazing area, usually close to the milking facilities, twice daily. Due to this frequency of animal movement the management of a dairy farm may be affected if access is temporarily restricted. Furthermore, landtake, even temporary, is potentially more significant on a dairy farm than other enterprises. There are a small number of dairy farms (3 No.) affected by the proposed road project.
- **Tillage:** Tillage farming is undertaken in the vicinity of the proposed road project and while tillage farms may not require daily or even weekly access they do require regular access and do require access that is suitable for large machinery. Furthermore, the effective operation of large machinery benefits from large square fields. Triangulation of a field due to severance or reduction in field size due to landtake may reduce the effective operation of large machinery.
- **Equine:** Horses, particularly thoroughbred horses are of a more nervous disposition than other stock types and are prone to stress caused by unaccustomed noise. Construction activities associated with the proposed road project may cause stress due to associated noise levels. There are no stud farms along the proposed road project[2], but a number of farms do have sport horses and do partake in equine activities. Furthermore, land take and severance of land parcels may result in fields of an irregular shape (e.g. triangular shaped fields with sharp/narrow corners). These fields may be less suitable for grazing with horses due to an increased risk of injury.

The significant criteria outlined in **Table 8.1** have been developed for assessing impacts on agriculture. These criteria are broadly based on EPA *"Revised Guidelines on the Information to be contained in Environmental Impact Statement"* (Draft, 2015) and *"Advice notes for Preparing Environmental Impact Statements"* (Draft, 2015) with reference specifically to the agricultural enterprise affected.

[2] Stud farm as listed in the "Directory of the Turf"
http://www.directoryoftheturf.com/search_results.cfm/searchcategory/Stud%20Farms/searchcounty/Co%20Dublin

Table 8.1: Assessment Criteria

Significance of Impact	Criteria
Imperceptible	The effects of a proposed road project have no noticeable consequences on an agricultural property.
Not Significant	The proposed road project is encroaching slightly on an agricultural boundary causing a slight inconvenience and/or creates a small level of disturbance but there are no noticeable consequences in the day to day management or current farming practices.
Slight Effects	The proposed road project causes a level of inconvenience and/or disturbance but does not require a significant change in current farming practices or day to day management. Mitigation in the form of accommodation works would overcome any problems.
Moderate Effects	The proposed road project causes a degree of land take, severance or disturbance that causes a change in current farming practices and day to day management leading to an increase in costs. Mitigation measures in the form of accommodation works should overcome most difficulties. Impacts not addressed in the accommodation works will be dealt with by way of compensation.
Significant Effects	The proposed road project requires a significant change in management practices with associated costs due to severance, land take, loss of buildings and/or disturbance. The level of impact requires considerable mitigation in the form of accommodation works and not all difficulties are negated. Impacts not addressed in the accommodation works will be dealt with by way of compensation.
Very Significant Effects	The proposed road project is such that while a level of farming can continue, no mitigation measures in the form of accommodation works can overcome the impact and the only mitigation is compensation. In this situation an intensive dairy farm may have to revert to a less intensive enterprise such as dry stock.
Profound Effects	The proposed road project is such that farming can no longer continue and no mitigation measures in the form of accommodation works can overcome the impact to allow any farming activities to continue in this location.

Table 8.2 shows the criteria used for this agronomic assessment to describe the duration of an impact:-

Table 8.2: Duration of Impact

Description	Duration
Momentary	Effects lasting seconds to minutes
Brief	<1 day
Temporary	<1 year
Short Term	1 to 7 years
Medium Term	7 to 15 years
Long Term	15 to 60 years
Permanent	>60 years

8.3 EXISTING ENVIRONMENT

8.3.1 Farming in Cork

There are 14,222 farms in County Cork, utilising approximately 541,858ha (CSO, 2010). The average farm size is 38.1ha. **Table 8.3** shows the breakdown of the numbers and percentages of farms specialising in different enterprises in County Cork.

Table 8.3: Numbers of Farms in County Cork in Different Enterprises

Enterprise Type	Number of Farms	Percentage of Total
Specialist Tillage	795	6
Specialist Dairy	4,037	28
Specialist Beef Production	5,999	42
Specialist Sheep	661	5
Mixed Grazing Livestock	1,206	8.5
Mixed Crops and Livestock	351	2.5
Mixed field crops	991	7
Other	182	1
Total	**14,222**	**100**

From this table, it can be seen that the majority of the farms in County Cork are involved in grass based livestock farming (84%) with a large number of farmers specialising in beef and dairy.

8.3.2 Farm Types along the Proposed M28 Road Project

The lands affected by the proposed road project are primarily under grass. **Table 8.4** shows the number and type of different enterprises affected by the proposed road project.

Table 8.4: Numbers and Types of Enterprises along the Proposed M28 Road Project

Enterprise Type	No.	Area within Landtake (Ha.)
Dairy	3	1.018
Drystock	17	35.602
Mixed (Tillage/Drystock)	6	27.613
Mixed (Tillage/Equine)	2	6.979
Tillage	5	20.305

8.3.3 Soil Types along the Proposed M28 Road Project

The National Soil Database was used to ascertain the soil type for each plot and is shown in the individual plot assessments shown in **Appendix 8A**.

Table 8.5 shows the different soil types as a percentage of the land to be acquired for the proposed road project. From **Table 8.5** it can be seen that the majority of the soils are deep well drained mineral (AminDW).

Table 8.5: Soil Type along the Proposed M28 Road Project (National Soil Database)

IFS Soil Database	% Within Landtake
(AminDW) Deep Well Drained Mineral	81.3
(AminSW) Shallow Well Drained Mineral	2.2
(BminSRPT) Shallow, Lithosolic-Podzolic Soils	16.5

8.3.4 Land Quality along the Proposed M28 Road Project

Land quality has been assessed based on the results from the EPA/Teagasc/GSI national soil database, current landuse and general on site observations.

The land quality has been classified as follows:-

- **Poor:** Land that is only suitable for rough grazing, poor forestry or peat harvesting. No grass will be mechanically harvested from this land. No fertiliser would be used on this land. These lands will generally have high levels of peat and/or be of poor drainage.
- **Poor/Medium:** Land that has seen some improvement through management. It may consist of cut-over peat or reclaimed from scrub or rock. This land will have limited usage and will primarily be used for summer grazing. Grass may be mechanically harvested from this land in a dry year.
- **Medium:** Land that would have little peat and consist mainly of mineral soils. The limiting factor on this land will be management. The same land, better managed, would be associated with some of the better farms in the area. This land would receive fertiliser and could be used for grass harvesting by mechanical means during dry periods.
- **Medium/Good:** Land that is well managed and would be used for dairy enterprises or more intensive beef production. This land will have some restricting factors such as soil, slope, drainage or aspect that prevents it being classified “good”.
- **Good:** Land that can be used for any of the farming enterprises typically practiced in that particular area. These lands would be managed very well. They would be the most productive lands in the area and the soils would be naturally free draining mineral soils.

Table 8.6 shows the percentage of land qualities affected by the proposed road project and the land quality for the individual plot is shown in the individual assessments in **Appendix 8A.**

Table 8.6: Land Quality along the Proposed M28 Road Project

Land Quality	% Along Route
Good	56
Medium/Good	39
Medium	5
Poor/Medium	0
Poor	0

8.4 POTENTIAL IMPACTS

8.4.1 Construction Stage

- Noise associated with construction activities can be an issue with certain types of livestock such as horses and dairy stock. However, it should be noted these animals are regularly seen grazing contentedly alongside motorways and construction sites in this country therefore it would be expected that the impact from noise is unlikely to be significant (see **Chapter 14: Noise and Vibration** for further details on the noise environment).
- Without mitigation the activity of construction machinery can generate dust in the immediate vicinity of the proposed M28 Road Project. The proliferation of dust has a nuisance value and livestock are at risk to eye irritations from high levels of wind-blown dust particles. Dust and other particulate matter deposited onto crops may also impact the quality of these crops.
- There will be an increase in traffic along local roads during the construction phases of the proposed road project, which has the potential to cause nuisance to agricultural traffic.
- Field drainage systems currently in-situ may be disturbed and in places disabled during construction. This disturbance may lead to wet or flooded fields during spells of wet weather and farm productivity could be reduced.
- The structure of soils within temporary construction and access areas will be potentially affected from being trafficked by construction vehicles. The potential to damage soil structures will become more pronounced when construction activities occur during wet periods.
- Without mitigation the construction of the proposed road project may disturb water supplies for livestock in fields and properties.
- Road construction is a linear development and therefore has the potential for carrying disease between fields and farms.
- The loss of lands along the proposed route from main agricultural practices will impact on payments for area based schemes.

8.4.2 Operation Stage

Meetings have taken place with landowners situated along the proposed road project route and their farming practices and enterprise type have been determined. Furthermore, all lands associated with the proposed road project have been assessed.

The impact assessment has been considered on a whole farm basis, where possible, while remaining cognisant of the potential impact the proposed road project will have from a field by field perspective. All data required for this assessment has been managed in a geographical information system (GIS) which has been used to determine the areas acquired, degree of severance affecting the folio, mitigation measures, and potential impacts.

Whilst every effort has been made to minimise the impact on agriculture, approximately 91.517 hectares of agricultural land will be permanently removed from production for this proposed road project. The average landtake from farms is 2.773 hectares. The significance of the residual impacts is shown in the individual assessments in **Appendix 8A**.

There will be 21 agricultural land parcels severed during construction of the proposed road project. A number of properties will be severed leaving parcels of land too small to carry out normal farming practices. The loss of this severed portion has been considered and assessed and is shown for each land parcel in the individual assessments contained in **Appendix 8A.**

Severance of larger plots has also been considered and assessed in the individual reports. Severance is particularly relevant to stock farms requiring access on a regular basis from grazing areas to facilities. The severance of large fields leaving triangulated plots will create increased management difficulties and potentially reduce the effectiveness of large machinery operations.

8.5 MITIGATION MEASURES

8.5.1 Construction Stage

The following measures are proposed to mitigate against the potential impacts identified in **Section 8.4** above:-

- Existing accesses to property, including homes, farms and farm facilities will, where practicable, be maintained during construction, otherwise reasonable temporary access will be provided.
- Mitigation measures regarding traffic, air and noise are outlined in the **Chapters 5, 13** and **14** respectively of this EIS and will mitigate the effects these impacts may have on agriculture.
- All drainage likely to be affected or disturbed during the construction phase will be identified and reinstated. Damage to crops and soils by flooding as a result of the construction of this road, will be rectified and/or compensated.
- Any lands temporarily acquired will, before return to the landowner, be subsoiled to alleviate compaction and minimise risk of impeded crop growth.
- Any disruption to water supply will be reinstated immediately by the Contractor or an alternative source supplied until the source is reinstated, unless otherwise agreed with the landowner.
- All machinery coming from outside of the State will be cleaned and disinfected on entry to the country.
- All machines will be sprayed with appropriate disinfectant prior to arrival on site. The Contractor will verify to the Project Liaison Officer (PLO)[3] that this has been done.

[3] The Project Liaison Officer will be appointed by the local authority.

- The PLO will liaise with the local District Veterinary Office (DVO) to establish the location of any restricted herds along the route of the proposed road project. The liaison will continue on a regular basis throughout the construction and reinstatement periods. Where any landholder becomes aware that his/her herd has become infected, it is his/her responsibility to inform the PLO as a matter of urgency.
- Where the PLO has been informed of a restricted herd along the route, it will require the Contractor to disinfect machinery and personnel before leaving the land concerned. The number of accesses across the working strip will be reduced to one in the case of lands having restricted herd status. The Contractor will arrange for disinfectant mats/baths to be replenished with disinfectants, as required.
- In the event of an outbreak of a Notifiable Disease, the proposed road project will be subject to such operational restrictions as are imposed by Department of Agriculture Food and the Marine (DAFM).

8.5.2 Operation Stage

The following measures are proposed to mitigate against the potential impacts identified in **Section 8.4** above:-

- Permanent and temporary landtake will be dealt with by way of compensation. Matters of compensation do not form part of this application process.
- All agricultural lands, temporarily acquired, will be re-instated to pre-construction conditions unless otherwise agreed with the landowner.
- Ducting will be provided to allow for the provision of services (electrical/water) across severed areas unless otherwise agreed with the landowner and where practicable.
- Where required, suitable stock proof fencing shall be erected along the proposed road project.
- Where any fences, walls or hedges are damaged they will be made stock proof immediately, unless otherwise agreed with the landowner.

The construction and operation of the proposed service area within the lands of the Port of Cork will not have a significant impact on agriculture in the vicinity therefore no mitigation is required.

8.6 RESIDUAL IMPACTS

The proposed M28 Road Project will not have a significant impact on agriculture from a national or regional perspective. It will have an impact on a local perspective due to loss of agricultural land and severance.

In summary, the road will have a permanent negative residual impact on 33 landowners as shown in **Table 8.7** and in **Appendix 8A** of this EIS**.**

Table 8.7: Residual Impact and Numbers at a Local Level

Residual Impact	Numbers
Imperceptible	3
Not Significant	6
Slight Effects	6
Moderate Effects	13
Significant Effects	3
Very Significant Effects	1
Profound Effects	1

While accommodation works will mitigate many residual impacts, not all can be mitigated in this manner and the remainder will be dealt with by way of compensation under the statutory code.

9. HYDROLOGY AND DRAINAGE

9.1 INTRODUCTION

This chapter examines the existing and proposed hydrology and surface water drainage along the proposed M28 Road Project (including the Service Area (SA) at Ringaskiddy).

The zone of influence for the proposed M28 Road Project extends beyond the study area to include surface water receptors which may be affected by the changes caused by the project, i.e. the coastal and transitional environment (see **Figure 9.1**).

The impact of the proposed road development on the receiving hydrological environment is illustrated on the drawings included in **Volume 5 (DR Series)**. These drawings illustrate the proposed surface water drainage system, proposed outfalls, culverts and stream diversions.

The objectives of this assessment are:-

- To undertake a desktop study to describe surface water features within the study area;
- To design a surface water drainage system that will have adequate capacity to collect, treat and discharge run-off generated by the proposed M28 Road Project;
- To account for climate change in the drainage design;
- To design a drainage system that will protect both human health and the aquatic environment by minimising adverse impact on the quality of natural waters;
- To assess the potential flood risk within the study area and ensure the drainage system will not increase the risk of flooding; and
- To identify and incorporate appropriate mitigation measures, where required.

9.2 METHODOLOGY

The assessment has been undertaken having particular regard to the following regulatory and best practice guidelines:-

- Draft River Basin Management Plan: 2018 – 2021;
- Water Quality in Ireland 2010-2012 (EPA, 2015);
- Guidelines on Procedures For Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2009);
- Environmental Impact Assessment of National Road Schemes – A Practical Guide (NRA, 2008);
- The Lee Catchment Flood Risk Assessment and Management Study (CFRAMS OPW 2009);
- NRA Design Manual for Roads and Bridges, Volume 4, Section 2: Drainage, Part 4 Design of Outfall and Culvert Details (NRA, 2015);
- 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): The Planning System and Flood Risk Management (OPW, 2009).

The following design documents published by the TII are referenced in relation to the surface water drainage design:-

- DN-DNG-03065 - Road Drainage and the Water Environment;
- DN-DNG-03022 - Drainage Systems for National Roads;
- DN-DNG-03061 - Design of Outlets for Surface Water Channels;
- DN-DNG-03063 - Vegetated Drainage Systems for Road Run-off;
- DN-DNG-03064 - Drainage of Run-off from Natural Catchments;
- DN-DNG-03066 - Design of Earthworks Drainage, Network Drainage, Attenuation and Pollution Control;
- DN-DNG-03067 - Spacing of Road Gullies;
- DN-DNG-03071 - Design of Outfall and Culvert Details;
- DN-DNG-03072 - Design of Soakaways; and
- DN-DNG-03073 - Grassed Surface Water Channels for Road Run-Off.

9.2.1 Desktop Assessment of Receiving Environment

The desktop assessment consists of a review of the available hydrological information including published maps, reports and information held by the Environmental Protection Agency (EPA), Office of Public Works (OPW) and Water Framework Directive Ireland (WFD Ireland). Walkover field surveys were carried out along the proposed route and at proposed culverts, stream diversion locations and at proposed outfalls. The following data sources were consulted:-

- OS Survey Vector and 'Discovery' Series Mapping (OSi);
- Cork County Council;
- The Office of Public Works (OPW);
- Environmental Protection Agency (EPA);
- Water Quality Monitoring Database and Reports;
- EPA flow and water level measurements (EPA Hydronet System);
- National Flood Hazard Website: www.floodmaps.ie;
- Geological Survey of Ireland online mapping: http://www.gsi.ie/mapping.htm;
- EPA Envision Mapping: http://maps.epa.ie/InternetMapViewer/mapviewer.aspx;
- EPA Catchments Mapping: https://www.catchments.ie/;
- NPWS Maps and Data: http://www.npws.ie/maps-and-data/;
- Inland Fisheries Ireland site: http://www.fisheriesireland.ie/;
- Ringaskiddy Port Development EIS (RPS 2014);
- The Irish Coastal Protection Strategy Study (ICPSS 2011);
- Maps and aerial photography of the study area and relevant associated watercourses;
- The Flood Studies Update (FSU) Web Portal: www.hydronet.com; and
- Information on the hydrology and drainage of the study area was obtained from the EPA website www.epa.ie.

9.2.2 Consultation

Consultation was undertaken with the following bodies:-

- The Office of Public Works (OPW);
- Inland Fisheries Ireland (IFI); and
- Cork County Council (CCC).

Please refer to **Chapter 10: Aquatic Ecology** for details of consultation undertaken as part of the aquatic ecology impact assessment.

9.2.3 Prediction and Evaluation of Effects

An assessment of the hydrological impact of the proposed surface water drainage on the receiving waters has been carried out in line with the TII Guidance "*Road Drainage and the Water Environment*" (DN-DNG-03065). This standard gives guidance on the assessment and management of the impacts that new construction and improvement projects may have on the existing water environment. These include possible impacts on the quality of water bodies and on the existing hydrology of catchments through which roads pass. The standard considers four areas:-

1. Effects of Routine Run-off on Surface Waters;
2. Effects of Routine Run-off on Groundwater;
3. Pollution Impacts from Spillages; and
4. Assessing Flood Impacts.

9.2.3.1 Effects of Routine Run-off on Surface Waters

Potential pollution effects on surface waters can be classified into two groups; those which directly and indirectly affect water quality; and those which affect the aquatic habitat quality. Depending on the type and form of the pollutant, its concentration and uptake by the organisms, the potential impact of the chemical pollutants can either be acute or chronic in nature.

Acute effects are usually associated with certain metals and organic pollutants. Chronic effects are usually associated with sparingly soluble metals such as zinc, chromium, nickel and lead, where there is toxicity through accumulation of the metals in animal tissue. More persistent hydrocarbons such as PAHs are also considered as constituents of the sediment-bound fraction.

There are a number of factors which influence both the pollutant concentrations in routine run-off and whether the run-off is likely to have an impact on the receiving water body. Site characteristics found to have a significant influence on copper and zinc concentrations were Annual Average Daily Traffic (AADT) flows and climatic region. Influential event characteristics were: month of rainfall event, maximum hourly rainfall intensity and antecedent dry weather period.

The potential impact of pollutants on the ecology of surface water is also dependent on the characteristics of the receiving waters, particularly its water quality, hardness, flow rate and flow velocity. For example, watercourses having low flow rates have less potential for diluting road run-off and are more vulnerable than those with high flow rates. Similarly, where soft water is encountered metals are more toxic.

9.2.3.2 Effects of Routine Run-off on Groundwater

The risk of groundwater pollution is affected by the mineralogy of the soil or rock, the depth of the unsaturated zone and the nature of the pathways between the point of discharge and the receiving groundwater. In general terms, groundwater is less susceptible to pollution by particulates, but remains at risk from soluble contaminants.

9.2.3.3 Pollution Impacts from Spillages

On all roads, there is a risk that a spillage or vehicle fire may lead to an acute pollution incident. It is generally accepted that the risk on any road is proportionate to the risk of a Heavy Goods Vehicle (HGV) road traffic collision. As new or improved roads are designed to reduce the collision rate, the risk of acute pollution impacts is reduced. Where spillages do reach a surface watercourse the pollution impact can be severe, but is usually of short duration, which is typical of an acute pollution impact. However, if groundwater is polluted the impact can be long lasting and difficult to remediate.

9.2.3.4 Assessing Flood Impacts

There may be an impact on flood risk if a project is constructed within an existing floodplain, affects the existing hydrology, or results in an increase in the rate of run-off to the receiving watercourses.

Transport infrastructure must be designed and constructed to:-

- Remain operational and safe for users in times of flood;
- Result in no increased risk of flooding; and
- Not impede water flows.

Construction in floodplains can affect the nature and extent of the flooding extent in the immediate area and for some distance upstream and downstream. This could have a significant impact on property owners within or near the floodplain, who may become exposed to a new or increased risk of flooding. Bridges and embankments, in particular, can obstruct or change the path of floodwaters, thereby changing the shape and/ or extent of the flood envelope. New roads should only be located within floodplains in accordance with *The Planning System and Flood Risk Management Guidelines,* as published by the OPW.

Consent is required under Section 50 of the Arterial Drainage Act 1945 for construction or alteration works on bridges and culverts; as such works can change the hydraulic characteristics of a watercourse. Construction or alteration of bridges/ culverts may result in:-

- An increase in flood levels upstream of the bridge/ culvert due to restriction in the watercourse;

- An increase in flood levels downstream of the bridge/ culvert due to the removal of a beneficial restriction in the watercourse;
- Erosion of or deposition of material in the watercourse or floodplain as a result of changes to the velocity in the watercourse due to a restriction; and
- Blockages of overland flow paths.

A project may also impact on flood potential by increasing the rate at which water reaches the hydrological environment and thereby increasing the flow rate and potential to cause flooding.

9.2.4 Effects of Climate Change

The trends in precipitation changes as a result of climate change are only recently becoming clearer. Increased intensity and frequency of rainfall events will require drains to be capable of transmitting a greater peak flow rate. Groundwater levels may be affected as a result with higher variability on range of levels observed, i.e. extreme low levels in summer and extreme highs in winter. TII publication DN-DNG-03022, *Drainage Systems for National Roads* stipulates the requirements for the incorporation of climate change in rainfall calculations in the design of drainage for National Roads projects, as follows:-

- The rainfall intensities used in the design of drainage systems must be increased by 20%; and
- Flood risk mitigation is to be designed for rainfall events with a 1% annual probability plus 20% allowance for climate change.

9.2.5 Procedure for Assessing Impacts

Methods are provided in TII publication DN-DNG 03065, *Road Drainage and the Water Environment* for assessing the potential impacts of proposed road projects on the water environment. The following methods are described for the assessment of the potential impacts presented in **Section 9.2.3**:

- Method A and B – Effect of Routine Run-off on Surface Waters;
- Method C – Groundwater Protection Response (GPR) for the use of permeable drain systems on Road Schemes;
- Method D – Pollution Impacts from Accidental Spillages; and
- Methods E and F – Assessing Flood Impacts.

The application of the each method and assessment of potential impacts associated with the proposed road project is included in the following sections. The potential impact on the aquatic environment is discussed in **Chapter 10: Aquatic Ecology**.

9.2.6 Effect of Routine Run-off on Surface Waters

UK research has shown that pollution impacts from routine run-off on receiving waters appear to be broadly correlated with Annual Average Daily Traffic (AADT). An assessment of the potential ecological impacts of routine run-off on surface waters is required in order to determine whether there is an environmental risk and if measures are required to treat run-off in specific circumstances.

The Highways Agency Water Risk Assessment Tool (HAWRAT) has been developed for this purpose and the methodology behind it has been derived from a collaborative research programme undertaken by the UK Highways Agency (HA) and UK Environment Agency (EA) which investigated the effects of routine road run-off on receiving waters and their ecology. HAWRAT is designed to assess the pollution risks related to the intermittent nature of road run-off. The toxicity thresholds determined through the research programme, which are used by the tool, have been designed to prevent adverse ecological effects in the receiving water.

The thresholds are consistent with the requirements of the Water Framework Directive (WFD) and the use of the tool, for the assessment of potential impacts of routine run-off on surface waters is appropriate for National Road Schemes in Ireland as per TII publication DN-DNG 03065, *Road Drainage and the Water Environment*.

The following pollutants have been incorporated within the HAWRAT assessment process:-

- Soluble pollutants associated with acute pollution impacts, expressed as Even Mean Concentrations (EMCs) for dissolved copper and zinc; and
- Sediment bound pollutants associated with chronic pollution impacts, expressed as Event Mean Sediment Concentrations (EMSCs) for total copper, zinc, cadmium, pyrene, fluoranthene, anthracene, phenanthrene and total Polycyclic Aromatic hydrocarbons (PAHs).

HAWRAT adopts a tiered consequential approach to assessment and can report the results at three different stages depending upon the level of assessment required for a given site:-

- Step 1 – Considers run-off quality only (prior to any pre-treatment and discharge into a water body. This step considers the traffic volumes, geographical location and associated 10 years of rainfall data);
- Step 2 – Takes the output from Step 1 to assess potential impacts to the receiving watercourse. This step considers the area draining to the outfall and the characteristics of the receiving watercourse in terms of dilution and dispersion at the outfall; and
- Step 3 – Considers the effects of mitigation, if required.

It uses a pass/fail reporting method at each step. Once the assessment concludes with a pass, it is concluded that there will be no short-term impacts associated with the road run-off, i.e. low risk.

An assessment of the long-term risks (using annual average concentrations) is also required to complete the risk assessment process. HAWRAT estimates in-river annual average concentrations for soluble pollutants (dissolved copper and dissolved zinc) which include the contribution from road run-off. These concentrations can be compared with published Environmental Quality Standards (EQSs) to assess whether there is likely to be a long-term impact on ecology.

The Annual Average Concentrations of soluble copper and zinc estimated using the HAWRAT Assessment methodology are compared with the Allowable Annual Average Concentrations published as part of the European Communities Environmental Objectives (Surface Waters) Regulations 2009, S.I. No. 272 of 2009 (as amended by S.I. No. 327 of 2012 and S.I. No. 386 of 2015).

It should be noted the TII Guidance advises that care is required when assessing outfalls where the receiving watercourse is tidal as flow is dictated by both freshwater and tidal conditions. Where it is proposed to outfall from the surface water drainage network to a tidal area or existing surface water drainage networks, Step 1 has been applied to calculate the concentration of pollutants within road run-off based on the climate and predicted traffic volumes. Based on the concentrations, treatment measures have been selected to ensure the run-off from the proposed road complies with the requirements of the WFD EQSs. Using the HAWRAT assessment methodology, the proposed surface water drainage outfalls have been assessed to ensure that there is no adverse impact as a result of routine run-off. **Table 9.1** summarises the HAWRAT steps applied to each proposed outfall.

Table 9.1: Assessment Steps Applied to Outfalls

Outfall No.	Receiving Water	Steps of HAWRAT Assessment
1	Lough Mahon	Stage 1
2	Woodbrook Stream	Stage 2
3	Woodbrook Stream	Stage 2
4	Woodbrook Stream	Stage 2
5	Donnybrook Stream	Stage 2
6	Donnybrook Stream	Stage 2
7	Glounatouig Drain	Stage 2
8	Glounatouig Drain	Stage 2
9	Glounatouig Drain	Stage 2
10	Glounatouig Stream	Stage 2
11	Existing Surface Water Drainage Network	Stage 1
12	Lough Beg	Stage 1
13	Cork Harbour	Stage 1

The HAWRAT assessment of surface water run-off concludes that the pollution risk is low. However, the proposed design includes measures to minimise the residual risk to water quality. The measures proposed are presented in **Section 9.6.5**.

9.2.7 Effect of Routine Run-off on Groundwater

For discharges to groundwater, the assessment procedure, Groundwater Protection Response (GPR), Method C, as provided in TII publication DN-DNG-03065 is utilised. For the purposes of this assessment, a permeable system is one which allows surface water run-off to enter groundwater. The application of this assessment procedure is further discussed in **Chapter 11: Soils, Geology and Hydrogeology** and has been reflected in the proposed surface water drainage design.

As specified in **Table 11.11**, the following restrictions on the use of permeable drainage systems apply as a result of the GPR assessment;

- Ch. 4,880 to Ch. 5,920: A closed drainage system is required as the proposed cut will intercept the unsaturated zone.
- Ch. 6,200 to Ch. 7,340: Drainage must be 15m away from known karst features.

- Ch. 7,340 to Ch. 7,825: A closed drainage system is required as vulnerability is classed as extreme.
- Ch. 7,825 to Ch. 7,900: Drainage must be 15m away from known karst features.
- Ch. 8,450 to Ch. 10,900: Drainage must be 15m away from swallow hole at Ch.9,150.
- Ch. 10,900 to Ch. 11,300: Drainage must be 15m away from known karst features.
- Ch. 11,300 to Ch. 12,450: A consistent thickness of 1m of material (natural or man-made) is required below invert levels of discharge point in section of cut.

Details of the Groundwater Protection Response assessment are included in **Chapter 11: Soils, Geology and Hydrogeology**.

9.2.8 Pollution Impact from Spillages

Spillages caused by accident or other causes can occur anywhere on the road network. Although the effect of many road projects will be to reduce the overall risk of collisions, it is important to assess the risk of an acute pollution impact. As referenced above, Method D contains a step-by-step guide to the calculation of this risk. The HAWRAT assessment tool includes a facility to assess spillage risk using Method D. The method initially estimates the risk that there will be a collision involving the spillage of a potentially polluting substance somewhere on the length of the road. It then calculates the risk, assuming a spillage has occurred, that the pollutant will reach and impact on the receiving watercourse.

Water bodies should be protected so that the risk of a serious pollution incident has an annual probability of less than 1%. In circumstances where an outfall discharges within close proximity to (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%. The higher standard of 0.5% was used for the purposes of this assessment given the downstream designated site of Cork Harbour SPA.

Where the risk is in excess of the acceptable limits, pollution control measures should be included to reduce the risk.

This methodology was applied to the proposed M28 Road Project. Based on the length of road draining to the proposed outfalls, the AADT, percentage HGVs and junction type, the likelihood of a serious pollution risk is calculated as low. However, to manage the residual risk, a containment volume of 25m^3 is provided within the surface water drainage system. Refer to **Sections 9.6.5** for more detail.

9.2.9 Assessing Flood Impacts

The risk of flooding to and resulting from the proposed road project has been assessed. The assessment of flood risk has been carried out with regard to *The Planning System and Flood Risk Management Guidelines*, as published by the OPW in 2009 and, where relevant, Methods E and F outlined in TII Publication DN-DNG-03065 (*Road Drainage and the Water Environment*).

The following sources of flooding were reviewed to establish the potential flood risk along the M28 Road Project:-

- Tidal/Coastal Flooding – flooding from the sea;
- Fluvial Flooding – flooding from rivers and watercourses;
- Pluvial Flooding – flooding that is caused by run-off during high rainfall events;
- Drainage Systems – flooding that occurs as a result of surcharging or blocking of drainage networks; and
- Groundwater – flooding when water normally stored below the ground rises above surface level or into ground spaces (such as basements).

Even where the proposed road is not located within a floodplain it is important to note that construction of the proposed road may cause local changes to catchment drainage patterns. The rate of run-off will increase as a greater area is paved, and without attenuation, there will be an increase in the rate at which run-off reaches the receiving water bodies.

An assessment of the potential flood risk to the proposed road project and the potential increase in flood risk as a result of the proposed road project is included in **Section 9.4**.

9.3 RECEIVING ENVIRONMENT

A desk study review of the water features information contained on the EPA's interactive mapping site Envision (www.gis.epa.ie) and the EPA's Catchments website (www.catchments.ie) was undertaken. The Water Framework Directive Ireland's Water Maps website (www.wfdireland.ie/maps), which contains data from the first cycle of the River Basin Management Plans (RBMP) were also consulted.

The assessment covers a study area of 500m radius either side of the proposed road in accordance with NRA publication *Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, 2009*.

9.3.1 Surface Water Features

A wide range of data is available to view online through the source referred to above. Data available includes surface water quality and status, water features, WFD risk scores, hydrometric areas, waterbody objectives and waterbody measures for river, lake, transitional, coastal water bodies and ground water bodies.

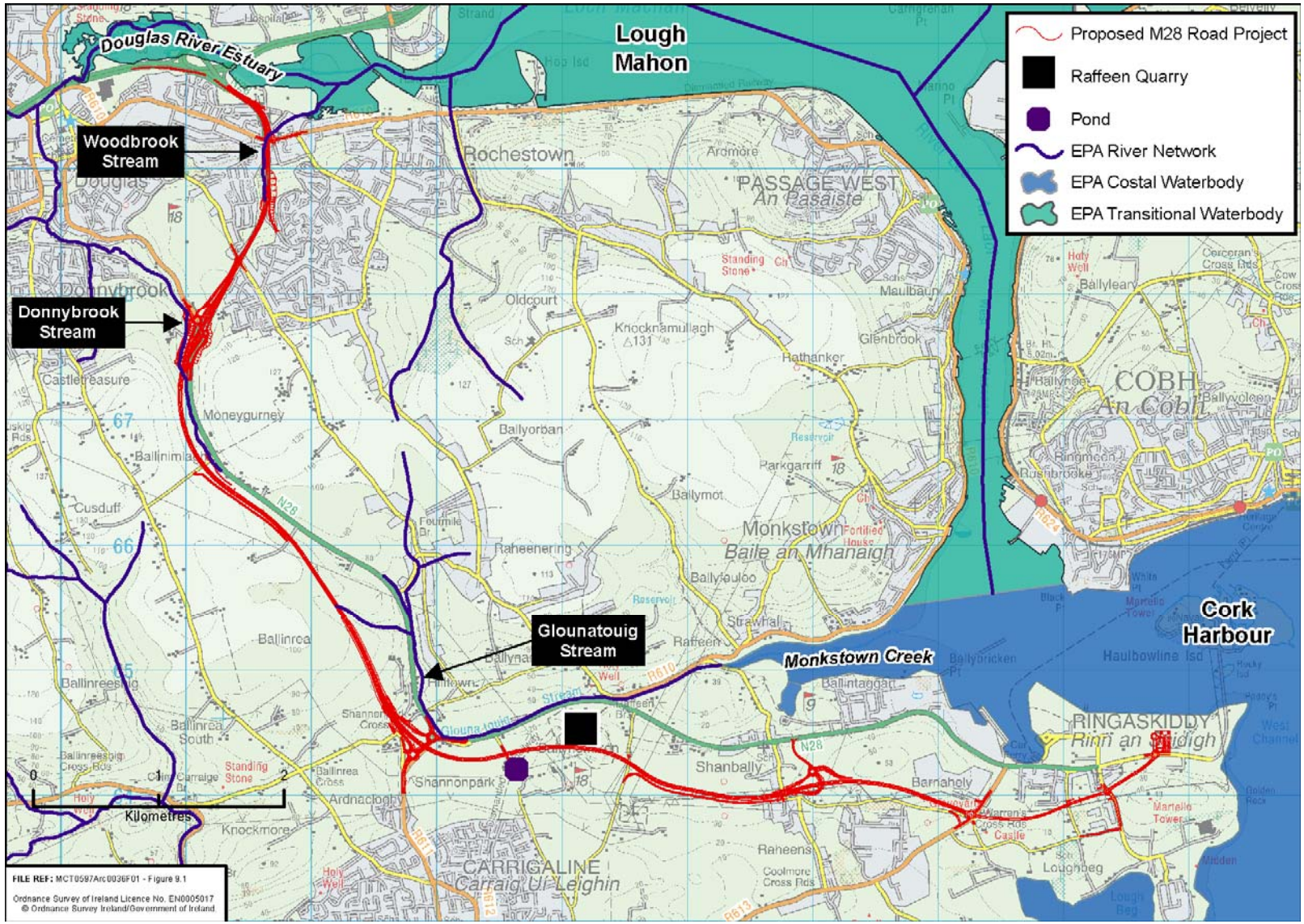
The surface water features within the zone of influence of the M28 Road Project are shown in **Figure 9.1: Surface Water Features.**

The study area is located within the South Western River Basin District (SWRBD), and specifically within the Lee, Cork Harbour and Youghal Bay catchment. The subcatchments through which the M28 Road Project crosses are the Owenboy [Cork]_SC_010 and the Glasheen [Cork City] _SC_010.

Surface water features were identified within the study area using MapInfo with Ordnance Survey mapping and aerial photography and were verified on the ground during a walkover survey. The water bodies of relevance to the M28 Road Project are as follows:-

- Woodbrook Stream (Moneygourney 19_010 water body).
- Donnybrook Stream (Moneygourney 19_010 water body).
- Glounatouig Stream (Hilltown 19_010 water body).
- Douglas River Estuary - part of Lough Mahon Transitional Water Body - (TWB) (IE_SW_060_0750).
- Monkstown Creek - part of Cork Harbour Coastal Water body (CWB) IE_SW_060_000).
- Lough Beg – part of Cork Harbour (CWB).

Figure 9.1: Surface Water Features within the Zone of Influence of the M28 Road Project



River Water Bodies (RWBs)

The study area lies within Hydrometric Area 19 within the SWRBD. The SWRBD contains the catchment areas of the Blackwater, the Lee, the Bandon, the Ilen, the Inny, the Maine and the Laune. Estuarine waters include Cork Harbour, where the Lee, Glashaboy and Owenboy Rivers flow into the sea. Part of the Lough Mahon Transitional Water Body (TWB) falls within the study area.

The proposed M28 Road Project lies in the Lee, Cork Harbour and Youghal Bay Catchment. Two subcatchments are relevant and are intersected by the scheme - Owenboy [Cork]_SC_010 and the Glasheen [Cork City]_SC_010. The M28 Road Project crosses the Donnybrook, Woodbrook and Glounatouig streams which are located in the EPA designated Moneygourney 19_010 and Hilltown 19_010 River Water Bodies. Refer to **Figure 9.1** for illustration of the watercourses affected by the project.

At the northern end of the study area, the Woodbrook Stream rises approximately 300m to the east of the existing N28 road, crosses the M28 Road Project at Ch. 1,150 at Maryborough Heights, flows northwards and parallel to the M28 Road Project before crossing the route at Rochestown Road and flowing east into the Douglas River Estuary.

The Donnybrook Stream starts adjacent to Ch. 3,400 and flows northwards in a meandering fashion parallel to the existing N28. It crosses the proposed M28 Road Project at Ch. 2,600 (Moneygourney) before turning and flowing in a north-westerly direction towards Douglas and the Douglas River Estuary.

Both the Woodbrook and Donnybrook streams discharge into the Douglas River Estuary pNHA, also known as the Lough Mahon Transitional Water Body (TWB) under the WFD. Lough Mahon TWB is an estuary that stretches from Douglas / Blackrock to Monkstown in Upper Cork Harbour.

The Glounatouig Stream crosses the existing N28 in three locations; to the north of the Shannonpark Roundabout, at approximately 0.75km east of the Shannonpark Roundabout at Ballyhemiken and again at Raffeen Bridge. The Glounatouig Stream rises in Ballyorban, flows in a southern direction on the eastern side of and parallel to the current N28 to Shannonpark Roundabout and then flows east and along the northern boundary of Raffeen Quarry before discharging into the Monkstown Creek (TWB) to the north east of Ringaskiddy, i.e., it discharges into Cork Harbour Coastal Water body (CWB). The drainage pattern within this catchment is strongly influenced by the underlying geology with the stream generally flowing from west to east parallel to the bedrock fold axes.

Two tributaries confluence with the Glounatouig Stream, one flowing adjacent to the N28 confluences with the Glounatouig at the existing N28 as it flows south. A second tributary, at Ballinrea, flowing in an easterly direction transects the N28 a little further south from the first tributary to also join the Glounatouig. From here, the Glounatouig continues to flow south adjacent to the N28 eventually veering east in line with the road. Close to Raffeen Bridge, the existing N28 takes a southerly direction towards Ringaskiddy while the Glounatouig Stream continues flowing east into Monkstown Creek pNHA intertidal area to the north east of Ringaskiddy and eventually discharging into Cork Harbour Coastal Water Body (CWB).

There are no mapped EPA streams or rivers within the vicinity of the proposed Service Area at Ringaskiddy.

Transitional Water Bodies (TWBs)

The relevant Transitional Water Body (TWB) to the study area is the Lough Mahon TWB. The M28 Road Project at Bloomfield lies along the shores of the Lough Mahon TWB, see **Figure 9.1** - **Surface Water Features**. This area comprises only a small fraction of the overall water body. Several of Cork City's suburbs including Douglas and Rochestown lie along the shores of Lough Mahon. Lough Mahon is part of Upper Cork Harbour and covers an area of over 12 km². Cork Harbour which encompasses Lough Mahon has a surface water area of around 100km² and is a large, sheltered, naturally deep water harbour. Strong estuarine influences dominate the upper reaches of the harbour in particular. Lough Mahon TWB comprises the Douglas River Estuary where both the Donnybrook and Woodbrook streams discharge. The Douglas River Estuary comprises intertidal mudflats with shingle and saltmarsh areas.

Coastal Water Bodies (CWBs)

The relevant Coastal Water Body (CWB) to the study area is the Cork Harbour CWB. The Cork Harbour CWB lies adjacent to the southern portion of the proposed M28 Road Project between Shanbally and Ringaskiddy and the Service Area in Ringaskiddy. The Cork Harbour CWB covers an area of 28km². The harbour is fed by Lough Mahon TWB (as well as the Owenboy Estuary TWB and North Channel Great Island TWB), before feeding into the Outer Cork Harbour CWB. Monkstown Creek is located within Cork Harbour CWB and comprises of intertidal mudflats and sand flats. The Glounatouig Stream discharges into the Monkstown Creek intertidal area. Lough Beg is also located within Cork Harbour CWB.

A full description of these features and their water quality and WFD status are described further in **Chapter 10: Aquatic Ecology**.

9.3.2 Protected Areas

The M28 Road Project does not directly impact upon any protected areas. The following European sites are within 15km of the study area; Great Island Channel SAC and Cork Harbour SPA. The following Proposed Natural Heritage Areas (pNHAs) lie within the zone of influence of the study area; Monkstown Creek pNHA, Douglas River Estuary pNHA, Lough Beg pNHA and Great Island Channel pNHA. A description of the protected areas and potential impacts within the zone of influence of the M28 Road Project are discussed in detail in **Chapter 10: Aquatic Ecology.**

9.3.3 Flow Measurements

Hydrometric monitoring is undertaken throughout the Republic of Ireland by the OPW and the EPA. The OPW maintains a tidal station at the National Maritime College of Ireland (NMCI) adjacent to the site of the proposed Service Area, Station number 19069. This gauge measures water level only. There are no OPW or EPA monitoring stations on the Glounatouig, Donnybrook or Woodbrook Streams.

9.3.4 Water Supply Sources

Information on the extent of the public water supply schemes within the study area was obtained from Cork County Council. The study area is served by the Cork City and Harbour Water Supply which is connected to the main County Council water supply. The storage of water is located at the Inniscarra Dam. Water is abstracted from the lake behind Inniscarra Dam. The supply is considered a Regional Water Supply Scheme.

9.3.5 Amenities

Cork Harbour is considered one of Ireland's five major tourism areas. Cork Harbour is widely used for commercial and recreational fisheries, both from boats and the shore. Once famous for its sea angling, this activity is now in decline due to over fishing, dredging, industrial development and other impacts (Coastal and Marine Research Centre, 2001), although it's still of significant value. The closest important angling point indicated by Inland Fisheries Ireland (IFI) dedicated angling website (www.fishinginireland.info) is at Paddy's Point, Ringaskiddy, located c. 700m north east of the M28 Road Project and Service Area. Sailing and boating are also popular around Cork Harbour. There are no designated Bathing Waters or Shellfish Areas adjacent to the study area, although Cork Harbour CWB supports three shellfish areas located on the opposite side of the harbour to the proposed road scheme, and Great Island Channel TWB also supports a further shellfish area, north-west of the proposed road scheme.

9.4 FLOOD RISK ASSESSMENT

The proposed road project has been assessed with regard to flood risk and includes the following:-

- A review of the history of flooding in the area has been carried out;
- The potential flood risk to the proposed road project has been assessed, with mitigation proposed, where required; and
- The potential for the proposed road to result in an increased flood risk has been assessed, with mitigation proposed, where required.

This flood risk assessment has been carried out in accordance with *The Flood Risk Management Guidelines*. These guidelines give guidance on flood risk and development and recommend a precautionary approach when considering flood risk management within the planning system. The core principle of the guidelines is to adopt a risk based sequential approach to managing flood risk and to avoid development in areas that are at risk. The guidelines include definitions of Flood Zones A, B and C as follows:-

- **Flood Zone A** – where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding);
- **Flood Zone B** – where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding); and
- **Flood Zone C** – where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding).

Flood Zone C covers all areas which are not in zones A or B.

It should be noted that these do not take into account the presence of flood defences, as there remains the risk of overtopping and breach of the defences. Once a flood zone has been identified, the guidelines set out the types of development appropriate to each zone.

A three staged approach to undertaking a Flood Risk Assessment is recommended:-

- Flood Risk Identification (Stage 1) – identification of any issues relating to the site that will require further investigation through a Flood Risk Assessment (FRA).
- Initial Flood Risk Assessment (Stage 2) – Involves establishing the sources of flooding, the extent of the flood risk, potential impacts of the development and possible mitigation measures.
- Detailed Flood Risk Assessment (Stage 3) – Assess flood risk issues in sufficient detail to provide quantitative appraisal of potential flood risk to the development, impacts of the flooding elsewhere and the effectiveness of any proposed mitigation measures.

This section addresses the requirements of Stages 1 and 2.

9.4.1 Flood Risk Identification (Stage 1)

At present the majority of the proposed M28 Road Project crosses agricultural land with sections of the proposed route overlapping with the existing N28. Run-off from the existing road is collected and discharged through a surface water drainage system while run-off generated within the greenfield areas ultimately outfalls to the sea via minor streams and tributaries.

9.4.1.1 Historic Flood Events

The Flood Hazard Mapping Website (www.floodmaps.ie) is a record of historic flood events maintained by the OPW. The data available was reviewed in order to obtain information on recorded flood events within the study area. Details of flooding events in the vicinity of the proposed M28 Road Project are outlined in **Table 9.2**. It is important to note that this may not be a complete record of flood events within the study area as the proposed route crosses lands which are used for agricultural purposes and flood events on such lands are less likely to be documented. Flood hazards identified from the OPW Flood Hazard mapping in the vicinity of the proposed M28 Road Project were:-

- 27th November 2002 – 4 locations at Raffeen Bridge, Coolmore Cross Roads, Shannonpark and Douglas.
- 28th June 2012 – Douglas Village.
- 27th October 2004 – Paddy's Point, Ringaskiddy.
- 3rd and 4th February 2014 – Car park at end of L2545, Ringaskiddy.

The following is an extract from the Flood Report for the Carrigaline area in relation to the 2002 flooding event at Raffeen Bridge:-

> *'There was water streaming across the road coming through local resident's land above the road and flowing into the stream below the road. The bank on the lower side of the road was being eroded away and there is a danger that the water may begin to take some of the road with it. Council workers went to work with a JCB to shore it up for the time being but repair works will need to be done in the future to prevent subsidence of the road. The lower bank will have to be reinstated with boulders and earth.'*

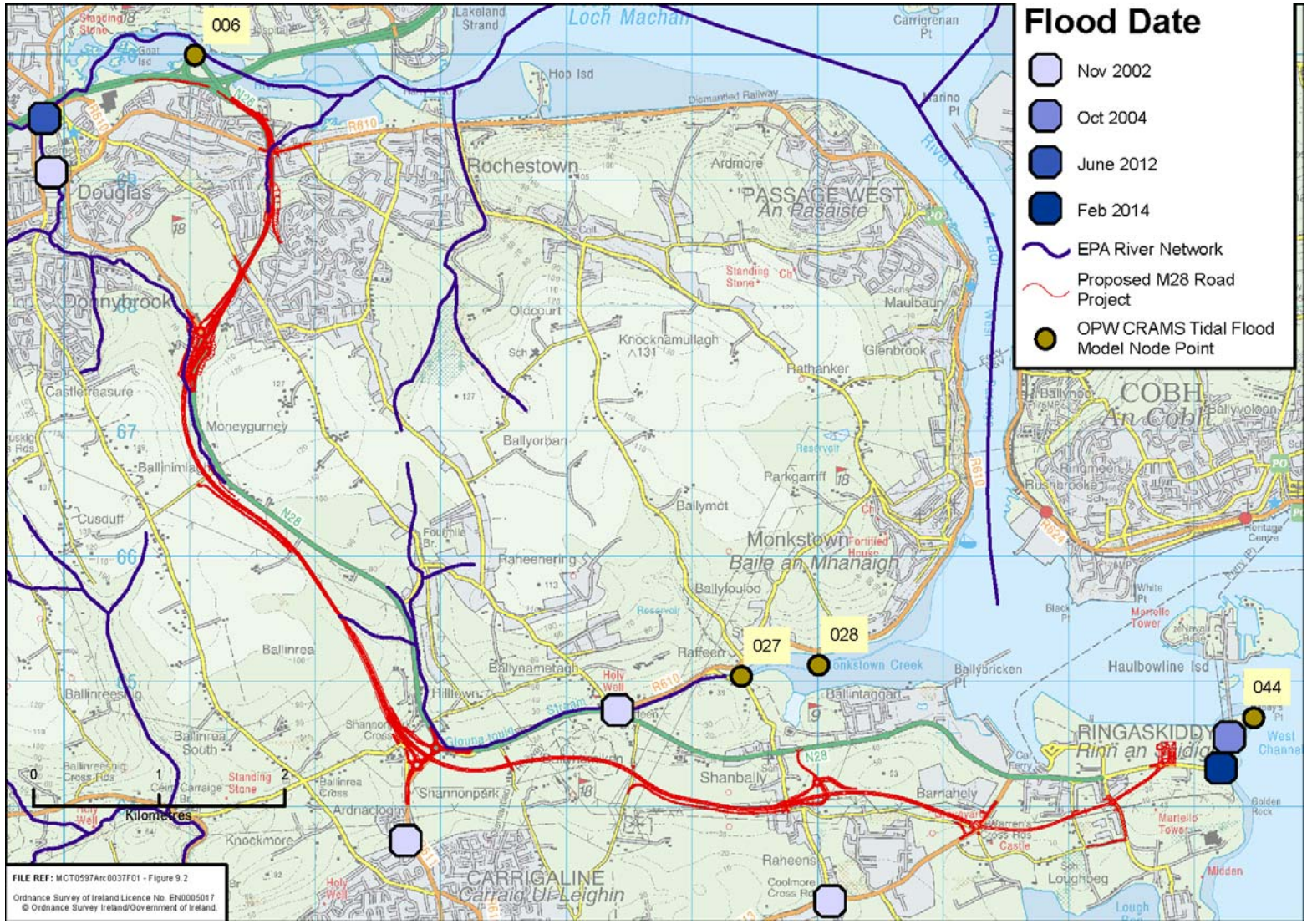
The Flood Data Collection Form submitted to OPW by Cork County Council stated in relation to the 2014 flooding in Ringaskiddy that '*50-60m of the L2545 was affected and that access to Haulbowline was cut off*'. This car park was previously flooded during the 2004 flood event.

There were no other flood hazards records identified from the OPW Flood hazard map that intersect or were close to the line of the proposed M28 Road Project. OPW Flood Hazards are indicated in **Figure 9.2**.

Table 9.2: Summary of Historical Flood Events in the Vicinity of the Study Area

Date	Description/Details	Frequency	Source of Flooding
27th November 2002	*Raffeen Bridge*: Vast volumes of rainfall over a short period of time meant that drainage pipes and gullies could not take the amount of water flowing. Surface water flowing from lands above the road flowed into the Glounatouig Stream and the river bank was eroded away. Localised flooding on the R611 at Shannonpark as a result of a culvert collapsed. No flooding here since culvert was repaired.		Pluvial - Peak rainfall figures occurred on Wed 20th when 40mm of rain fell and again on Wed 27th when 18.6mm fell.
27th October 2004	*Paddy's Point,* Ringaskiddy: Flooding of road associated with a combination of heavy rainfall and extreme tidal conditions. The post flood reported stated 'The surface of the car park has been significantly damaged and part of the sea wall has been washed away'.	Subsequent flooding occurred again in 2014, see below.	Pluvial/Tidal - Severe gales and heavy rainfall on the 27th, 28th and 29th of October - 75mm of rainfall recorded over the three days. The event coincided with the autumnal equinox resulting in the storm surge being combined with spring tide levels.
28th June 2012	*Douglas Village*: Flooding occurred in Douglas as a result of flow in the Donnybrook River and Tramore River. Flooding occurred in the Togher /Douglas catchment when the Donnybrook River burst its banks upstream of the village at a blocked bridge with flood water flowing onto the road and through the park. 12 residential properties were affected along with a medical centre, meeting hall and shopping centre.	Flooding has occurred before at this location	Fluvial flooding contributed to by pluvial flooding. Reports of very high rate of surface water run-off from Donnybrook Hill may also have contributed to the flood event.
3rd and 4th February 2014	*Ringaskiddy*: The post flood report states that flooding occurred 'From Monday morning, 3rd February, to Tuesday evening, 4th February 2014. Flood water extended approx. 60m from car park at end of local road (L2545) and was approximately 13 - 15 inches deep.' No people or properties were affected; however access to Haulbowline was cut off.	The same car park was flooded in the 2004 above.	Coastal Flooding caused by a combination of south-easterly winds and high tides.

Figure 9.2: OPW Flood Hazards within the Study Area



9.4.2 Flood Risk Assessment (Stage 2)

9.4.2.1 Estimate of Flood Zone and Flood Risk

The CFRAM (Catchment Flood Risk Assessment and Management) Programme is a national programme which produced a series of Preliminary Flood Risk Assessment (PFRA) which cover the entire country, see (http://ww.cfram.ie/pfra/interavtive-mapping/). **Figure 9.3** is taken from the Preliminary Flood Risk Assessment (PFRA) map for the study area and illustrates areas that may be at risk of fluvial, coastal, pluvial and groundwater flooding. Please note that the map shown in **Figure 9.3** does not cover part of the southern end of the proposed road; however the relevant map does not illustrate areas as being at risk of flooding.

9.4.2.2 Potential Sources of Flooding

The following sources of flooding have been assessed in order to establish the potential impact of the proposed road on each and the risk to the proposed road from each:-

- Fluvial Flooding – flooding from rivers and streams.
- Coastal Flooding – flooding from the sea.
- Pluvial Flooding – flooding that is caused by run-off during high rainfall events.
- Drainage Systems – flooding that occurs as a result of surcharging or blocking of drainage networks.
- Groundwater – flooding when water normally stored below the ground rises above surface level or into ground spaces (such as basements).

Fluvial Flooding

Fluvial flooding is the result of a river exceeding its capacity and excess water spilling out on to the adjacent floodplain. Given the location of the proposed road project and its proximity to a number of streams and rivers, it is considered that fluvial flooding does pose a risk to the proposed road project.

Based on a review of the flood risk mapping available for the study areas, it is considered that the fluvial flood risk is associated with the Glounatouig and Woodbrook streams. The catchments associated with both streams are relatively steep are likely to react rapidly to rainfall in the area.

The OPW PFRA maps (2011) for Ireland illustrates the areas that may be at risk of flooding should a fluvial flood event with magnitude of 1% AEP (1 in 100 year return period) occur. The PFRA map for the study area indicates the estimated extent of such an event in the Glounatouig and Woodbrook streams. The proposed road lies outside the 1% AEP fluvial flood extents (Flood Zone A) associated with the Glounatouig Stream.

The route of the proposed road crosses through the estimated 1% AEP fluvial flood extent (Flood Zone A) associated with the Woodbrook stream. This section of the proposed road will be located on the footprint of the existing N28. Currently, a culvert conveys flows in the Woodbrook north east under the N28 from the Rochestown Rise residential area. Incidents of flooding as a result of the culvert inlet becoming blocked have been reported in the past.

A trash screen at the inlet to the existing culvert is reported to have contributed to blockages of the inlet. The road levels on the existing N28 are significantly higher than the lands around the inlet to the culvert. Due to the difference in the ground levels, blockage of the existing culvert has not resulted in the existing N28 becoming flooded, therefore it is considered that the risk to the proposed road is low.

Detailed assessments of the other streams within the study area have not been carried out to date and are ungauged. However, given the absence of any significant watercourse in the vicinity of the proposed road and the fact that there are no *recorded* incidences of fluvial flooding where the M28 Road Project crosses existing watercourses it can be concluded that the risk of fluvial flooding is considered low.

Coastal Flooding

Coastal flooding is caused by higher sea levels than normal, resulting in the sea overflowing onto the land. The northernmost (at Bloomfield), southernmost (at Ringaskiddy) portions of the M28 Road Project are situated in close proximity to the western coast of Lough Mahon TWB and Cork Harbour CWB respectively. These portions of the project may therefore be affected by coastal flooding.

The Lee Catchment Flood Risk Assessment and Management Study (CFRAM Study, 2009) estimated extreme water levels based on extreme surges and extreme astronomical tides using joint probability methods. Flood extent maps developed for the CFRAM study show the areas that may be at risk of coastal flooding during events with return periods of 1 in 200 year (0.5% AEP) and 1 in 1000 year (0.1%) for both the current and future scenarios.

The route of the existing N28 is through an area that is indicated as being at risk of coastal flooding, however the road itself is not shown to be at risk. The lands to the west of the N28 are shown as being at risk of coastal flooding during a 1 in 200 year event (0.5% AEP). This area is also illustrated as being a 'defended area'. Unless there is a breach or failure of the defence protecting this area this area is unlikely to flood. The mapping also indicates that the confidence level in the flood extent shown is low.

The estimated current scenario 1 in 200 year flood level at Node 006 is approximately 2.78m OD in the Douglas River estuary (upstream of the existing N28); while the Mid Range Future Scenario 1 in 200 year flood level at this node is approximately 2.91m OD. The lowest level on the existing N28 at Bloomfield is approximately 4.0m OD. Given that the proposed road levels along this section will match those of the existing, it is considered that the risk of coastal flooding is low.

The remainder of the proposed M28 route is not located within areas considered to be at risk of coastal flooding in the current of future scenarios. However, the risk of flooding at the site of the proposed Service Area is likely to be greater due to its proximity to Cork Harbour.

The predictive mapping prepared shows that the site in question is not at risk of coastal flooding in the current and future scenarios. The estimated current scenario 1 in 200 year flood level at Node 044 is approximately 2.66m OD; while the Mid Range Future Scenario 1 in 200 year flood level at this node is approximately 3.21m OD. **Figure 9.2** indicates the locations of nodes 006 and 044.

The Irish Coastal Protection Strategy Study (ICPSS) undertaken by RPS on behalf of the OPW in 2011 was also reviewed. This study derived instantaneous extreme coastal water levels around Ireland's coastline using the Irish Seas Tidal and Surge Model (ISTSM). The estimated water level associated with a 1 in 200 year event in the vicinity of Haulbowline Island is approximately 2.73m OD.

The proposed site of the Service Area is generally a reclaimed area located within the Port of Cork lands, east of Ringaskiddy village. The indicative development level for the Service Area is 3.3 mOD. A local road (L2545) runs from east to west at the south of the site. The area has, in the past been subject to coastal flooding, the most recent event being a flood event in 2014 where floodwater was reported to have extended approximately 60m from the car park at the end of local road L2545.

Reports prepared for previous planning applications in the area (Indaver and IMERC) have also noted occurrences of surface water flooding on the L2545 road. To prevent flooding on the existing L2545, the Indaver application proposes to upgrade the existing L2545 by raising road levels and providing a new surface water drainage network.

The proposals would significantly reduce the risk of flooding on the road adjacent to the Service Area access. However, if the proposed works are not carried out on the L2545, the existing flood risk in the area will remain unresolved. In order to ensure that emergency access to and from the Service Area is not cut off, the road levels at the entrance roundabout should be raised above the estimated 1 in 200 year return period flood level. This will allow access to and from the Service Area through the Lough Beg section of the proposed M28 Road Project in the event of an emergency.

Due to the uncertainty associated with Climate Change the OPW recommends allowing for a 0.55m rise in water levels to account for the Mid Range Future Scenario. Based on the mapping prepared to reflect this allowance, the flood risk to the Service Area site is considered low.

Pluvial Flooding

Pluvial flooding results due to overland flow from sewer surcharging, blocked gullies, high run-off rates etc. usually associated with high intensity rainfall. There are no records of such events occurring in the vicinity of the proposed road project and the PFRA mapping does not indicate that there is a risk of pluvial flooding in the study area.

Pluvial flooding may also arise as a result of rainfall generated overland flow. Overland flow occurs when the amount of rainfall exceeds the infiltration capacity of the ground to absorb it. This excess water flows overland, ponding in natural hollows and low-lying areas or behind obstructions before entering a watercourse or drainage network. This can also occur as a result of high intensity rainfall events causing run-off to overwhelm the surface water drainage system.

The following aspects of the proposed surface water drainage system will protect it from pluvial flooding:

- Where the road is in cut, interceptor ditches have been designed to intercept over land flow,
- Where the road is in fill, the proposed road levels will prevent overland flow from encroaching onto the road, and
- The proposed ground levels within the Service Area site have been designed to direct run-off away from the proposed building itself and also to prevent run-off ponding within the site.

Flooding of Surface Water Drainage Networks

The existing road network is served by surface water drainage networks, therefore if these systems block or if a rainfall event occurs that exceeds the discharge and storage capacity of these networks, flooding of the carriageways and surrounding areas could occur. These drainage systems are maintained by Cork County to ensure that they function correctly and do not become blocked.

Surface water run-off from the proposed road will be managed through the design and construction of an engineered drainage system. A general description for this drainage system is presented in this EIS (see **Section 9.6**). The proposed surface water drainage network has been designed to provide capacity for a 1 in 5 year return period event without surcharging. Where it is proposed to discharge run-off from the proposed surface water drainage network to existing networks the rate of discharge will be limited to the 1 in 100 year greenfield run-off rate. On this basis, the risk of flooding associated with the proposed surface water drainage network has been minimised to an acceptable level.

Groundwater Flooding

The majority of the proposed M28 Road Project lies on a Locally Important Aquifer. There is potential for prolonged rainfall to raise the groundwater level within these aquifers above the ground surface level, resulting in flooding. As the majority of the proposed M28 Road Project will be raised above ground level by embankments, the road is unlikely to be at risk of flooding associated with high groundwater levels. In areas of cut, the proposed road sub-surface drainage system will serve to locally lower ground water levels. This measure will be sufficiently robust to cater for any risk of groundwater flooding.

9.4.2.3 Climate Change and Flood Risk Assessment

It is widely predicted that Ireland will experience increased sea levels and rainfall intensities in the future. Increased sea levels will increase the risk of coastal flooding and also lead to higher water levels upstream in river estuaries. Guidance for the application of climate change in terms of sea level rise is provided in '*Assessment of Future Scenarios for Flood Risk Management*' (OPW, 2009).

This recommends that two potential future scenarios are considered: Mid Range Future Scenario (MRFS) which represents a 'likely' future scenario; and High End Future Scenario (HEFS) which represents a more extreme potential future scenario. It is recommended by the OPW that a mid-range future scenario of 550mm rise in sea levels is considered and a 1,000mm increase in sea levels is considered for the high end future scenario. The mid range future scenario impact on water levels in the study area has been considered in the proposed design and the associated risk is considered low. The following allowances have been made in the proposed design to account for the impact of climate change:

- An increase of 20% in rainfall intensities has been allowed for in the design of the surface water drainage network;
- An increase of 20% in fluvial flow rates has been allowed for in the design of the proposed culverts and swales; and
- The mid range future scenario coastal flood extents during a 1 in 200 year flood event has been considered in the proposed design.

9.4.2.4 Douglas Flood Relief Scheme

Douglas was selected as an Area for Further Assessment (AFA) following the completion of the PFRA. The Douglas Flood Relief Scheme (FRS) is currently at the environmental assessment and planning stage. Preferred options have been outlined and the constraints report highlights environmental issues that could be affected by the proposed flood alleviation measures for the Tramore River/ Douglas River. The study area for the Scheme encompasses the Tramore River, the Douglas River (Ballybrack Stream) and the Grange and Donnybrook streams.

The Donnybrook Stream is a tributary of the Tramore/ Douglas River (Lee). The Donnybrook Stream drains the land to the south of the FRS study area before joining the Douglas River (Lee) at Douglas. The proposed works for the scheme include 2m of channel widening along the Douglas River at Douglas Community Park, culvert replacement at Church Road, bridge replacement at Church Road and upgrade of a trash screen. There are no proposed measures for the Donnybrook Stream itself.

The proposed surface water drainage system outfall to the Donnybrook Stream as part of the M28 Road Project are unlikely to have an impact on the alleviation measures proposed for the Douglas FRS as any increase in run-off arising from the proposed M28 Road Project will be attenuated upstream of the proposed outfall to the stream.

9.4.3 Potential Impact of Development on Flooding Elsewhere

Construction in floodplains can affect the nature and extent of the flood envelope in the area of construction and for some distance upstream and downstream. This could have a serious impact on properties within or near the floodplain, which may become exposed to a new or increased risk of flooding. Bridges and embankments, in particular, can obstruct or change the path of floodwaters, thereby changing the shape and/ or extent of the flood extent.

The effect on floodwater levels in any area of floodplain caused by any one element of road construction may be small. However, the consequence of developing the whole floodplain could lead to a significant cumulative loss of floodplain storage.

Based on the information presented in **Sections 9.4.1** and **9.4.2**, the proposed M28 Road Project is not located within areas at risk of flooding. As a result, the impact of the proposed road on flood risk elsewhere is considered low.

The culverts proposed as part of the surface water drainage system will comply with the requirements of the OPW under Section 50 of the Arterial Drainage Act 1945, and will be such that the flood risks upstream and downstream are not increased. The proposed stream diversions will be constructed to provide the capacity of the existing streams with the existing invert levels and gradients maintained.

In order to minimise the impact on receiving waters, run-off discharged from the proposed surface water drainage network to streams/ rivers will be limited to the 1 in 100 year greenfield run-off rate.

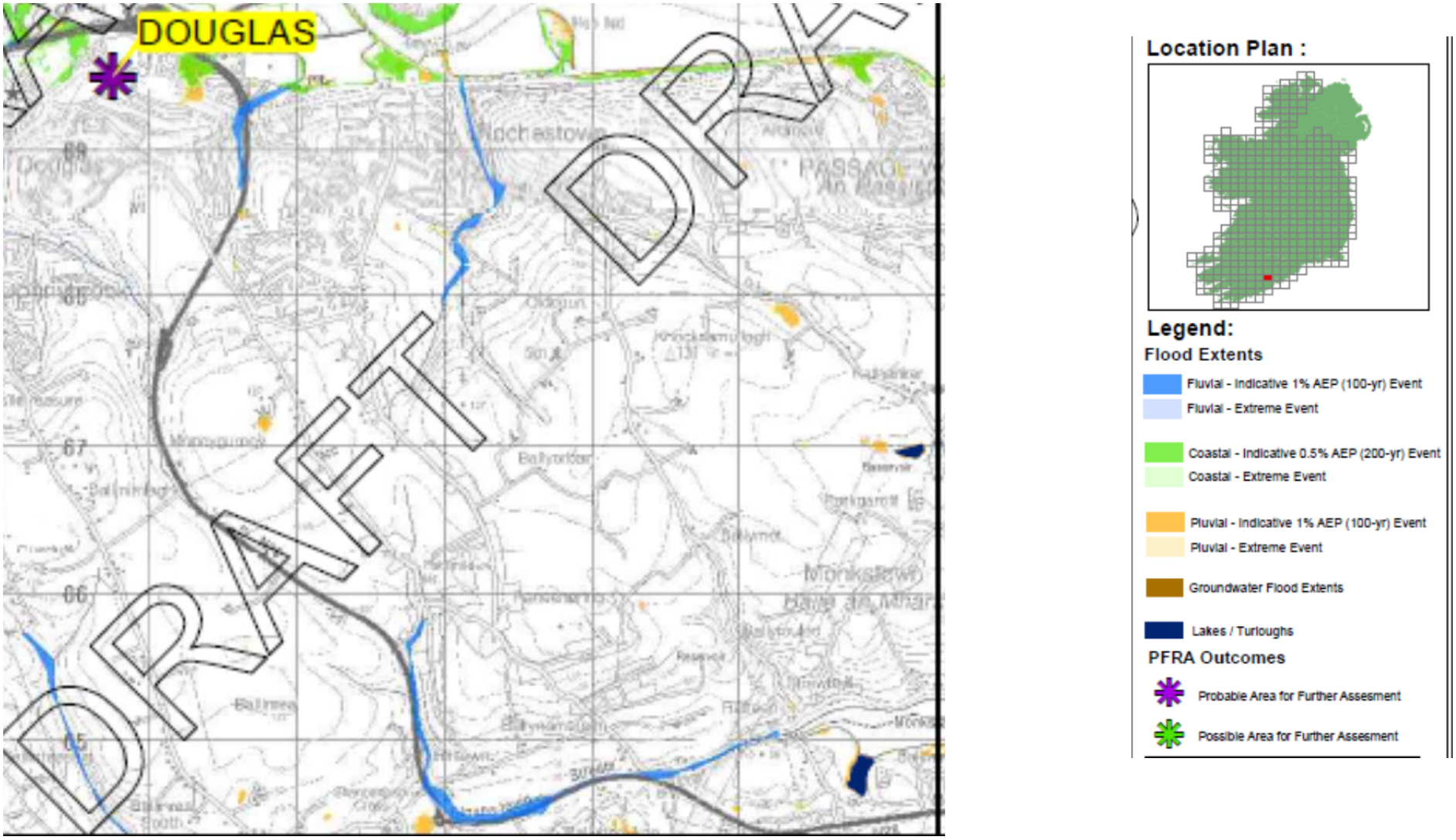
9.4.4 Conclusion

Based on the information available on flood risk and extents in the study area, it is considered that the flood risk to the proposed road is low. The potential impact of climate change on the proposed road has been considered in the proposed surface water drainage and culvert design. The potential impact on flood risk elsewhere has also been assessed and potential flood storage volumes will not be reduced as a result of the proposed road. The risk assessment is summarised in **Table 9.3**.

Table 9.3: Summary of Flood Risks to the M28 Road Project

Source of Flood Risk	Risk to M28 in Current Scenario		Risk to M28 in Future Scenario (Allowing for Potential Impact of Climate Change)	
Coastal Flooding	Low	Results confirmed by ISTSM Modelling	Low	Increased sea levels likely to significantly increase tidal flood risk. From a comparison of the estimated coastal flooding levels, the OPW recommendations on Climate change and the proposed road levels the risk is considered to be low.
Fluvial Flooding	Low	Limited data available; however there are no recorded incidences of fluvial flooding along the route of the Proposed M28 Road Project.	Low	An increase in rainfall intensities is likely to result in greater flows in streams and rivers. The design of the proposed stream diversions, culverts and overall road layout has been carried out to minimise the impact on the receiving environment. This will help to ensure that the risk to and as a result of the proposed road is low.
Pluvial Flooding	Low	Pluvial flood risk and overland flow will be managed through the provision interceptor ditches	Low	An increase in rainfall intensities is likely to result in greater run-off rates. However, the measures proposed as part of the drainage system have made an allowance for climate change.
Flooding of Surface Water Drainage Networks	Low	Drainage systems to be maintained.	Low	The proposed surface water drainage networks associated with the M28 Road Project has been designed to account for increases in flow rates resulting from climate change.
Groundwater Flooding	Low	For the majority of the route, the proposed road is approximately 4.0 m above the surrounding ground levels therefore; the risk of flooding associated with ground water is low. In areas of cut, the ground water levels will be lowered through the provision of sub-surface drainage.	Low	Groundwater levels may increase over time as a result of climate change. However, the risk to the proposed road is considered to remain low as a result of the proposed ground levels and sub-surface drainage.

Figure 9.3: Preliminary Flood Risk Assessment Map for the Study Area



9.5 EXISTING SURFACE WATER DRAINAGE

Run-off from the existing N28 is primarily over embankments to fields which eventually discharge to existing watercourses. The Woodbrook, Donnybrook and Glounatouig Streams are culverted at a number of locations where the watercourses cross the existing N28. The Woodbrook and Donnybrook streams ultimately discharge to the Douglas River Estuary and the Glounatouig Stream to Monkstown Creek.

Run-off from the existing N28 road area at Bloomfield drains through kerbs and gullies and is likely to be conveyed untreated to Douglas River Estuary through an unattenuated surface water drainage network.

Surface water generated as a result of rainfall on the existing N28 from Carr's Hill north to Rochestown Road is primarily discharged over embankments into the Woodbrook Stream. This stream is conveyed under the existing N28 at Rochestown through a 1200 mm diameter culvert. Surface water run-off has also been observed to flow along the road surface and discharge to a gully to the north of the existing Rochestown underbridge. Based on the information available, this gully is likely to discharge run-off to the existing 1200 mm diameter culvert under the N28 at Rochestown. Current run-off to the Woodbrook Stream is likely to be unattenuated.

The catchment of the Donnybrook Stream is defined by two topographic highs at Ballinimlagh and Moneygourney with surface water draining eastwards and westwards towards the stream. The Donnybrook stream runs adjacent to the existing N28 at Carr's Hill before deviating to the north-west towards Douglas.

In the southern section of the study area, surface water follows the natural topography of the landscape which falls from 127m OD at Moneygourney south-westerly to 20m OD towards the Glounatouig Stream. The Glounatouig Stream then drains the study area from west to east before discharging at Monkstown Creek (Cork Harbour). The nature of the karstic system in this part of the study area can lead to rapid exchanges of water between the surface and groundwater. Swallow holes and caves receive surface water; this is indicated by the general lack of surface water drainage features in the area between Shannonpark and Ringaskiddy. Surface water generated on the existing N28 from Carr's Hill to Ringaskiddy is primarily over embankments to fields which eventually discharge to existing watercourses in the area.

There are no particular treatment or attenuation measures in place to control run-off from the existing N28. However, natural treatment and attenuation is likely to occur through the over the edge drainage system that operates on much of the existing N28. At present, surface water run-off at the site of the proposed Service Area discharges directly to Cork Harbour. Some surface water run-off generated will infiltrate to ground while the remaining run-off is eventually discharged to the following waterbodies:-

- Woodbrook Stream;
- Donnybrook Stream;
- Glounatouig Stream;
- Lough Mahon, and
- Cork Harbour.

9.6 PROPOSED SURFACE WATER DRAINAGE NETWORK

The proposed M28 Road Project involves the construction of a new surface water drainage system for the proposed road including new outfalls to existing watercourses, existing surface water drainage networks or to the foreshore. Furthermore, the proposed road project will cross a number of local watercourses, necessitating stream realignments, new culvert crossings and extensions to existing culverts.

The proposed surface water drainage network is described here for comparative purposes with the existing drainage system. The proposed road areas have been divided into 13 No. catchments based on the longitudinal profile of the road and locations of suitable outfall locations.

Surface water run-off can impact on receiving watercourses in two ways:-

- Discharge Rate: if the rate of discharge from the proposed road exceeds that of the existing catchment area then it is possible that overloading of the existing watercourse could occur, causing localised flooding or erosion of watercourse banks within the catchment.
- Quality of run-off: Carriageway run-off can contain pollutants from the carriageway because of the traffic loading.

The stream diversions, culverts, surface water drainage network, and catchment run-off interceptors have been designed so as to minimise the potential impact on the receiving watercourses. The assessment procedures presented in **Section 9.2.3** have guided the design of the surface water drainage network so as to ensure that the impact on the receiving environment is minimised. The measures proposed as part of the proposed surface water drainage system and their effectiveness is presented in the following sections.

9.6.1 Design Requirements

The design of the proposed drainage collector systems includes:-

- Consideration of pollution and flood risk requirements;
- Determination of the design storm used in the design of the drainage elements;
- Calculation of the flows from the design storm within each drainage element;
- Establishment of the hydraulic adequacy of each drainage element;
- Determination of the location of outfalls or soakaways;
- Determination of structural loading upon drainage conduits (where necessary);
- Specification of appropriate chambers and covers; and
- The rainfall intensities used in the design will be increased by 20% in order to allow for the future effects of climate change.

9.6.2 Hydraulic Capacity

Run-off rates from the road alignment have been determined using rainfall intensities, run-off coefficients adopted to allow for variations in surfacing type and the extent of the proposed surfaces.

Where carrier pipes and filter drains are proposed, the proposed network has been designed to convey run-off associated with a 1 year return period rainfall event (highest intensity storm expected in 1 given year) and checked for surcharging during a 5 year return period rainfall event.

Where the proposed road is in fill, over the edge drainage has been designed where feasible in conjunction with a swale to allow for infiltration of run-off to ground or conveyance to suitable outfalls. Where over the edge drainage is not feasible other collector systems such as surface water channel and carrier pipe will be used. Drawings illustrating the proposed surface water drainage system are included in **Volume 5 (DR Series)**.

9.6.3 Attenuation of Run-off

Attenuation measures in the form of attenuation tanks/ponds and grassed swales are proposed to reduce the rate of run-off discharged to the receiving watercourses. The proposed attenuation tank, ponds and grassed swales proposed as part of the surface water drainage design are illustrated in the drawings contained in **Volume 5 (DR Series)**. In order to minimise the risk of overloading the receiving streams/rivers and existing surface water drainage networks, it is proposed to limit the rate at which flow is discharged from the attenuation tanks and ponds to the 'greenfield' or predevelopment run-off rate from that catchment area.

While the primary purpose of the attenuation tank, ponds, and swales is to reduce the risk of flooding in the receiving watercourse/ networks, they will also contribute to improved water quality by facilitating settlement and deposition of sediment and contaminants carried through the pipe network from the carriageway.

9.6.4 Proposed Outfalls

The surface water drainage network will discharge run-off from the mainline of the road to ground, watercourses, existing surface water drainage networks or onto the foreshore. A total of 13 No. outfall locations are proposed for the mainline road drainage. The outfall locations are identified on drawings included in **Volume 5 (DR Series)**.

9.6.5 Treatment of Run-off and Accidental Spillage

The application of assessment Methods A and D, Water Quality and Spillage Risk respectively, indicated that the risk of adverse impact on the receiving watercourses is low. However, in conjunction with a conservative approach and best practice the proposed surface water drainage system includes measures to reduce the concentrations of pollutants that are routinely found in road run-off and which pose a risk of short-term acute impacts (from dissolved/ soluble pollutants) and/ or long-term chronic impacts (from sediment bound pollutants) on receiving waters.

As part of the proposed surface water drainage design, a Class I by-pass hydrocarbon interceptor will be provided upstream of each proposed outfall. During routine operation surface water run-off from the proposed road will pass through the interceptors which are designed to treat water to achieve a concentration of 5 mg/ litre of oil. The proposed by-pass interceptors are designed to treat 10% of the peak flow with flows generated by higher rainfall rates passing through part of the separator and bypassing the main separation chamber. The hydrocarbon interceptors are primarily aimed at removing hydrocarbons from run-off.

To manage residual water quality risk and to ensure that the concentrations of other types of pollutants, e.g. heavy metals and sediment are reduced to an acceptable level, the following aspects of the surface water drainage design will contribute to the treatment of surface water run-off from the Proposed M28 Road Project:-

- Filter Drains,
- Grassed Swales,
- Retention Ponds.

The typical treatment effectiveness of each element incorporated within the proposed surface water drainage network is included in **Table 9.4**. This information is taken from TII Publication DN-DNG-03022.

Table 9.4: Indicative Treatment Efficiencies of Measures Incorporated

Treatment System Type	Suspended Solids (% removal)	Dissolved Copper (% removal)	Dissolved Zinc (% removal)
Swales and Grassed Channels	80	50	50
Filter Drains	60	0	45
Wet/ Retention Ponds	60	40	30

The incorporation of the above measures is shown on the drawings included in **Volume 5 (DR Series).** These measures ensure that run-off discharged will be of an acceptable quality and pose no risk to the receiving watercourses.

When considering the impacts on water bodies from road run-off, acute pollution is most commonly associated with spillages of vehicle fuel and substances carried on roads. The proposed surface water drainage system has been assessed and designed such that the following criteria are satisfied:

- The calculated spillage risk return period is not greater than 1 in 100 years;
- The calculated spillage risk return period is not greater than 1 in 200 years where spillage could affect protected areas for conservation; and
- Spillage risk from existing outfalls must not be increased.

The risk of spillage along the route is calculated to be low. However, to manage the residual risk, a containment volume of 25 m^3 upstream of each outfall is proposed. Should a spillage occur on the carriageway, the outlet from each storage area can be blocked to minimise the risk of polluting substances reaching the receiving watercourses. The proposed spill storage is provided upstream of each hydrocarbon separator and pond. This will allow for further treatment following an incident.

Table 9.5 summarises the proposed water treatment measures incorporated into the drainage system prior to discharge to receiving watercourses. These measures ensure that any residual risk of damaging pollution reaching the receiving environment is minimised and that the proposed M28 Road Project poses no risk.

Table 9.5: Proposed Treatment Measures

Outfall No.	Treatment Measures	Management of Residual Spillage Risk
1	Filter Drains, where possible Class 1 By-pass Hydrocarbon Interceptor Retention Pond	25 m^3 containment
2	Filter Drains, were possible Class 1 By-pass Hydrocarbon Interceptor	25 m^3 containment
3	Filter Drains, were possible Class 1 By-pass Hydrocarbon Interceptor Attenuation Pond	25 m^3 containment
4	Filter Drains, were possible Class 1 By-pass Hydrocarbon Interceptor Attenuation Pond	25 m^3 containment
5	Filter Drains, were possible Class 1 By-pass Hydrocarbon Interceptor Attenuation Pond	25 m^3 containment
6	Filter Drains, were possible Class 1 By-pass Hydrocarbon Interceptor Attenuation Pond	25 m^3 containment
7	Filter Drains, were possible Grassed swales Class 1 By-pass Hydrocarbon Interceptor Retention Pond	25 m^3 containment
8	Filter Drains, were possible Class 1 By-pass Hydrocarbon Interceptor Retention Pond	25 m^3 containment
9	Grassed swales Class 1 By-pass Hydrocarbon Interceptor Retention Pond	25 m^3 containment
10	Grassed swales Filter Drains Class 1 By-pass Hydrocarbon Interceptor Retention Pond	25 m^3 containment
11	Grassed swales Filter Drains Class 1 By-pass Hydrocarbon Interceptor Retention Pond	25 m^3 containment
12	Grassed swales Filter Drains Class 1 By-pass Hydrocarbon Interceptor Retention Pond	25 m^3 containment
13	Filter Drains, were possible Class 1 By-pass Hydrocarbon Interceptor Retention Pond	25 m^3 containment

9.6.6 Interceptor Ditches

In order to limit the frequency and severity of flooding incidents caused by run-off from beyond the road boundary interceptor ditches are proposed.

The proposed interceptor ditches have been designed in accordance with the methodology set out in TII publication DN-DNG-03064 and are illustrated on the drawings included in **Volume 5 (DR Series)**.

9.6.7 Service Area (SA) Surface Water Drainage Design

Within the Service Area, the proposed surface water drainage network is separated into two networks; one serving fuel filling and storage areas and one serving hard-standing and parking areas.

The risk of contamination in the fuel filling and storage areas is significantly greater, therefore run-off from these areas will be treated by a Class I forecourt separator. A forecourt separator is designed to ensure that flow cannot exit the unit without first passing through the coalescer assembly. In normal operation conditions, the forecourt separator has sufficient capacity to provide storage for separated pollutants within the main chamber. In the event of an accidental spillage from a fuel delivery tanker compartment on the forecourt, this type of separator is capable of storing up to 7,600 litres of pollutants.

Forecourt separators are designed to ensure that oil and other hydrocarbons cannot exit the separator in the event of an accidental spillage. In the event of an accidental spillage, the separator must be emptied and materials disposed of at a suitable facility.

The risk of contamination in non fuel filling and parking areas is lower than fuel filling and storage areas therefore run-off from such areas will be treated by a Class I By-Pass separator prior to discharge. By-pass separators are designed to treat 10% of the peak flow rate. Flows generated by higher rainfall rates will pass through part of the unit and will bypass the main separation chamber.

Class I separators (both by-pass and forecourt) are designed to achieve a concentration of 5 mg/litre of oil.

9.6.8 Stream Diversions

As part of the proposed road, a number of sections of existing watercourses will require diversion, which will be provided through an open channel. Where diversions are proposed, the channel capacity of the diversion will match that of the existing channel.

There are 5 no. stream diversions proposed:

- 2 no. of Donnybrook Stream,
- 2 no. of Woodbrook Stream,
- 1 no. of the Glounatouig Drain.

Details of the proposed stream diversions are included in **Table 9.6**. Drawings illustrating the proposed diversions are included in **Volume 5 (DR Series)**.

Table 9.6: Summary of Stream Diversions

No.	Watercourse	Length of Realignment (m)
SD-1	Woodbrook Stream	132
SD-2	Woodbrook Stream	170
SD-3	Donnybrook Stream	210
SD-4	Donnybrook Stream	250
SD-5	Glounatouig Drain	30

9.6.9 Culverts

The Proposed M28 Road Project will necessitate several crossings of existing watercourses with culverts. There are 17 no. proposed culverts (including an existing culvert extension) of which 10 are required on existing watercourses - 1 no. crosses the Woodbrook Stream, 2 no. cross the Donnybrook Stream and 7 no. cross the drains which flow to the Glounatouig Stream. The remaining culverts are proposed as part of the surface water drainage system. All new culverts on existing watercourses will be bottomless and will include mammal ledges, where required.

Culverts on existing watercourses will comply with the requirements of the OPW, the statutory authority responsible for arterial drainage and TII requirements. At minimum, new culverts will provide capacity for the following:

- The 1 in 100 year flood flow rate generated within the upstream catchment;
- An increase of 20% on the 1 in 100 year flood flow to allow for climate change effects; and
- Culverts must operate under the above conditions while maintaining a freeboard of at least 300 mm.

The proposed culverts will include measures specified by Inland Fisheries Ireland (IFI) to minimise any negative effect they may have the aquatic environment. The measures provided will be agreed with IFI. Details of the consultation process are provided in **Chapter 6: Non -Statutory Consultation** and **Chapter 10: Aquatic Ecology**.

Table 9.7 indicates the proposed culvert lengths and the watercourse which will flow through each culvert. Drawings illustrating the proposed culverts are included in **Volume 5 (DR Series)**.

Table 9.7: Schedule of Proposed Culverts

Culvert No.	Culvert Length (m)	Watercourse
C1	30	Woodbrook Stream
C2	34	Donnybrook Stream
C3	67	Donnybrook Stream
C4	18	Surface Water Drainage System
C5	18	Surface Water Drainage System
C6	30	Surface Water Drainage System
C7	45	Glounatouig Drain
C8	15	Glounatouig Drain
C9	25	Surface Water Drainage System
C10	55	Glounatouig Drain
C11	45	Glounatouig Drain
C12	88	Glounatouig Drain
C13	72	Surface Water Drainage System
C14	40	Glounatouig Drain
C15	70	Glounatouig Drain
C16	36	Surface Water Drainage System
C17	12	Surface Water Drainage System
C18	25	Surface Water Drainage System

Insofar as possible, the profile, capacity and invert levels of both the proposed culverts and stream diversion channels will match those of the existing channels. This will help to ensure that flow velocities and existing channel morphology are maintained.

The OPW recommends a minimum culvert dimension of 900mm diameter for any culvert in order to reduce the likelihood of blockage with debris during high flows. Where stream diversions are not required, new culverts will be constructed along the line of the existing watercourse.

The design and construction of the proposed culverts will be carried out in line with the guidelines and standards of Transport Infrastructure Ireland (TII) and Inland Fisheries Ireland (IFI). **Chapter 10: Aquatic Ecology** also outlines the appropriate mitigation measures in terms of culvert construction and stream diversions for the construction phase of the M28 Proposed Road Project.

9.7 CONSTRUCTION STAGE

9.7.1 Potential Construction Phase Impacts

The principal impacts during the construction phase are likely to be associated with:-

- Flooding;
- Accidental Spillage; and
- Sediment being conveyed to surface waters adjacent to the works area.

9.7.1.1 Flooding

The creation of impermeable areas may alter flow patterns in the immediate vicinity of the construction areas and compounds potentially leading to localised surface water ponding.

Flooding of the Service Area site during the construction stage may result in pollution of Cork Harbour due to materials and substances entering the water following a flood event.

In order to avoid causing flooding during the construction phase all existing surface water drainage and discharge points will be maintained.

A surface water drainage system to manage surface water run-off and dewatering requirements will be provided to reduce the potential risk of flooding.

In order to avoid materials and substances entering Cork Harbour as a result of flooding, the working platform within the Service Area site will be above a level of 3.30 m OD for the duration of the works. Dewatering of excavations will be treated prior to any discharge to Cork Harbour.

9.7.1.2 Accidental Spillage

A variety of materials and chemicals are likely to be used during the construction phase which may have potential to cause pollution if they reach the receiving waters. Potential sources of polluting substances include;

- Accidental spillage of oils/chemicals in or adjacent to watercourses;
- Accidental spillage of cement/ concrete in or adjacent to watercourses;
- Faecal contamination of watercourses due to ineffective treatment and disposal of wastewater drainage from site compound; and
- Construction plant and vehicle washing.

The proposed construction works will involve the use of plant and machinery, and may involve the temporary storage of construction materials, oils, fuels and chemicals. During the construction phase there is the potential for accidental spillage or release of construction materials, fuels or chemicals into nearby watercourses. It is also possible that residual contaminants post-construction may be mobilised by surface run-off and washed into the harbour.

The spillage of concrete during construction of structures can result in significant impact to watercourses altering the pH and smothering the stream bed. In addition, fresh concrete and cement are highly alkaline and therefore will affect water quality if washed into nearby watercourses. To mitigate this effect it is proposed that the proposed culvert structures, which will be constructed at or near existing watercourses will be installed as precast concrete units with in situ stitching to tie them together.

The use of cast in situ concrete in close proximity to watercourse requires precautionary measures. It is essential to ensure that the use of wet concrete and cement in or close to any water body is carefully controlled so as to minimise the risk of any material entering the water, particularly from shuttered structures or the washing of equipment.

Where in situ concrete is required, the control measures outlined in PPG 6 - Working at demolition & construction sites (Environment Agency, 2012), shall be adhered to. If on site concrete production is required, careful initial selection of a site for mixing facilities will be required, with a minimum of 100m required between the mixing facility and any adjacent watercourses or water bodies.

Where the use of pre-cast units is not possible, where in situ stitching is required or where concrete is to be placed under water or in tidal conditions, a specific fast-setting mix will be required to limit segregation and washout of fine material / cement. This will normally be achieved by having either a higher than normal fines content, a higher cement content or the use of chemical admixtures.

The use of oils and chemicals on-site requires significant care and attention. The following procedures will be followed to reduce the potential risk of oil or chemical spillage:-

- Fuel, oil and chemical storage will be sited on an impervious base within a bund and secured. The base and bund walls will be impermeable to the material stored and of adequate capacity. PPG 26 “Safe storage – drums and intermediate bulk containers” (Environment Agency, 2011a) shall be implemented to ensure safe storage of oils and chemicals.
- The safe operation of refuelling activities shall be in accordance with PPG 7 “Safe Storage – *The safe operation of refuelling facilities”* (Environment Agency, 2011b).
- With regard to potential oil spills during stream diversions or culvert placement works, emergency spill kit and oil spill containment equipment will be available in near proximity to the works.
- Guidelines for the protection of Fish during Construction Works in and adjacent to Waters (IFI, 2016); and
- A contingency plan for the construction phase shall be prepared by the Contractor in accordance with PPG 21 Pollution Incident Response Planning (Environment Agency, 2009).

Wastewater generated during the construction phase will be connected to an existing wastewater drainage system where available. Where this is not available wastewater shall be contained and disposed of at a suitable licensed facility. Run-off generated as a result of washing of construction plant and vehicles shall be discharged to a sediment pond.

Further measures for the protection of aquatic ecology from accidental spillages are outlined in **Chapter 10: Aquatic Ecology.**

9.7.1.3 Sediment

Potential sources of sediment loading during the construction phase include:-

- Construction within and adjacent to watercourses including the proposed culverts, stream diversions, attenuation ponds and outfalls;
- Erosion of newly constructed embankment works and stream diversion excavations; and
- Wash-out and erosion of exposed bare soils during normal earth movement and stockpiling.

Suspended solids can cause aquatic ecological issues including clogging fish gills, smothering spawning grounds, reducing light penetration for flora growth, and adding bacteria and algae to the water.

Stream diversions and the provision of culverts on existing watercourses are required at the locations presented in **Section 9.6.8**. The diversion works will include the removal of vegetation and the excavation of soil to form a new channel. The new channel will then be connected to the existing stream to allow for diversion of flow.

The locations of the proposed stream diversions, culvert works, attenuation ponds, and outfalls associated with the proposed road are included in **Volume 5 (DR Series)**.

There will be some construction work on the foreshore at Bloomfield, Lough Beg, and Ringaskiddy however these works will not fall within the boundary of Cork Harbour SPA or Lough Mahon.

Impacts associated with sediment loading during the construction phase could have an indirect impact outside of the proposed road due to the transportation of sediment. The discharge locations include Lough Mahon, Lough Beg and Cork Harbour at Ringaskiddy.

The risk to the receiving aquatic environment is assessed in **Chapter 10: Aquatic Ecology**.

Given the sensitivity of the receiving environment, appropriate erosion and sediment control measures will be required with due regard to best practice and to ensure there is no adverse impact during the construction phase. Mitigation and control measures to address the risk of impact from suspended sediments associated with construction activities follow best practice guidance and sound design principles. Contractors shall implement best practice and relevant guidance to ensure silt laden or contaminated surface water run-off from the entire construction site; i.e. site compound, proposed roads, proposed road upgrades and service area, does not discharge directly to nearby watercourses.

Sediment control measures incorporated during the construction phase will be consistent with the following guidance:-

- Technical Guidance C648: Control of Water Pollution from Linear Construction Projects, (CIRIA, 2006);
- Technical Guidance C532: Control of Water Pollution from Construction Sites: Guidance for Consultants and Contractors (CIRIA, 2001);

- Guidelines for the protection of Fish during Construction Works in and adjacent to Waters (IFI, 2016); and
- PPG 6 Working at demolition & construction sites (Environment Agency, 2012).

The following water quality control measures shall be implemented during construction:

- The construction of culverts and diversion of streams will be carried out during dry weather/ low flow periods.
- Run-off from stockpiles will be collected via a shallow toe drain which will discharge to a settlement pond. Settlement ponds will be designed and sized to adequately attenuate suspended solid run-off from stockpile areas. Sediment build-up will be removed at regular intervals by manual means only and will be treated at an appropriately authorised waste management facility.
- Existing and proposed surface water drainage and discharge points shall be mapped on a site plan including the location of existing and proposed measures such as monitoring points, sediment traps, settlement lagoons and hydrocarbon separators.
- Excavations for foundations and piles will be carried out so as to minimise sediment run off.

The construction of culverts and stream diversions will be carried out in line with the guidelines and standards of Transport Infrastructure Ireland (TII) and Inland Fisheries Ireland (IFI). Further mitigation measures for the protection of the aquatic environment are described in **Chapter 10: Aquatic Ecology.**

Generally, culverts will be installed at the existing stream gradient otherwise they may result in a change in water velocities which may create a drop below the culvert or may create a hydraulic jump at the end of the culvert. The culverts will be installed so that it has a constant slope through its length. Stream diversions will be excavated in isolation of stream flow, starting from the downstream end of the diversion channel and working upstream to minimise sediment production.

Section 10.5.1.4 and **Section 10.5.1.5** in **Chapter 10: Aquatic Ecology** details further the mitigation measures required for culverts and stream diversions respectively.

9.8 RESIDUAL IMPACTS

No significant residual impacts are expected on hydrological regimes.

9.9 MONITORING

Monitoring required to ensure the protection of surface water and groundwater is discussed in **Chapter 10: Aquatic Ecology** and **Chapter 11: Soils, Geology and Hydrogeology** respectively.

10 AQUATIC ECOLOGY

10.1 INTRODUCTION

10.1.1 Scope and Objectives

This chapter assesses the potential impact of the proposed M28 Road Project on water quality and aquatic ecology. This assessment included a desktop and walkover study, field assessment of baseline ecology, liaison with the design team and stakeholders, identification of potential impacts, and development of mitigation measures.

The proposed route comprises a motorway from the N40 South Ring Road, Bloomfield Interchange to Barnahely with a single-carriageway from Barnahely to the eastern side of Ringaskiddy and a Service Area (refer to **Chapter 3: Description of the Proposed Road Development** for full details of the project description). The projects Zone of Influence (ZoI) includes the sub-catchments and catchment in which it sits as defined by the Environmental Protection Agency for the purposes of the Water Framework Directive, and further to downstream receptors in the marine environment, including designated sites (See **Figure 10.1**).

10.2 METHODOLOGY

The assessment methodology is based primarily upon the *National Road Authority Guidelines for Assessment of Ecological Impacts of National Road Schemes*, Revision 2 (NRA, 2009), and the baseline ecological survey methodology is based on the NRA *Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna on National Road Schemes* (NRA, 2008).

The assessment had regard to the following publications:-

- DHPCLG (2017). Public Consultation on the River Basin Management Plan for Ireland (2018-2021);
- CIEEM (2016). Guidelines for Ecological Impact Assessment in the UK and Ireland – Terrestrial, Freshwater and Coastal. 2nd Edition;
- IFI (2016). Requirements for the protection of fisheries habitat during construction and development works at river;
- EPA (2015a). Draft Revised Guidelines on the Information to be contained in Environmental Impact Statements;
- EPA (2015b). Draft Advice Notes for preparing Environmental Impact Statement;
- Transport Infrastructure Ireland (2015). Road Drainage and the Water Environment (including Amendment No. 1 dated June 2015);
- NPWS (2013). The Status of EU Protected Habitats and Species in Ireland, Volumes 1-3;
- NRA (2009). Guidelines for the Assessment of Ecological Impacts of National Road Schemes Revision 2;
- NRA (2008a). Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna on National Road Schemes;
- NRA (2008b). Guidelines for the crossing of Watercourses during the construction of national road schemes;

- EC (2007). Interpretation Manual of European Union Habitats. Version EUR 27;
- CIRIA (2006). Control of water pollution from linear construction projects;
- EPA (2003). Advice Notes on current practice in the preparation of Environmental Impact Statements;
- EPA (2002). Guidelines on the information to be contained in Environmental Impact Statements;
- EC (2002). Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg, and
- EC (2000). Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg.

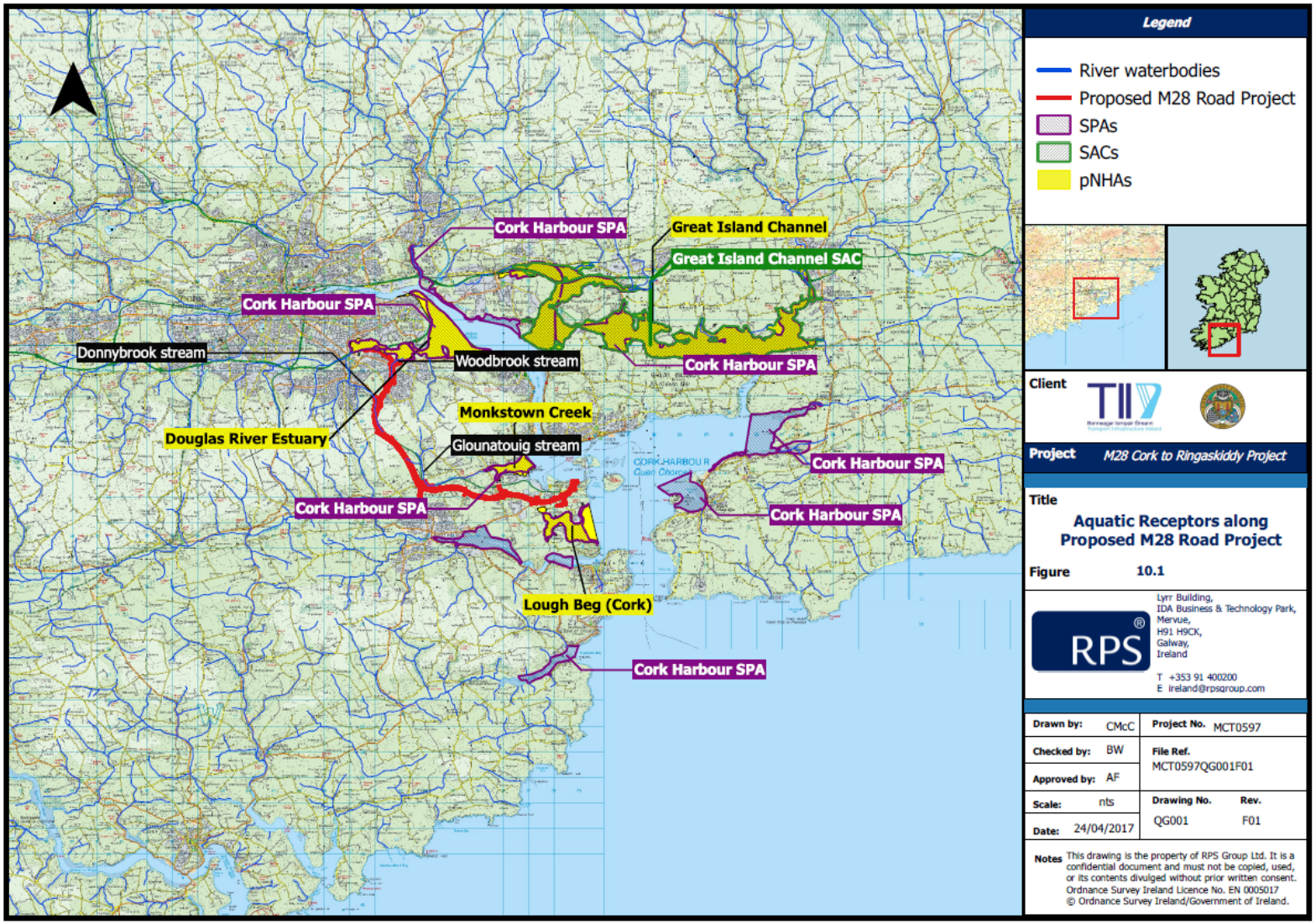
Aquatic surveys and the assessment of impacts were also carried out with regard to the following key legislation:-

- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (referred to hereafter as the Habitats Directive);
- Directive 2009/147/EC (codified version of Directive (79/409/EEC as amended (referred to hereafter as the Birds Directive);
- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy (referred to here after as the Water Framework Directive (WFD));
- European Communities (Birds and Natural Habitats) Regulations 2011 (as amended);
- European Communities (Water Policy) Regulations (S.I. No. 722 of 2003);
- European Union (Water Policy) Regulations (S.I. No. 350 of 2014);
- European Communities (Environmental Impact Assessment) Regulations, S.I. No. 349 of 1989 (as amended);
- European Communities (Environmental Liability) Regulations, 2008 (S.I. No. 547 of 2008);
- European Communities (Surface Waters) Regulations (S.I. No. 272 of 2009)(as amended by S.I. No. 327 of 2012, and S.I. No. 386 of 2015);
- European Communities (Quality of Salmonid Waters) Regulations, S.I. No. 293 of 1988;
- Planning and Development Act, No. 30 of 2000 (as amended);
- The Local Government (Water Pollution) Act, 1977 (as amended) (and associated Regulations); and
- The Wildlife Act 1976 (as amended).

The methodology comprises of the following elements:-

- Desktop Study;
- Consultation; and
- Field Assessments.

Figure 10.1: Aquatic Receptors within the ZoI of the Proposed M28 Road Project



10.2.1 Desktop Study

As part of the desktop study, the following resources were reviewed:-

- Design descriptions and drawings for the proposed M28 Road Project;
- Maps and aerial photography of the study area and relevant associated watercourses;
- Site synopses, conservation objectives and qualifying interests data for designated areas;
- Scoping comments from IFI (see Section 10.2.2);
- Scoping comments from the Department of Arts, Heritage and the Gaeltacht (DAHG) (now known as Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs (DAHRRGA)) (refer to Chapter 6: Non Statutory Consultation)1;
- A wide range of guidelines and best practice published by the NRA and IFI on the aquatic environment;
- A range of peer-reviewed literature and reports of scientific research carried out in Ireland and internationally in relation to potential impacts of similar works on aquatic ecology and resources;
- A wide range of guidelines and best practice published by the Office of Public Works (OPW) regarding the potential environmental impacts of drainage on the aquatic environment with particular reference to:
  - Environmental Management Protocols April 2011; and
  - Environmental Drainage Maintenance Guidance Notes (10 Steps to Environmentally Friendly Maintenance) April 2011.
- Various online resources including:-
  - EPA, Envision Mapping: http://maps.epa.ie/InternetMapViewer/mapviewer.aspx
  - Geological Survey of Ireland (GSI) online mapping: http://www.gsi.ie/mapping.htm
  - IFI WFD reports (www.wfdfish.ie), and Codes of practice, operating procedures and environmental guidelines (http://www.fisheriesireland.ie/Fisheries-management/fisheries-management.html
  - National Biodiversity Data Centre (NBDC) Live Maps: http://www.biodiversityireland.ie/biodiversity-data/access-biodiversity-data/
  - NPWS Maps and Data: http://www.npws.ie/mapsanddata/
  - Ordnance Survey Ireland Map viewer: http://maps.osi.ie/publicviewer/#V1,591271,743300,0,10
  - Water Matters or WFD site for the 1st cycle River Basin Management Plans: http://www.wfdireland.ie/
  - EPA Catchments Website – for the 2nd cycle River Basin Management Planning www.catchments.ie

10.2.2 Consultations

As part of the EIS Scoping Assessment, non-statutory informal consultation was undertaken with EIA statutory consultees including the Development Applications Unit (DAU) of the DAHRRGA, IFI, EPA and the OPW. Consultation responses in relation to the aquatic environment are summarised below in **Table 10.1**.

[1] Now Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs (DAHRRGA).

Table 10:1: Aquatic Ecology Non-Statutory Informal Consultation Responses and Issues Raised

Proposed M28 Road Project EIA Scoping Response Summary Table			
Organisation	**Date**	**Form of Consultation**	**Responses and Key Issues Raised by Consultees**
DAU	17/02/2015	Email	Acknowledgement only.
NPWS	11/06/2014	Meeting with NPWS: Southern Division Ecologist, Ranger and District Conservation Officer.	A meeting was held with the EIS Project Manager and members of the NPWS to discuss the proposed road project and potential impacts on ecological receptors in the vicinity of the proposed road project. No aquatic ecology constraints were identified, with the exception of otter (see **Chapter 12: Terrestrial Ecology**).
NPWS	18/02/2015	Email	Based on the Carr's Hill Interchange proposals advise that it is likely that the DAHG will recommend otter and bat surveys of the entire Donnybrook Stream (discussed further in **Chapter 12: Terrestrial Ecology**).
EPA	23/02/2015	Email	Acknowledgement only.
IFI	19/02/2015	Email	Acknowledgement only.
IFI	23/02/2015	Phone Correspondence	Phone correspondence with IFI prior to biological surveys. IFI recommended Q-Values and Habitat Assessment for the Woodbrook, Donnybrook and Glounatouig streams and also on two ephemeral streams located at the northern end of the 'The Heights' housing estate in Mount Oval west of Rochestown Bridge.
IFI	24/02/2015	Email	In relation to road proposals at Carr's Hill – IFI recommended an electrofishing survey and asked to be provided with the results. IFI advised that if fish were present in the stream, the design as proposed in relation to the culverting would be unsatisfactory. It was requested that an alternative approach of diverting the Donnybrook Stream to the west of proposed roadway and provision of one culvert to the south of the interchange be explored and that a meeting to discuss alternative design details would be recommended.
IFI	02/03/2015	Email	IFI advised that based on available information at the time, the preferred route option had the potential to interfere with both the Donnybrook and Glounatouig streams and tributaries. IFI recommended electrofishing surveys in both streams and to revert to IFI with survey results. In relation to the Donnybrook Stream, IFI advised that Carr's Hill Interchange proposals are far from satisfactory and if fish are deemed to be present then IFI suggests an alternative proposal (as per previous email 24/02/2015). IFI requested a meeting to discuss detailed design and timing of works.

Proposed M28 Road Project EIA Scoping Response Summary Table			
Organisation	**Date**	**Form of Consultation**	**Responses and Key Issues Raised by Consultees**
			In the case of the Glounatouig Stream and its tributaries, IFI advised that the information as submitted was not detailed enough to assess impacts and therefore requested RPS to revert when greater footprint information was available. Recommended in all cases that any instream works or works liable to increase suspended solids level of a waterbody above ambient level should be limited to the period of May to September. IFI also recommended in all cases that any instream works or works liable to increase suspended solids levels of a water body above ambient level should be limited to the period of May to September.
IFI	02/11/2015	Email	IFI advised that the Donnybrook Stream upstream of "Carr's Hill Underbridge" should be diverted at a right angle and then carried in open channel (newly constructed to fishery design spec) to the west of the proposed new carriageway. This would minimise the impact. IFI noted that the new road appears to avoid the Glounatouig Stream with the exception of a crossing over a tributary (Site 4) which has limited fisheries potential upstream of the crossing point.
IFI	03/05/2017	Meeting	This meeting focused on the drainage design and further requirements for consultation with IFI in the event that planning is granted.
South Western River Basin District (SWRBD)	20/02/2015	Email	Advised the EPA should be consulted in respect of the matter. An acknowledgement was received from the EPA.

10.2.3 Field Assessments

10.2.3.1 Study Site Selection

All watercourses that were identified within the study area of the proposed road project were reviewed using Arc GIS with Ordnance Survey 1:50,000 discovery series mapping. Potential impact sites e.g. at proposed new underbridges or over bridges and at areas where culverting or stream diversions were proposed, were selected for survey. Detailed site notes and photographs for fisheries assessments and targeted biological surveys were recorded at all selected sites. The locations where aquatic surveys were undertaken are shown in **Figure 10.2**, while electrofishing survey sites are shown in **Figure 10.4**.

10.2.3.2 Habitat Assessments

The general physical characteristics and hydromorphological features of each site were recorded including substrate, flow types and aquatic vegetation during surveys. All sites were assessed in terms of:-

- Stream width and depth;
- Substrate type, listing substrate fractions in order of dominance, i.e. large rocks, cobble, gravel, sand, mud etc.;
- Flow type, listing sampling area type, e.g., riffle, glide and pool;
- Instream vegetation, listing plant species occurring and their percentage coverage of the stream bottom at the sampling site;
- Dominant bankside vegetation, listing the main species overhanging the stream;
- Estimated cover by bankside vegetation, and estimated shading of the sampling site, and
- The degree of siltation was recorded on a scale of clean, slight, moderate and heavy, prior to kick sampling.

Grid references were recorded at all sites using a GPS and site photographs were taken using a digital camera.

10.2.3.3 Criteria Used for Assessment of Salmonid Habitat Quality

Each site surveyed was assessed in terms of its salmonid habitat quality. A habitat section within each site was rated for its potential to support the different life stages of salmonid fish (trout and salmon) based on the physical and hydromorphological features listed above, and following Bjorn and Reiser (1991[2])**.** NRA (2008a) was also adhered to. The more diverse the stream habitat in terms of substrate, flow rate, depth, riparian vegetation, light conditions etc., the richer the biological community is likely to be, and the more suitable it is likely to be for salmonid fish. Assessment of the quality of salmonid spawning habitat, nursery habitat and adult habitat is based on personal expertise and on published information from Bjorn and Reiser (1991) such as the following:-

- Favourable locations for salmon spawning are likely to occur where the gradient of a river is 3% or less;
- Typical spawning sites are the transitional areas between pool and riffle where flow is accelerating and depth decreasing, where gravel of suitable coarseness is present and interstices are kept clean by up-welling flow;
- Salmon fry and parr occupy shallow, fast-flowing water with a moderately coarse substrate with cover;
- Deep or slow-moving water, particularly when associated with a sand or silt substrate, does not support resident juvenile salmonids;
- Suitable cover for juveniles includes areas of deep water, surface turbulence, loose substrate, large rocks and other submerged obstructions, undercut banks, overhanging vegetation, woody debris lodged in the channel, and aquatic vegetation; and

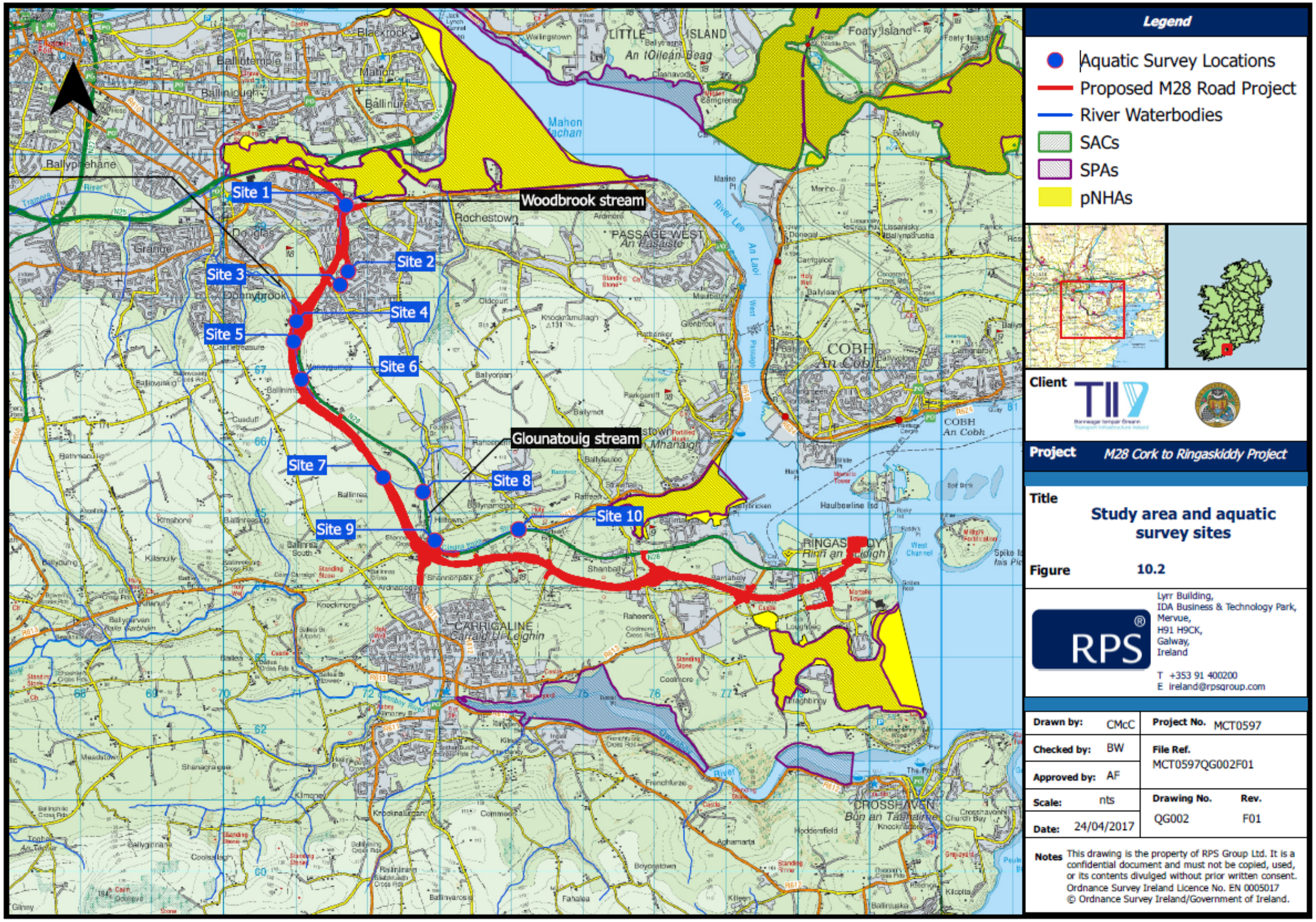
[2] Bjorn, T.C. and D.W. Reiser, 1991. Habitat Requirements of salmonids in streams. Pages 83-138 in W.R. Meehan, editor. Influences of Forest and Rangeland Management on salmonid fishes and their habitats. Special publication 19. American Fisheries Society.

- The juxtaposition of habitat types is also important. The proximity of juvenile habitat to spawning gravels may be significant to their utilisation. In addition, adults require holding pools immediately downstream of spawning gravels in which they can congregate prior to spawning. Cover for adult salmon waiting to migrate or spawn can be provided by overhanging vegetation, undercut banks, submerged vegetation, submerged objects such as logs and rocks, floating debris, deep water and surface turbulence (Bjorn and Reiser, 1991).

The rating of survey sites for salmonid spawning, nursery and adult habitat potential was on a scale of None/ Poor/ Fair/ Good/ Very Good/ Excellent which is broadly based on a qualitative procedure described by Kennedy (1984). This rating assesses the physical suitability of the habitat; the presence/absence/density of salmonids at the site will also depend on present and historical water quality and accessibility of the site to fish. A rating of "none" indicates that the ecologist carrying out the assessment regards it as impossible that the stream could support salmonid fish in the relevant life stage. A rating of "None - Poor" indicates that it is regarded as possible but extremely unlikely that the stream could support salmonid fish in the relevant life stage.

Habitat suitability assessments can be undertaken throughout the year for salmonids. Electrofishing surveys are recommended between July to end of September.

Figure 10.2: Aquatic Survey Sites along the Proposed M28 Road Project



10.2.3.4 Criteria Used for Assessment of Lamprey Habitat Quality

Each stream habitat section was also rated for its quality to support lamprey following Maitland (2003[3]). Lamprey habitat preferences change with the stages of their life cycle. They show a preference for gravel-dominated substratum for spawning. After hatching, lamprey larvae (ammocoetes) swim or are washed downstream by the current to areas of sandy silt in still or slow flowing water where they burrow and spend the next few years in tunnels. Lampreys therefore require mainly silt and sand dominated substratum for nursery habitat. Other important environmental characteristics for optimal ammocoete habitat are shallow waters with low water velocity, and the presence of organic detritus and/or plant material. Suboptimal habitat supporting only a few individuals may consist of a few square centimetres of suitable silt in an open, comparatively high-velocity, boulder-strewn streambed. Spate rivers with high flow velocities tend to support fewer ammocoetes because they contain smaller areas of stable sediment.

Manual searches for juvenile lamprey are possible during November through to end of April, while electrofishing surveys are recommended between May and end of September.

10.2.3.5 Benthic Macroinvertebrate Sampling

Benthic macroinvertebrate samples were collected at 8 of the 10 sites selected for survey. Two sites were not possible to sample due to a dry stream bed and overgrowth at Site 2 and extremely steep slopes with dense overgrowth at Site 8 preventing access to the site. Samples were taken using a 2-minute 'kick' sampling method in the fast flowing (riffle) areas of the streams/rivers using a standard hand net (250 mm width, mesh size 1 mm). The survey technique adhered to the ISO Standard (10870:2012) for kick sampling, NRA Survey Guidelines (NRA, 2008a) and utilised the EPA standard protocol and recording sheet. Stone washing was undertaken to ensure that species that cling to stone surfaces – e.g. leeches and gastropods, were adequately collected. Macroinvertebrate were identified at the stream bank and returned to the stream on completion of analysis. The optimal survey period for macroinvertebrates is between March and end of September, however Irish research has shown that Q values remain largely consistent across seasons (Spring, Summer and Autumn) with few sites moving between status classes (Kelly-Quinn et al., 2005).

The Biotic Index of Water Quality (BIWQ), better known as the Q-value, was developed in Ireland by the EPA. Q-values and water quality classes are assigned using a combination of habitat characteristics and structure of the macroinvertebrate community within the water body. Individual macroinvertebrates are ranked for their sensitivity to organic pollution and the Q-value is assessed based, primarily, on their relative abundance within a biological sample. The EPA's Q-rating, water quality status class and corresponding WFD status classification is presented in **Table 10.2**.

The Environmental Quality Ratio or EQR represents the relationship between the values of the biological parameters observed for a given body of surface water and the values for these parameters in the reference conditions applicable to that body. The ratio is expressed as a numerical value between zero and one, with high ecological status represented by values close to one and bad ecological status by values close to zero. In Ireland it is calculated as Observed Q-value/Reference Q-value (i.e., Q5). The EQR allows comparison of water quality status across the European Union as each member state has an EQR value for 'High'; 'Good' etc., based on an inter calibration of boundaries between water quality categories e.g., 'High-Good'; 'Good–Moderate'.

[3] Maitland, P.D. 2003.. Ecology of the River, Brook and Sea Lamprey. Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

Table 10:2: EPA Q-Rating and Equivalent WFD Water Quality Status Classes

Q-rating	EQR[4]	EPA Quality Status	Water Quality	WFD Status
Q5	1.0	Unpolluted	Good	High
Q4-5	0.9	Unpolluted	Fair-to-Good	High
Q4	0.8	Unpolluted	Fair	Good
Q3-4	0.7	Slightly Polluted	Doubtful-to- Fair	Moderate
Q3	0.6	Moderately Polluted	Doubtful	Poor
Q2-3	0.5	Moderately Polluted	Poor-to-Doubtful	Poor
Q2	0.4	Seriously Polluted	Poor	Bad
Q1-2	0.3	Seriously Polluted	Bad-to-Poor	Bad
Q1	0.2	Seriously Polluted	Bad	Bad

10.2.3.6 Electrofishing Survey

The following steps were undertaken in order to assess fish stocks within the watercourses within the ZoI of the project:-

- A Section 14 licence from the Department of Communications, Energy and Natural Resources (DCENR) for an electro-fishing stock assessment was obtained;
- All biosecurity protocols as submitted to and agreed with the DCENR were followed during surveying;
- Surveys were carried out using a Safari Back Pack electro-fishing unit;
- Five sites were surveyed in total;
- Approximately 70-80m were surveyed at each site;
- Captured fish were held in a large container of oxygenated water, and
- After processing, fish were allowed to fully recover and were then returned to the water.

10.2.4 Ecological Valuation Criteria for Aquatic Resources

Values were assigned to the receiving watercourses on the basis of their known (or perceived) rarity, status and distribution. This involved consideration of contextual information for the resource at a geographic level (NRA, 2009[5]).

Observations and biological sampling results were assessed in the context of national trends, guidelines and standards and EU (WFD) standards as appropriate. In the absence of any standards or guidelines, scientific literature was consulted for direction. **Table 10.3** details the Ecological valuation of Aquatic Resources (NRA, 2009), which identifies the criteria which can be used to evaluated the ecological importance of natural resources such as surface waters. This classification approach was adopted in this chapter.

[4] EQR = Environmental Quality Ratio (Observed/Reference). As per European Communities (Surface Water) Regulations, S.I. No. 272 of 2009.
[5] NRA (2009). Guidelines for the Assessment of Ecological Impacts of National Road Schemes Revision 2. National Roads Authority.

Table 10:3: Ecological Valuation Criteria for Aquatic Resources (from NRA, 2009)

Relevant Criteria	Classification
International Importance: 'European Site' including Special Area of Conservation (cSAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation. Features essential to maintaining the coherence of the Natura 2000 Network. Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive. Resident or regularly occurring populations (assessed to be important at the national level) of species of animal and plants listed in Annex II and/or IV of the Habitats Directive. Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988). Major salmon river fisheries	**A**
National Importance: Site designated or proposed as a Natural Heritage Area (NHA). Statutory Nature Reserve. Refuge for Fauna and Flora protected under the Wildlife Acts. National Park. Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park. Resident or regularly occurring populations (assessed to be important at the national level) of species protected under the Wildlife Acts; and/or; species listed on the relevant Red Data list. Site containing 'viable areas' of the habitat types listed in Annex I of the Habitats Directive. Major trout river fisheries Commercially important coarse fisheries Waterbodies with high amenity value.	**B**
County Importance: Area of Special Amenity. Area of High Amenity, or equivalent, designated under the County Development Plan. Resident or regularly occurring populations (assessed to be important at the County level) of species of animal and plants listed in Annex II and/or IV of the Habitats Directive, and/or; species protected under the Wildlife Acts; and/or; species listed on the relevant Red Data list. Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance.	**C**
Local Importance (higher value): Locally important populations of priority species or habitats or natural heritage features identified in the Local Biodiversity Action Plan (BAP), if this has been prepared; Resident or regularly occurring populations (assessed to be important at the Local level) of species of animal and plants listed in Annex II and/or IV of the Habitats Directive, and/or; species protected under the Wildlife Acts; and/or; species listed on the relevant Red Data list. Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality; Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value. Sites of 'High' water quality status (Q4-5, Q5) Water body with some fisheries values and potential salmonid habitat.	**D**
Local Importance (lower value): Sites containing small areas of semi-natural habitat that are of some local importance for wildlife. Sites or features containing non-native species that are of some importance in maintaining habitat links. Water body with no fisheries value and poor fisheries habitat.	**E**

10.2.5 Compliance with the Water Framework Directive (2000/60/EC)

The potential for the proposed M28 Road Project to impact upon water quality is assessed in the context of the EU WFD (Directive 2000/60/EC). The WFD established a framework for the management of water resources throughout the EU. The WFD overarching goal is to achieve at least good ecological status and good chemical status for all surface waters by 2015, or by 2021/2027 via extended deadlines. The WFD aims are specified in Article 1:-

- Prevent further deterioration and protect and enhance the status of aquatic ecosystems and associated wetlands;
- Promote the sustainable consumption of water;
- Reduce pollution of waters from priority substances and phasing out of priority hazardous substances; and
- Prevent the deterioration in the status and to progressively reduce pollution of groundwater
- Contribute to mitigating the effects of floods and droughts.

The WFD established four core environmental objectives to be achieved for surface waters which include rivers, lakes, transitional and coastal waters (out to 1 nautical mile):-

- Prevent deterioration;
- Protect, enhance and restore good status by 2015;
- Protect and enhance artificial and heavily modified water bodies (aim to achieve Good Ecological Potential and good surface water chemical status); and
- Progressively reducing pollution from priority substances and ceasing or phasing out emissions, discharges and losses of priority hazardous substances.

In addition, the WFD requires achievement of compliance with any standards and objectives for protected areas set by other legislation i.e. designated under the Bathing Water Directive, the Shellfish Water Directive, the Drinking Water Directive, the Urban Waste Water Treatment Directive and the Habitats and Birds Directives.

The Department of Housing, Planning, Community and Local Government (DHPCLG) set the environmental objectives for each water body, based on the scientific evidence, extensive surface water quality monitoring, and risk characterisation undertaken by the EPA. While there is currently no licensing requirement for discharges from roads to surface waters, the Surface Water Regulations place duties on public authorities to promote the requirements of the regulations and requires that sources of pollution are controlled so as to prevent or limit the input of pollutants[6]. The impact assessment presented in this chapter has reviewed the outcomes of the monitoring and characterisation processes undertaken by the EPA for the waters within the ZoI of the proposed road project, and has incorporated the findings into the impact assessment for this project.

More stringent requirements may apply to specific water bodies, in particular those within areas designated as SACs or SPAs. Given that all the relevant watercourses (streams and rivers) within the study area are not part of any SAC or SPA, but are however directly hydrologically connected to the downstream SPA of Cork Harbour and support remote connectivity to Great Island Channel SAC via Lough Mahon, the impact assessment and mitigation outlined was strongly influenced by this factor.

[6] P.8 TII (2015). http://www.tiipublications.ie/library/DN-DNG-03065-02.pdf

The environmental objective for these waters is good status, as per the Draft River Basin Management Plan for Ireland 2018 – 2021.

10.2.6 Impact Assessment

The information gathered from the desktop study, non-statutory informal consultations and field assessments have been used to make an ecological impact assessment (EcIA) of the proposed M28 Road Project upon the identified ecological receptors (ER). The EcIA has been undertaken following the methodology set out in CIEEM (2016), and with regard to the Draft Revised Guidelines on Information to be contained in Environmental Impact Statements (EPA, 2015a). EcIA is based upon a source-pathway-receptor model, where the source is defined as the individual elements of the proposed road project that have the potential to affect identified ERs. The pathway is defined as the means or route by which a source can affect the ERs. A receptor or ER is defined as the species, habitat or ecologically functioning unit of natural heritage importance. Each element can exist independently however an effect is created where there is a linkage between the source, pathway and feature/receptor.

A significant effect is defined in CIEEM (2016) as:-

> *"An effect that is sufficiently important to require assessment and reporting so that the decision maker is adequately informed of the environmental consequences of permitting a project. A significant effect is a positive or negative ecological effect that should be given weight in judging whether to authorise a project: it can influence whether permission is given or refused and, if given, whether the effect is important enough to warrant conditions, restrictions or further requirements such as monitoring".*

The methodology for the assessment of impacts which was employed for this chapter is derived from and uses the terminology of Section 3.7 of the EPA Draft Guidelines (2015a), while also having regard to Section 5 of CIEEM (2016). When describing changes/activities and impacts on ecosystem structure and function, reference will be made to the following parameters (CIEEM, 2016):-

- ***Positive or negative***: Positive and negative impacts/effects are determined according to whether the change is in accordance with nature conservation objectives and policy e.g. improves the quality of the environment or reduces the quality of the environment (similar to *Quality of Effects*, EPA 2015a);
- ***Extent:*** The spatial or geographical area over which the impact/effect may occur (similar to *Magnitude of Effects*, EPA 2015a);
- ***Magnitude:*** 'Magnitude' refers to size, amount, intensity and volume. It should be quantified if possible and expressed in absolute or relative terms (similar to *Magnitude of Effects*, EPA, 2015a);
- ***Duration:*** 'Duration' is defined in relation to ecological characteristics as well as human timeframes e.g. five years, which might seem short-term in the human context or that of other long-lived species, would span at least five generations of some invertebrate species. The duration of an activity may differ from the duration of the resulting effect caused by the activity. Effects may be described as short, medium or long-term and permanent or temporary. Short, medium, long-term and temporary will need to be defined in months/years (similar to *Duration of Effects*, EPA, 2015a);

- ***Frequency and timing:*** The number of times an activity occurs will influence the resulting effect. The timing of an activity or change may result in an impact if it coincides with critical life-stages or seasons (similar to *Magnitude of Effects*, EPA, 2015a);
- ***Reversibility:*** An irreversible effect is one from which recovery is not possible within a reasonable timescale or there is no reasonable chance of action being taken to reverse it. A reversible effect is one from which spontaneous recovery is possible or which may be counteracted by mitigation. In some cases, the same activity can cause both reversible and irreversible effects (similar to *Duration of Effects*, EPA, 2015a).

Section 3.7 of the Draft EPA Guidelines (2015a) provides definitions of impacts as per **Table 10.4** below and these descriptions have been utilised in this impact assessment in **Section 10.4**.

Table 10:4: Definitions of Impacts (as per EPA, 2015a)

Quality of Effects	
Positive	A change which improves the quality of the environment
Neutral	A change which does not affect the quality of the environment
Negative / adverse	A change which reduces the quality of the environment
Significance of Effects	
Imperceptible	An effect capable of measurement but without noticeable consequences.
Not Significant	An effect which causes noticeable changes in the character of the environment but without noticeable consequences.
Slight Effects	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate Effects	An effect that alters the character of the environment in a manner that is consistent with existing and emerging trends.
Significant Effects	An effect which, by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant Effects	An effect which, by its character, magnitude, duration or intensity significantly alters the majority of a sensitive aspect of the environment.
Profound Effects	An effect which obliterates sensitive characteristics.
Magnitude of Effects	
Extent	Describe the size of the area, the number of sites, and the proportion of a population affected by an effect
Duration	Describe the period of time over which the effect will occur
Frequency	Describe how often the effect will occur (once, rarely, occasionally, frequently, constantly- or hourly, daily, weekly, monthly, annually)
Context	Describe whether the extent, duration, or frequency will confirm or contrast with established (baseline) conditions
Probability of Effects	
Likely Effects	The effects that can reasonably be expected to occur as a result of the planned project if all mitigation measures are properly implemented
Indeterminable Effects	When the full consequences of a change in the environment cannot be described
'Worst case' Effects	The effects arising from a project in the case where mitigation measures substantially fail
Duration of Effects	
Momentary	Effects lasting from seconds to minutes

Brief	Effects lasting less than a day
Temporary	Effects lasting less than a year
Short-term	Effects lasting one to seven years
Medium-term	Effects lasting seven to fifteen years
Long-term	Effects lasting fifteen to sixty years
Permanent	Effects lasting over sixty years
Types of Effects	
Cumulative Effects	The addition of many small effects to create one larger, more significant, effects
'Do Nothing Effects'	The environment as it would be in the future should no project of any kind be carried out
Indeterminable Effects	When the full consequences of a change in the environment cannot be described
Irreversible Effects	When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost
Residual Effects	The degree of environmental change that will occur after the proposed mitigation measures have taken effect
Synergistic Effects	Where the resultant effects is of greater significance than the sum of its constituents
Indirect Effects	Effects that arise off-site or are caused by other parties that are not under the control of the developer (such as a quarry)
Secondary Effects	Effects that arise as a consequence of a project (a new waste water treatment plant will reduce the yield of mussels in a nearby estuary)

10.2.7 Timing of Surveys

RPS ecologists have undertaken walkover surveys of the study area between 2016-2017. Site specific aquatic surveys were undertaken by RPS Ecologists on the 26th and 27th February, 2015. In addition, and following acquisition of an electrofishing licence (from the DCENR), an electrofishing survey was carried out on the Woodbrook, Donnybrook and Glounatouig Streams by Dixon-Brosnan Consultants in September 2015.

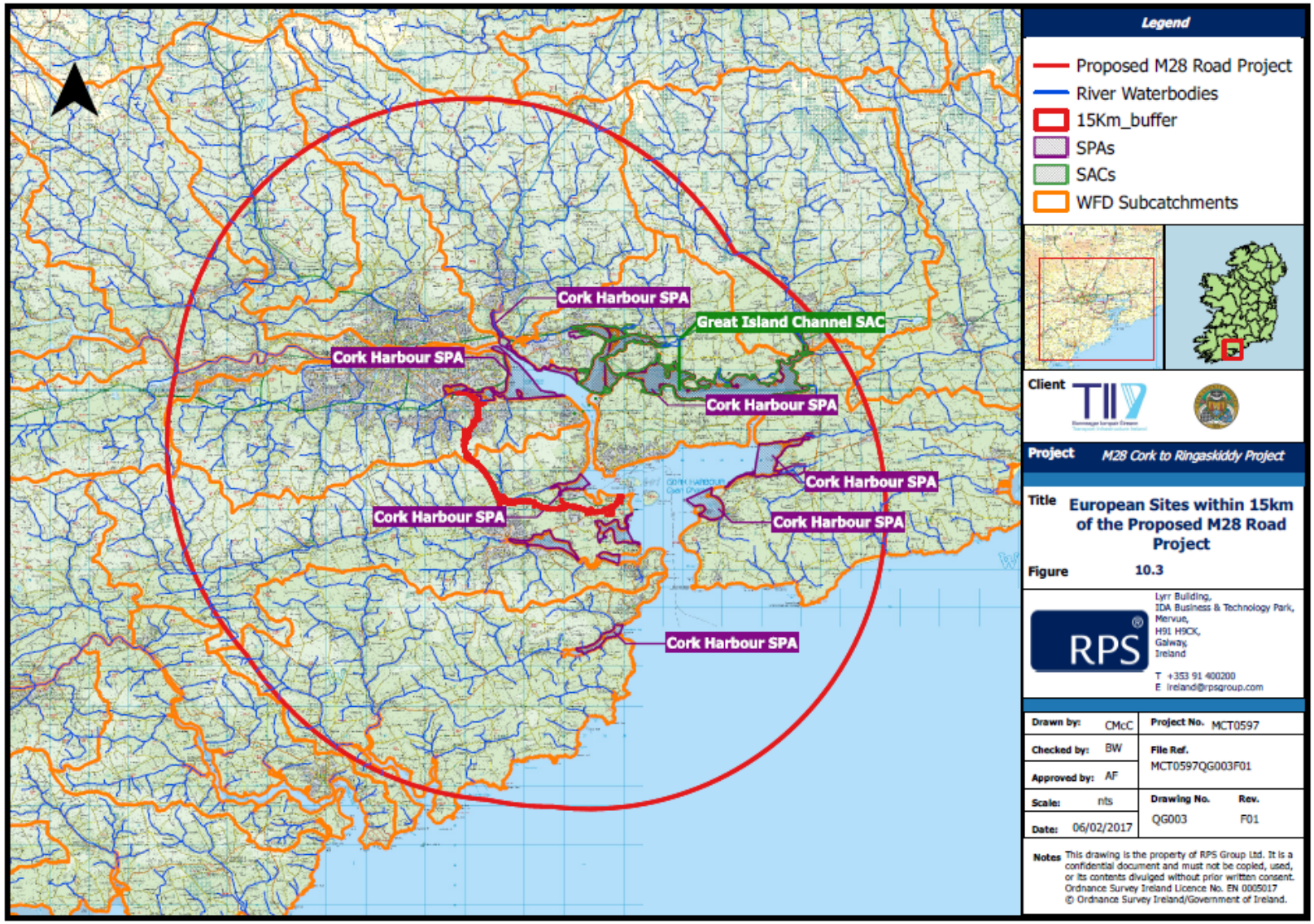
10.3 RECEIVING ENVIRONMENT

10.3.1 Designated Sites

The proposed road project is not located within any site designated for nature conservation. It is located within 15km of two European Sites (see **Figure 10.3**):-

- Cork Harbour SPA (Site Code: 004030), and
- Great Island Channel SAC (Site Code: 001058).

Figure 10.3: European Sites within 15km of the Proposed M28 Road Project



SPAs are designated under the EU Birds Directive to protect the habitat of rare and vulnerable species (listed under Annex I of the Directive) and to protect wetland habitats which attract large numbers of migratory birds on a regular basis. Such sites are deemed of international importance where they support 1% or more of the population of a species, or where more than 20,000 birds regularly use the site.

Cork Harbour SPA is of international importance for wintering waterfowl as it regularly supports in excess of 20,000 birds and is one of the top five wintering sites in the country. It supports internationally important numbers of redshank (5 year mean = 1,614) along with nationally important numbers of a further 15 species[7]. A nationally important common tern (Annex I listed) breeding colony (maximum of 102 pairs in 1995) is also present, and in addition the site hosts numerous Annex I listed species (including whooper swan, golden plover, bar-tailed godwit, ruff and little egret)[8]. The proposed road project is located approximately 70m from the boundary of the SPA at its closest point located immediately south of the N40 Bloomfield Interchange.

The Great Island Channel SAC stretches from Little Island to Middleton, with its southern boundary formed by Great Island. The site is of major importance for two habitats listed on Annex I of the E.U. Habitats Directive i.e. mudflats and sand flats not covered by seawater at low tide and Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*), as well as for its important numbers of wintering waders and wildfowl[9]. The proposed road project is located approximately 5.3km from the boundary of the SAC at its closest point, north-east of the N40 Bloomfield Interchange. Unlike Cork Harbour SPA, the Great Island Channel SAC is separated from the proposed road project by a body of water, Lough Mahon, therefore the proposed road project area is not directly hydrologically connected to the Great Island Channel SAC but rather remotely via Lough Mahon.

There are four pNHAs (designated under the Wildlife (Amendment) Act 2000) that are within a 15km buffer of the study area and are hydrologically connected to the study area (**Figure 10.1:** These pNHAs are: -

- Douglas River Estuary pNHA (Site Code: 001046);
- Monkstown Creek pNHA (Site Code: 001979);
- Lough Beg pNHA (Site Code: 001066), and
- Great Island Channel pNHA (Site Code: 001058).

The Douglas River Estuary pNHA is fed by the Woodbrook and the Donnybrook Streams which drain the study area to the north. The Glounatouig Stream drains the southern and eastern stretches of the study area and supports connectivity to Monkstown Creek pNHA. While there is no direct hydrological connectivity from the proposed road project to Lough Beg pNHA, the proposed road project is located in relatively close proximity (approximately 340m) to the protected site boundary, and will include an outfall to Lough Beg pNHA. All three pNHA sites are also part of Cork Harbour SPA (Site code: 004030). Their habitat is mainly comprised of intertidal mudflats with shingle and saltmarsh areas that are of international importance as foraging areas for waders and shorebirds.

[7] NPWS Site Synopses - 21.01.2015.
[8] NPWS Site Synopses - 21.01.2015.
[9] NPWS Site Synopses - 23.09.2015.

While there is no direct connectivity between the proposed road project and the Great Island Channel pNHA, there is remote connectivity via Lough Mahon transitional water body at its far eastern end. This pNHA also overlaps with the Great Island Channel SAC (Site Code: 001058).

Table 10.5 and **Table 10.6** provide details on the qualifying habitats and species of those European Sites and pNHA sites respectively located within a 15km buffer of the proposed road project. Further information on the European Sites is available in the Appropriate Assessment and NIS prepared for the proposed road project.

Table 10:5: European Sites within 15km of the Study Area

Site Code	Site Name	Qualifying Features	Distance from the Study Area	Connectivity
001058	Great Island Channel SAC	[1140] Mudflats and sand flats not covered by seawater at low tide [1330] Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	5.2km north-east via Lough Mahon	No direct hydrological connectivity. Remote connectivity *via* Lough Mahon transitional water body at its far eastern end.
004030	Cork Harbour SPA	Little grebe (*Tachybaptus ruficollis*) [wintering] Great crested Grebe (*Podiceps cristatus*) [wintering] Cormorant (*Phalacrocorax carbo*) [wintering] Grey heron (*Ardea cinerea*) [wintering] Shelduck (*Tadorna tadorna*) [wintering] Wigeon (*Anas penelope*) [wintering] Teal (*Anas crecca*) [wintering] Pintail (*Anas acuta*) [wintering] Shoveler (*Anas clypeata*) [wintering] Red-breasted Merganser (*Mergus serrator*) [wintering] Oystercatcher (*Haematopus ostralegus*) [wintering] Golden Plover (*Pluvialis apricaria*) [wintering] Grey Plover (*Pluvialis squatarola*) [wintering] Lapwing (*Vanellus vanellus*) [wintering] Dunlin (*Calidris alpina*) [wintering] Black-tailed Godwit (*Limosa limosa*) [wintering]	70m east via Glounatouig Stream	Direct hydrological connectivity *via* the Woodbrook and Donnybrook streams discharging into the Douglas Estuary / Lough Mahon, and *via* the Glounatouig Stream discharging into Monkstown Creek / Cork Harbour. Direct connectivity *via* outfalls to the marine environment.

Site Code	Site Name	Qualifying Features	Distance from the Study Area	Connectivity
		Bar-tailed Godwit (*Limosa lapponica*) [wintering] Curlew (*Numenius arquata*) [wintering] Redshank (*Tringa totanus*) [wintering] Black-headed Gull (*Chroicocephalus ridibundus*) [wintering] Common Gull (*Larus canus*) [wintering] Lesser Black-backed Gull (*Larus fuscus*) [wintering] Common Tern (*Sterna hirundo*) [breeding]		

Table 10:6: Proposed Natural Heritage Areas with 15km of the Study Area

Site Code	Site Name	Qualifying Features	Distance	Connectivity
001058	Great Island Channel pNHA (Overlaps with Great Island Channel SAC)	Mudflats and sand flats not covered by seawater at low tide Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	5.2km north-east via Lough Mahon	No direct hydrological connectivity. Remote connectivity *via* Lough Mahon transitional water body at its far eastern end.
001979	Monkstown Creek pNHA	Mudflats, shingle and saltmarsh areas supporting viable roosting and feeding habitat for avifauna. (Contained within Cork Harbour SPA)	600m east via Glounatouig Stream	Direct hydrological connectivity *via* the Glounatouig Stream.
001046	Douglas River Estuary pNHA	Mudflats, shingle and saltmarsh areas supporting viable roosting and feeding habitat for avifauna (Contained within Cork Harbour SPA)	35m north-east via the Woodbrook Stream	Direct hydrological connectivity *via* the Woodbrook Stream and Donnybrook Stream.
001067	Lough Beg pNHA (Predominantly contained within Cork Harbour SPA)	Mudflats, shingle and saltmarsh areas supporting viable roosting and feeding habitat for avifauna	180m south east	Direct hydrological connectivity *via* proposed outfall to Lough Beg.

10.3.2 Water Bodies

The proposed M28 Road Project will intersect with two EPA river water bodies, *via* three streams known locally as the Woodbrook Stream, Donnybrook Stream and the Glounatouig Stream. The local stream names vary to those names defined by the EPA as part of their river water body naming schema. The study area is located within the SWRBD, and specifically within the Lee, Cork Harbour and Youghal Bay Catchment. The sub-catchments within which the proposed M28 Road Project is located in are the Owenboy [Cork] SC_010 and the Glasheen [Cork City] SC_010.

Table 10.7 provides a list of all surface water (aquatic) ERs within or downstream of the study area. Local stream names will be used throughout the remainder of this chapter.

Table 10:7: Surface Water Bodies, WFD Status and WFD Risk Characterisation

Aquatic Ecological Receptor Code	Aquatic Ecological Receptor	EPA Water Body Name	Water Body Type	EPA Code	EPA Catchment	EPA sub-catchment	Connectivity	WFD Ecological Status	WFD Chemical Status	Risk Characterisation
ER 1	Woodbrook Stream	Moneygourney 19_010	River water body	19M300900	Lee, Cork Harbour and Youghal Bay	Glasheen [Cork City]_SC_010	Direct connectivity to Lough Mahon TWB* / Cork Harbour SPA / Douglas River Estuary pNHA	Not monitored	Not monitored	Review
ER 2	Donnybrook Stream	Moneygourney 19_010	River water body	19M300900	Lee, Cork Harbour and Youghal Bay	Glasheen [Cork City]_SC_010	Direct connectivity to Lough Mahon TWB / Cork Harbour SPA / Douglas River Estuary pNHA	Not monitored	Not monitored	Review
ER 3	Glounatouig Stream	Hilltown 19_010	River water body	19H050470	Lee, Cork Harbour and Youghal Bay	Owenboy [Cork] SC_010	Direct connectivity to Cork Harbour CWB** / Cork Harbour SPA /Monkstown Creek pNHA	Not monitored	Not monitored	Review
ER 4	Lough Mahon TWB/ Douglas River Estuary pNHA	Lough Mahon	Transitional water body	IE_SW_060_0750	Lee, Cork Harbour and Youghal Bay	N/A	Within Cork Harbour SPA / Fully contains Douglas River Estuary pNHA	Moderate	Good	At Risk
ER 5	Raffeen Coastal Lagoon, Shanbally	Raffeen Lake, Shanbally	Coastal water body (lagoon)	IE_SW_060_1000	Lee, Cork Harbour and Youghal Bay	Owenboy [Cork] SC_010	Direct connectivity to Cork Harbour CWB / Cork Harbour SPA / Monkstown Creek pNHA	Unassigned	Unassigned	Review
ER 6	Monkstown Creek pNHA	Cork Harbour	Transitional Water Body	IE_SW_060_0000	Lee, Cork Harbour and Youghal Bay	N/A	Contained within Cork Harbour CWB / Part of Cork	Good	Good	Review

Aquatic Ecological Receptor Code	Aquatic Ecological Receptor	EPA Water Body Name	Water Body Type	EPA Code	EPA Catchment	EPA sub-catchment	Connectivity	WFD Ecological Status	WFD Chemical Status	Risk Characterisation
							Harbour SPA / Monkstown Creek pNHA			
ER 7	Cork Harbour CWB / Cork Harbour SPA	Cork Harbour	Coastal water body	IE_SW_060_0000	Lee, Cork Harbour and Youghal Bay	N/A	Western Celtic Sea CWB	Good	Good	Review
ER 8	Lough Beg pNHA	Cork Harbour	Coastal water body	IE_SW_060_0000	Lee, Cork Harbour and Youghal Bay	N/A	Contained within Cork Harbour CWB / Part of Cork Harbour SPA / Contained within Lough Beg pNHA	Good	Good	Review
ER 9	Great Island Channel SAC / pNHA	Cork Harbour	Coastal water body	IE_SW_060_0000	Lee, Cork Harbour and Youghal Bay	N/A	Partially within Cork Harbour CWB / Lough Mahon TWB / Lough Mahon Harper's Island TWB	Good / Moderate	Good	At Risk

*TWB: Transitional Water Body and **CWB: Coastal Water Body

10.3.2.1 River Water Bodies

ER 1 Woodbrook and ER 2 Donnybrook Streams

The Woodbrook Stream is located at the northern end of the study area. The stream intersects the study area between the Bloomfield Interchange and Carr's Hill and flows directly adjacent to the existing N28 road before veering east and flowing into the Douglas River Estuary/Lough Mahon.

The Donnybrook Stream drains the northern side of Carr's Hill before flowing in a northerly direction adjacent to the western margins of the existing N28. The stream intersects the proposed road project at Moneygourney and flows directly along the route before flowing west adjacent to the R609 through the suburbs of Donnybrook and Douglas. It discharges to the Douglas River Estuary.

ER 3 Glounatouig Stream

The Glounatouig Stream drains the southern section of the proposed road project. The Glounatouig Stream has four tributaries, two of which confluence south of Four Mile Bridge to form the upper reaches of the Glounatouig Stream. From here, the Glounatouig Stream flows in a southerly direction adjacent to the existing N28. A third tributary flowing adjacent to the N28 also confluences with the Glounatouig as it flows south. A fourth tributary, at Ballinrea, flowing in an easterly direction transects the N28 to also join the Glounatouig. From here, the Glounatouig continues to flow south adjacent to the N28 eventually veering east in line with the road. Close to Raffeen Bridge, the existing N28 takes a southerly direction towards Ringaskiddy while the Glounatouig Stream continues flowing east into Monkstown Creek intertidal area to the north east of Ringaskiddy and eventually discharging into Cork Harbour.

There are no mapped EPA streams or river water bodies within the ZoI of the Service Area at Ringaskiddy.

10.3.2.2 Transitional and Coastal Water Bodies

ER 4 Douglas River Estuary/ Lough Mahon

As discussed above, the Woodbrook and Donnybrook streams discharge into the Douglas River Estuary pNHA, which forms part of Lough Mahon TWB. Lough Mahon TWB is an estuary that stretches from Douglas/Blackrock to Monkstown in Upper Cork Harbour. It is bordered by the Cork City suburbs of Blackrock, Mahon, Ballinure, Douglas, Rochestown, Passage West and Monkstown. The estuary covers an area of 12.23km² and is strongly influenced by the marine environment.

Lough Mahon inner is part of Cork Harbour SPA. The SPA, owing to the sheltered conditions, contains muddy intertidal flats. Salt marshes are scattered throughout the site and these provide high tide roosts for birds. The site is of special conservation interest for holding an assemblage of over 20,000 wintering waterbirds, and also for its populations of Black-tailed Godwit and Redshank.

Lough Mahon receives surface water inputs from Glashaboy estuary and the Lee estuary lower, and also from the following river water bodies: the *Glashaboy (Lough Mahon)_030*, *Moneygourney 19_010* (includes Woodbrook / Donnybrook streams) and *Tibbotstown_010*. The Glashaboy estuary is currently at Poor status under the WFD while the Lee Estuary Lower is at Moderate status.

Lough Mahon was surveyed by IFI in October 2010[10]. A total of 16 fish species were recorded. Sprat was by far the most abundant species (N=4118), followed by sand goby (N=365) and two spotted goby (N=69). Red Data Book (Kind *et al.,* 2011) species that were recorded included eel (N=2) and flounder (N=13). A higher species diversity was found during this survey when compared with previous surveys. Other species found were sand smelt, cod, plaice, scad, thick-lipped grey mullet, common goby, common dragonet, five-bearded rockling, gunnel (butterfish), fifteen-spined stickleback and greater pipefish. Lough Mahon was assigned 'Good' status under the WFD in 2008 and 'Moderate' status in 2010 on the basis of fish surveys undertaken by IFI.

Anthropogenic pressures on Lough Mahon include Cobh Waste Water Treatment Plan (WWTP) with an agglomeration of 14,400 population equivalents (P.E.), Cork City WWTP with 300,013 P.E., and Passage-Monkstown WWTP with 9,120 P.E.[11]. The EPA (2015) have identified waste water priorities to address the environment, and identified 124 urban areas where improvements are required – this list includes Cobh, Cork City and Passage-Monkstown. The Cork City WWTP failed its nitrogen standard in 2015 and requires nitrogen removal to meet more stringent standards for the nutrient sensitive area into which it discharges. Cobh and Passage-Monkstown currently discharge untreated waste water into the marine environment (as of end of 2015[12]), however the estimated date for the provision of treatment for these WWTPS is 2019 and 2018 respectively (dates provided to the EPA by Irish Water in July 2016).

Little Island, one of the major centres of chemical and pharmaceutical activity in Ireland, is located on the eastern side of Lough Mahon. A shipping channel passes through the centre of it allowing large sea-going vessels access to the Port at Ringaskiddy. As Lough Mahon is adjacent to a major urban centre and a major industrial centre, water quality can be variable, and it is currently classified at 'Moderate' status under the WFD classification system by the EPA.

ER 5 Raffeen Lake, Shanbally Coastal Water Body

Raffeen lake is a coastal lagoon classified as a CWB by the EPA. It is included within the extent of Cork Harbour SPA (ER 7). The lagoon is not designated within an SAC context. Coastal lagoons are lakes or ponds that are fully or partially separated from the sea by a permeable barrier that can be entirely natural (such as shingle), or can be an artificial embankment. Salinity varies depending on such factors such as freshwater inputs and barrier permeability. Raffeen lake has no freshwater inputs, and is an artificial lagoon formed behind a coastal embankment. The lagoon is part of a landscaped golf course and has a relatively large permanent tidal inlet. The lagoon is currently not monitored by the EPA as part of WFD national monitoring programme.

Oliver (2006[13]) quotes the lagoon as having a generally high salinity of 28 - 32psu and of 4ha in size. Oliver also describes the morphological lagoon type as "artificial" and based on his biological classification, it was defined as an "estuarine" lagoon with 0 – 35 psu approximately. Raffeen lake is an "estuarine" lagoon, and much of the bed of the lagoon is bare soft mud, except for the rocky shoreline of the embankment and tidal inlet. The lagoon was found to have a relatively large number

[10] http://www.wfdfish.ie/wp-content/uploads/2011/11/Greater_Cork_Harbour_estuary_report_2010.pdf
[11] Source: http://www.epa.ie/pubs/reports/water/wastewater/2015%20urban%20waste%20water%20report_Web%20Version.pdf
[12] Source: http://www.epa.ie/pubs/reports/water/wastewater/2015%20urban%20waste%20water%20report_Web%20Version.pdf
[13] http://www.irishlagoons.com/PhD%20Nov-06.pdf

of faunal taxa (N=45) when surveyed in 2006[14] (Oliver, 2007) most of which were typically estuarine or rocky shore species but with a small suite of lagoonal species, with 1 floral and 6 faunal lagoonal specialist species, and several notable species. The overall conservation value was determined to be moderate, and the lagoon was classified as at favourable conservation.

ER 6 Monkstown Creek and ER 7 Cork Harbour CWB / Cork Harbour SPA and ER 8 Lough Beg

Monkstown Creek pNHA (ER 6) and Lough Beg (ER 8) are contained within the Cork Harbour CWB. Cork Harbour CWB constitutes an area of 27.8km², a mid-sized water body. It is a large sheltered coastal system that stretches from Monkstown in the north to Carlislefort in the south and Saleen in the east. It is bordered by a varied coastline of infrastructure, shallow cliffs, intertidal mudflats, reed beds and shingle and rocky foreshores.

The principal rivers discharging into Cork Harbour are the Rivers Lee, Douglas, Owennacurra, Owenboy, and Glashaboy. Cork Harbour CWB specifically receives inputs from the North Channel Great Island TWB, Lough Mahon TWB, Owenboy Estuary TWB, Farrannamanagh_010 RWB, Hilltown 19_10 RWB (i.e. Glounatouig stream) and Knockamadderee_010 RWB. The North Channel Great Island TWB is currently at 'Good' status under the WFD, while Lough Mahon is at 'Moderate' status. All other water bodies are unassigned i.e. not monitored. Cork Harbour CWB feeds into the Outer Cork Harbour CWB (IE_SW_050_000).

Cork Harbour CWB supports three designated Shellfish Areas – Rostellan South and Rostellan North (see **Figure 10.5**) designated under the European Communities (Quality of Shellfish Waters)(Amendment) Regulations S.I. No 55 of 2009, and Rostellan West designated under the European Communities (Quality of Shellfish Waters)(Amendment) Regulations S.I. No 464 of 2009. Oysters (*Crassostrea gigas*) are the species involved within these production areas, and they are currently classified by the Sea Fisheries Protection Authority (SFPA) as at Class B (meaning that the shellfish must be depurated, heat treated or relayed to meet class A requirements[15]). Pollution Reduction Programmes (PRPs) have been produced for each of the designated shellfish areas in order to set an action plan to ensure water quality compliance with the standards and objectives set under the European Communities (Quality of Shellfish Waters) Regulations, S.I. No. 268 of 2006. There will be no direct impact to any shellfish water as a result of the proposed road project, given their location on the eastern side of Cork Harbour versus the location of the proposed road project which is on the western side of Cork Harbour (see **Figure 10.5**). The potential for indirect impacts is discussed further in **Section 10.410.4**).

The NPWS Site Synopsis for Cork Harbour SPA (Site Code: 004030[16]) describes it as including most of the main intertidal areas of Cork Harbour, including all of the North Channel, the Douglas River Estuary, inner Lough Mahon, Monkstown Creek, Lough Beg, the Owenboy River Estuary, Whitegate Bay, Ringabella Creek and the Rostellan and Poulnabibe inlets. Owing to the sheltered conditions, the intertidal flats are often muddy in character. Salt marshes are scattered through the site and provide high tide roosts for birds. The site is of major international importance for waders and wildfowl regularly supporting in excess of 20,000 wintering waterfowl, which are supported by the presence of extensive mudflats around Lough Mahon (ER 4), the Douglas River Estuary (ER 4) and the North Channel, Lough Beg, Saleen, Rostellan and Whitegate. Cork Harbour is designated as a

[14] Oliver, G.A. 2007. *Inventory of coastal lagoons in the Republic of Ireland.* Unpubl. report on behalf of NPWS.
[15] http://www.sfpa.ie/SeafoodSafety/Shellfish.aspx
[16] Source: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY004030.pdf, accessed 6th April 2017, dated 21st January 2015

Ramsar wetland site of international importance. **Chapter 12: Terrestrial Ecology** discusses this site in greater detail in terms of its bird qualifying features.

Anthropogenic pressures on Cork Harbour include Cork WWTP (300,013 P.E.), Ringaskiddy – Crosshaven – Carrigaline WWTP (116,982 P.E.), and smaller plants including – Ringaskiddy Village (942 P.E.) and Whitegate-Aghada WWTPs (2,266 P.E). As stated above, the Cork City WWTP failed its nitrogen standard in 2015 and requires nitrogen removal to meet more stringent standards for the nutrient sensitive area into which it discharges. Ringaskiddy – Crosshaven – Carrigaline WWTP is one of 29 areas which failed to meet the mandatory effluent quality standards specified in the Urban Waste Water Treatment Directive (91/271/EEC). The plant currently does not have secondary treatment, but is expected to be in compliance in 2017[17] (dates provided to the EPA by Irish Water in July 2016). Ringaskiddy village is also estimated to have secondary treatment in 2017, while for Whitegate-Aghada it will be 2019.

There is significant industrial development in Ringaskiddy. The Port of Cork terminal is also located at Ringaskiddy which operates as a cargo and ferry port linking Ireland to the UK and France. At the north-western end of the proposed road project lies the urban areas of Douglas, Rochestown and Donnybrook, which are predominately residential in character. The majority of the proposed road project transects agricultural land, which is predominately grassland.

ER 9 Great Island Channel SAC/pNHA

The Great Island Channel SAC stretches from Little Island to Midleton, with its southern boundary being formed by Great Island. Within the site is the estuary of the Owennacurra and Dungourney Rivers. These rivers, which flow through Midleton, provide the main source of freshwater to the North Channel. The site is selected for tidal mudflats and sandflats and Atlantic salt meadows. Owing to its sheltered conditions, the intertidal flats are composed mainly of soft muds[18]. The site is an integral part of Cork Harbour which is a wetland of international importance for the birds it supports. It also is extremely important for wintering waterfowl. The main land use within the site is aquaculture (oyster farming), however NPWS[19] recognise the greatest threats to its conservation come from road works, infilling, sewage outflows and possible marine developments.

North Channel Great Island TWB supports one designated Shellfish Area – Cork Great Island North Channel (see **Figure 10.5**) designated under the European Communities (Quality of Shellfish Waters)(Amendment) Regulations S.I. No 55 of 2009. Oysters (*Crassostrea gigas*) are the species involved within this production area, and they are currently classified by the SFPA as at Class B (meaning that the shellfish must be depurated, heat treated or relayed to meet Class A requirements[20]). A PRP has been prepared for the designated shellfish area in order to set an action plan to ensure water quality compliance with the standards and objectives set under the European Communities (Quality of Shellfish Waters) Regulations, S.I. No. 268 of 2006. There will be no direct impact to this shellfish water as a result of the proposed road project, given its location to the north of the proposed road project (see **Table 10.5**). The potential for indirect impacts is discussed further in **Section 10.4**).

[17] Source: http://www.epa.ie/pubs/reports/water/wastewater/2015%20urban%20waste%20water%20report_Web%20Version.pdf
[18] https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY001058.pdf
[19] https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY001058.pdf
[20] http://www.sfpa.ie/SeafoodSafety/Shellfish.aspx

The North Channel Great Island TWB is part of the Great Island Channel SAC and Cork Harbour SPA. It covers an area of 7.96km^2 and is located approximately 15km east of Cork city. It is strongly influenced by the marine environment and has a substrate composed of mainly mud, with some areas of gravel and stones. The water body receives freshwater from the Owenacurra and Dungourney Rivers. The west side of the upper estuary contains extensive mud flats.

North Channel Great Island TWB was surveyed by IFI in October 2010[21]. A total of 23 fish species were recorded. Sand goby was the most abundant species followed by common goby, sand melt and thick-lipped grey mullet. A slightly higher number of species was recorded during this survey in contrast to the previous survey in 2008. European eel (N=2) was the only Red Data Book (Kind *et al.,* 2011) species recorded. Other species found were plaice, two-spot goby, corkwing wrasse, cod, five-bearded rockling, long-spined sea scorpion, flounder, painted goby, ballan wrasse, fifteen-spined stickleback, haddock, Pollack, lesser spotted dogfish, goldsinny wrasse, dab, short-pined sea scorpion, sprat and greater pipefish. North Channel Great Island was assigned 'Good' status under the WFD on the basis of fish surveys undertaken by IFI in 2008 and 2010.

10.3.2.3 Surface Water Quality and Risk Characterisation

Surface water body (rivers, lakes, transitional and coastal waters) monitoring is conducted by the EPA as part of WFD national surface water quality monitoring programme. Water bodies are classified on the basis of a combination of ecological status (a combination of biological status, and the supporting elements of hydromorphology and physico-chemical parameters) and chemical status. The overall status of a water body is classified into one of five classes, as per Schedule 3 of the Surface Water Regulations 2009 (S.I. No. 272). The first three-year cycle of WFD monitoring was undertaken between 2007 and 2009, and the second three year cycle between 2010 and 2012. Data from 2013-2015 was published in late 2016 and is available on the EPA's EnVision mapping tool and the www.catchments.ie website[22].

In addition, the EPA have recently characterised all water bodies nationally, to determine their risk of failing to meet their environmental objectives set under the WFD. Each water body is classified into one of three categories – At Risk, Review or Not at Risk. The risk assessment approach considered the linkages and dependencies between the sources of environmental pressures, and the pathways linking those pressures to the receptors e.g. transitional or coastal water bodies. The assessment included examining the evidence from the monitoring data from 2007 – 2015, including a review of the trends over time to see if conditions were likely to remain stable, improve or deteriorate by 2021. Account was taken of the sensitivity of some water-based ecosystems to nutrients and/or sediment and/or water abstraction arising from human activities, and of physical alterations to surface waters, such as dredging, river bank works and channelisation, which can also damage aquatic ecosystems. Models were used to help determine the most important environmental issues and pressures in each sub-catchment and to identify the key areas to target to achieve improved outcomes. Evidence and expertise from a range of public bodies has also informed the process. The outcome of these assessments is helping to inform the setting of objectives for water bodies and the measures that need to be taken to achieve those objectives. The risk characterisation[23] for the 2nd cycle River Basin Management Plan is also available on www.catchments.ie. Environmental objective setting is on-going work in 2017, the results of which are currently not available.

[21] http://www.wfdfish.ie/wp-content/uploads/2011/11/Greater_Cork_Harbour_estuary_report_2010.pdf
[22] Accessed on 4th April 2017.
[23] Accessed on 4th April 2017.

ER 1 Woodbrook, ER 2 Donnybrook and ER 3 Glounatouig Streams

The Woodbrook, Donnybrook and Glounatouig streams are currently not monitored by the EPA as part of the WFD national rivers monitoring programme. This is not surprising given the small nature of these coastal discharging rivers. The EPA risk assessment has placed all three streams 'At Review' – which means that they require additional monitoring and/or assessment to establish their risk category and to determine associated pressures. Water quality assessments have now been identified for these streams, and potential pressures have been identified as diffuse urban pressures and road drainage.

ER 4 Lough Mahon

Lough Mahon waterbody was classified as having a 'Moderate' ecological status for the period 2007 - 2009 and for the period 2010 - 2012. For the 2007 – 2009 monitoring period, dissolved inorganic nitrogen (DIN) and dissolved oxygen (DO, % saturation) failed their respective standards and were the driving elements for the ecological status determination. Ecological status results for 2013-2015 indicate that Lough Mahon has remained at 'Moderate' ecological status – with status again being determined by DO standard failures (EPA, *pers. comm*).

Lough Mahon is monitored for specific pollutants, priority substances and priority hazardous substances specified under Schedule 5 of the Surface Water Regulations S.I. No. 272 of 2009 (as amended). Chemical status results are presented as one of two categories: Good or failing to achieve Good. Lough Mahon achieved Good chemical status between 2013 – 2015 (EPA, *pers. comm*.).

Lough Mahon is also a nutrient sensitive area designated under the Urban Waste Water Treatment (Amendment) Regulations, S.I. No. 48 of 2010[24]. The sensitive area includes the Lee Estuary and extends from the salmon weir (downstream of water-works intake) to Monkstown (excluding North Channel and Great Island).

Risk characterisation places this water body At Risk due to dissolved oxygen conditions which are preventing the water body from achieving 'Good' status under the WFD. There are also elevated nitrogen levels which are having a knock on effect on the water column, however there is currently no EQS for DIN in transitional waters.

ER 5 Raffeen Lake, Shanbally

Raffeen lake coastal lagoon is currently not monitored by the EPA. It has been placed in 'Review' based on a preliminary risk assessment completed by the EPA, and therefore further information or further investigation is required before the risk category for this water body can be determined.

ER 6 Monkstown Creek, ER 7 Cork Harbour and ER 8 Lough Beg (contained within Cork Harbour CWB)

Cork Harbour was classified as a Heavily Modified water body (HMWB) in the South Western RBMP (2009-2015) due to the Port activities and the extensive port development. HMWB means a body of surface water which as a result of physical alterations by human activity is substantially changed in character, and is identified and designated by the Member State, Ireland in this case, in accordance with the provisions of Annex II of the WFD. On the basis of this designation, the environmental

[24] http://www.irishstatutebook.ie/eli/2010/si/48/made/en/pdf

objective for this water body is 'good ecological potential' (GEP) which recognises that the water body has been altered hydromorphologically, and therefore cannot meet the objective of 'good ecological status' (GES) which includes an assessment of the hydromorphological condition of a water body. The objective of GEP still means however that the water body is required to meet all other assessment criteria for calculating surface water ecological potential e.g. phytoplankton, macroalgae, fish, general conditions, specific pollutants, priority substances and priority hazardous substances as per Schedule 5 of the Surface Water Regulations.

Cork Harbour had an overall status of 'Moderate' in 2007 – 2009 due to a failure of the DIN ecological standard. In addition, this water body also failed its chemical status objective, due to concentrations above environmental quality standards for Tributylin (TBT) and lead compounds[25]. As no WFD monitoring was undertaken at this time, the classification was based on data collated, reviewed and assessed by the Marine Institute from related monitoring programmes. During the 1960s the chemicals industry developed anti-fouling paints using metallic compounds, in particular the organotin compound TBT. By the 1970s, most seagoing vessels had TBT painted on their hulls[26]. However it was identified through environmental studies that organotin compounds persist in the water and in sediments, killing sea life other than that attached to the hulls of ships. TBT was also shown to cause shell deformations in oysters; sex changes (imposex) in whelks; and immune response, neurotoxic and genetic affects in other marine species. In 2001, the International Maritime Organisation (IMO) adopted the International Convention on the Control of Harmful Antifouling Systems on Ships (AFS Convention). The AFS Convention called for a global prohibition on the use of organotin compounds on ships from 1 January 2003, and a complete prohibition by 1st January 2008. In 2010 and 2011, the degree of imposex in female dogwhelks was assessed at 63 sites around the Irish coast. Trends in imposex since 1987 were also examined. A number of sterile females (OSPAR Ecological Quality Objective) were found at 14 of the 63 sites, including Cork Harbour.

For the period 2010 – 2012, the status of Cork Harbour improved with the water body achieving good ecological potential. Chemical status was assessed by compliance with environmental standards for priority substances (Schedule 5, Table 11 of Surface Water Regulations) and priority hazardous substances (Schedule 5, Table 12 of Surface Water Regulations) that are listed in the WFD (Annex X) and the Environmental Quality Standards (EQS) Directive (2008/105/EC). The first round of the national monitoring programme for chemical status began in late 2011, and was completed at the end of 2014. Monitoring was undertaken by the Marine Institute on behalf of the EPA. For the biota sampling undertaken (using the common mussel, *Mytilus edulis*) in late 2011 in 32 areas, four areas, including Cork Harbour, exceeded the EQS for mercury. The concentrations found were well below standards for fishery products, and therefore were deemed not to pose a risk to human health[27]. In addition, and taking into account background levels naturally found in Irish waters, the persistent nature and the long-range transport of the substance, non-compliant results do not infer specific issues local to a water body or even a river basin district[28]. TBT levels also appear to be within EQS levels required.

[25] Source: http://www.epa.ie/wfdstatus/TraC/TraC_Chemistry.pdf
[26] Source: http://www.imo.org/en/OurWork/Environment/Anti-foulingSystems/Documents/FOULING2003.pdf
[27] P.31 http://www.epa.ie/pubs/reports/water/waterqua/wqr20102012/WQR_transitional_and_coastal.pdf
[28] P. 31 http://www.epa.ie/pubs/reports/water/waterqua/wqr20102012/WQR_transitional_and_coastal.pdf

Ecological status results for 2013-2015 indicate that Cork Harbour has maintained its GEP classification and also passed its chemical status tests (EPA, *pers. comm*). Nevertheless, the water body has been placed in review as part of the characterisation process given that some elements which determine status, are close to their respective EQS boundaries. The review is placed in relation to ortho-phosphate (as P), dissolved inorganic nitrogen (as N) and chlorophyll.

ER 9 Great Island Channel SAC/pNHA

Great Island Channel SAC lies partially within Cork Harbour CWB, Lough Mahon TWB and Lough Mahon Harper's Island TWB. Cork Harbour is currently at 'Good' status, while Lough Mahon TWB and Lough Mahon Harper's Island TWB are both at 'Moderate' status.

10.3.3 Previous Surveys within the Study Area

The Woodbrook, Donnybrook and Glounatouig streams were surveyed by Conservation Services Limited in 2006 (unpublished report). The elements covered during these surveys included a habitat assessment, invertebrate water quality assessment, aquatic plants, fish and ecological importance.

The survey found that the three watercourses had been modified, canalised and culverted in such a way as to obstruct the passage of fish in various sections of the streams. The Donnybrook Stream was identified as the least affected by modification in the route corridor. It was reported that the three watercourses each had areas of dense overgrown bankside vegetation and the Woodbrook Stream had areas of very steep slopes making it inaccessible at some points. The riparian vegetation varied from thick brambles to willow, hazel, elder and sycamore.

The survey also found that all three streams had salmonid habitat value although the culverts prevented movement of fish at various points along the streams.

The three steams were also surveyed for the presence of Annex II species listed under the EU Habitats Directive (92/43/EEC) and for the presence of suitable habitat for these species. The Southern Regional Fisheries Board[29] (now part of IFI) and NPWS were consulted with regard to these species. Neither lamprey nor salmon were observed in any of the stream surveys at the time.

The surveys found the Glounatouig Stream and the Donnybrook Stream supported good populations of brown trout and both had good salmonid habitat value. No trout were found during the survey of the Woodbrook Stream but the stream was identified as having good salmonid habitat value. Lamprey, although not recorded, were identified as possibly being present in all three streams. **Table 10.8** summarises the results of the aquatic survey for the three watercourses undertaken in 2006.

[29] Now amalgamated with the Central Fisheries Board and the 7 Regional Fisheries Boards to form the single agency IFI.

Table 10:8: Summary of Aquatic Ecology Results from Previous Surveys of the Study Area

Watercourse	Q-Rating	Aquatic Plants	Fish	Ecological Importance*
Woodbrook Stream	Q3	10% cover of *Apium nodiflorum* at the sampling site.	Ca. 30 Eel Species	High local value on the basis of being a stream with good salmonid habitat value.
Donnybrook Stream	Q4	None recorded at the sampling site.	Brown Trout	High local value on the basis of being a stream with good salmonid habitat value and a population of brown trout.
Glounatouig Stream	Site 3A: Q3 Site 3B: Q3	None recorded at the sampling site.	Site 3A: Brown trout Site 3B: Brown trout and eels	High local value on the basis of being a stream with good salmonid habitat value and a population of brown trout.

10.3.4 Field Surveys

Habitat and biological water quality assessments were carried out by RPS aquatic ecologists on the 26th and 27th February 2015 on the Woodbrook, Donnybrook and Glounatouig streams located within the study area, with further follow up walkover surveys in 2017. A total of ten sites within the study area were surveyed as depicted in **Figure 10.2**. Electrofishing assessments were carried out in September 2015 by Dixon-Brosnan Consultants on behalf of RPS.

10.3.4.1 Biological Water Quality Assessments

RPS aquatic ecologists undertook survey work in February 2015. The following section presents Q-Value results obtained from each survey site, eight of the ten sites in total, across the Woodbrook, un-named ephemeral streams, Donnybrook and Glounatouig Streams (**Table 10.9**). It was not possible to sample Site 2 due to its dry stream bed and overgrowth or Site 8 due to its inaccessibility as a result of steep slopes and dense overgrowth.

Table 10.9 classifies the invertebrate community according to their Q-value determined from the project survey work and corresponding EQR, EPA status, Water Quality and WFD Status. A full list of species obtained during sampling is available in **Appendix 10C**.

The Q-values recorded ranged from a Q3 to Q4. Those sites with a Q-value of Q3 are indicative of a much reduced community of unsatisfactory condition and a WFD status of 'Moderate'. Those sites with a Q-value of Q4 are indicative of a reduced community but of satisfactory condition and a WFD status of 'Good'.

Table 10:9: EPA and WFD Quality Values Recorded at each Sampling Site

Site No.	Stream	Q-Value	EQR	EPA Quality Status	Water Quality	WFD Status
1	Woodbrook	3	0.6	Moderately Polluted	Doubtful	Poor
2	Unnamed Stream	-	-	-	-	-
3	Unnamed Stream	3	0.6	Moderately Polluted	Doubtful	Poor
4	Donnybrook	4	0.8	Unpolluted	Fair	Good
5	Donnybrook	3-4	0.7	Slightly Polluted	Doubtful-to-Fair	Moderate
6	Donnybrook	3-4	0.7	Slightly Polluted	Doubtful-to-Fair	Moderate
7	Glounatouig	3-4	0.7	Slightly Polluted	Doubtful-to-Fair	Moderate
8	Glounatouig	-	-	-	-	-
9	Glounatouig	4	0.8	Unpolluted	Fair	Good
10	Glounatouig	3	0.7	Moderately Polluted	Doubtful	Poor

Based on the Q-Value assessment, the Woodbrook Stream (Site 1) merited a Q3, or 'Moderately Polluted' quality status, with an EQR of 0.6 equating to 'Poor' WFD status. This result concurs with the findings of the 2006 survey by Conservation Services.

Site 3 located on an unnamed stream and surveyed at the request of IFI, merited a Q3 or 'Moderately Polluted' quality status, with an EQR of 0.6 equating to 'Poor' WFD status.

Sites 4, 5 and 6 on the Donnybrook Stream were surveyed for macroinvertebrates. Sites 5 and 6 merited a Q3-4, or 'Slightly Polluted' quality status, with an EQR of 0.7 equating to 'Moderate' WFD status with Site 6 producing a Q-Value of 4. Taking into consideration the Q4 status determined by Conservation Services (2006) for the Donnybrook Stream on most sites sampled, the current result overall suggests deterioration in water quality in recent years.

The Glounatouig Stream was surveyed at two locations, Sites 9 and 10. Site 9 merited a Q4, or 'Unpolluted' quality status, with an EQR of 0.8 equating to 'Good' WFD status. Site 10 merited a Q3 or 'Moderately Polluted' quality status, with an EQR of 0.6 equating to 'Poor' WFD status. The Conservation Services Survey in 2006 also surveyed the Glounatouig Stream at 2 locations, albeit at different locations to those surveyed for this report. One site was located at the point where the Shannon Park tributary converges with the Glounatouig Stream while the other was located to the west of Raffeen quarry. Similar to the results observed during the 2015 survey, both sites had a Q-rating of Q3 in the 2006 survey indicating 'Moderately Polluted' conditions.

10.3.4.2 Habitats Assessments

A general assessment of fishery habitat quality was carried out on all sampling sites 1-10. This assessment consisted of walking/wading the stream channel. Habitat quality was assessed, taking into account width, depth, type of flow (riffle/glide/pool), bottom material, bankside vegetation, etc. Based on these observations, the value of each stream section for spawning, as a nursery area for juveniles and as an area for adult salmonids, was estimated. All site photographs are available in

Appendix 10A while habitat assessment results can be found in **Appendix 10B**. **Table 10.12** provides a summary of habitat assessment requirements.

10.3.4.3 Assessment of Fish Stock

During the EIA Scoping consultation phase, IFI, recommended an electrofishing on the Donnybrook, Woodbrook and Glounatouig streams to assess each stream for fish stocks on the basis of historical records and local knowledge of salmonid habitat in those areas. In addition, the Conservation Services survey from 2006 reported the occurrence of brown trout during its aquatic survey of the Donnybrook and Glounatouig streams while no fish were observed in the Woodbrook Stream.

Appropriate sampling points on all streams were further discussed and determined by RPS and agreed with IFI. On behalf of RPS, Dixon-Brosnan Consultants carried out electrofishing surveys in September 2015. Results obtained are presented in **Table 10.10** and **Table 10.11** were used to further inform this impact assessment.

Five sites were surveyed as follows:-

- One sampling stretch on the Woodbrook Stream (Site 1);
- Two samplings stretches on the Donnybrook Stream (Sites 2 and Site 3); and
- Two sampling stretches on the Glounatouig Stream (Site 4 and Site 5).

The locations of the electrofishing sampling sites are shown below in **Figure 10.4.** Site photographs can be found in **Appendix 10A.**

Figure 10.4: Electrofishing Survey Sites within the Study Area

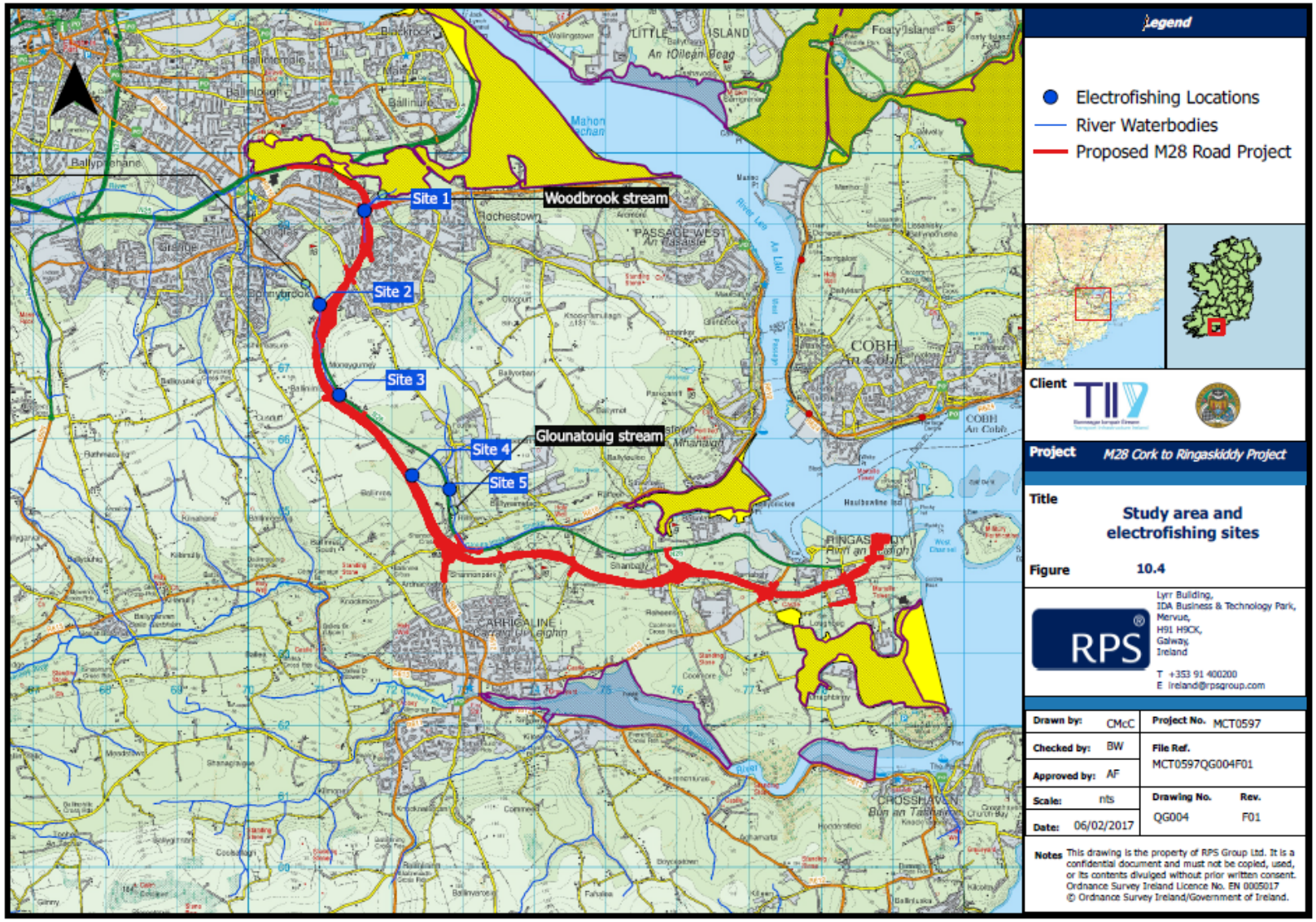


Figure 10.5: Shellfish Areas within Cork Harbour and Great Island Channel

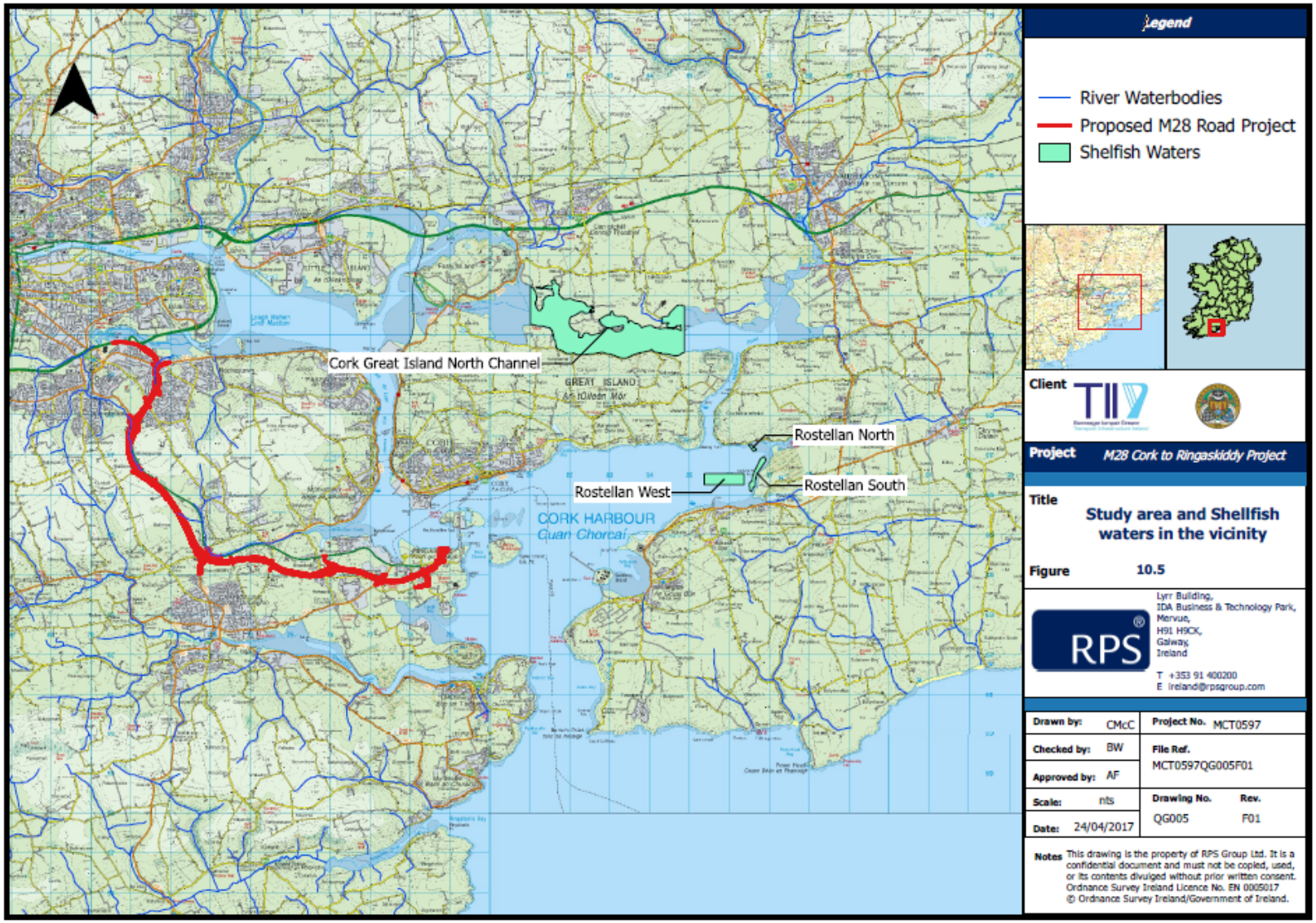


Table 10:10: Site Characteristics

Site	Description
Site 1 (Woodbrook Stream)	Heavily shaded to 80%. Riffle and glide system with one pool in the centre. Located above a culvert.
Site 2 (Donnybrook Stream)	Riffle with some small waterfalls. Very heavily shaded to 85%. Large amounts of woody debris in the stream.
Site3 (Donnybrook Stream)	A drainage ditch that is heavily overgrown with no possibility of fish. Map suggests it was previously a stream, but has been significantly altered.
Site 4 (Glounatouig Stream)	Open sections were almost completely un-shaded with Hemlock and Fools parsley on the bankside. Riffle over cobbles and gravel substrate.
Site 5 (Glounatouig Stream)	About 2.5 to 3 m wide with a very open riffle and glide structure. 15% shaded by the scattered trees on the river bank. One 10m long pool below the bridge to 60cm deep which supported most of the fish captured.

Table 10:11: Electrofishing Survey Results

Location	Brown Trout (*Salmo trutta*) Total Numbers	Brown Trout (*Salmo trutta*) Size Classes	European Eel (*Anguilla anguilla*) Total Numbers	European Eel (*Anguilla anguilla*) Size Classes	Atlantic Salmon (*Salmo salar*)	Brook Lamprey (*Lampetra planeri*)
Site 1 (Woodbrook Stream)	-	-	1	0-20cm (1)	-	-
Site 2 (Donnybrook Stream)	6	0-15cm (6)	-	-	-	-
Site 3 (Donnybrook Stream)	Dry	-	Dry	-	-	-
Site 4 (Glounatouig Stream)	-	-	-	-	-	-
Site 5 (Glounatouig Stream)	14	0-15cm (4) 15-20cm (8) 18-23cm (2)	6	0-20cm (5) 20-25cm (1)	-	-

10.3.5 Species of Conservation Value Occurring Within Sampled Streams

A summary of the species of conservation concern and their potential to occur within the streams is summarised below.

Atlantic Salmon (*Salmo salar*)

It is considered improbable that Atlantic Salmon (*Salmo salar)* (listed on Annex II of the Habitats Directive) would occur in the streams surveyed due to poor water quality, lack of holding pools, barriers to migration and lack of spawning habitat. No Atlantic Salmon were recorded during the 2015 surveys.

Lamprey Species

Lamprey species are of high conservation value and three species occur in Ireland namely Sea lamprey (*Petromyzon marinus*), River lamprey (*Lampetra fluviatilis*) and Brook lamprey (*Lampetra planeri)*. Lamprey are listed on Annex II of the EU Habitats Directive. The presence of migratory lamprey species (sea lamprey and river lamprey) is unlikely due to barriers to migration and lack of spawning habitat. Brook lamprey could potentially occur within suitable areas of habitat within all three streams however no Brook lamprey were recorded during the 2015 surveys.

European Eel (*Anguilla anguilla*)

Although not protected under the EU Habitats Directive, European eel (*Anguilla anguilla*) is a species very much under threat, with numbers in catastrophic decline. This is seen in the fisheries for yellow and silver eels, as well as in surveys of the number of glass eels that are returning to Europe. The decline can be tracked back to the early 1980s and considerable effort is now needed to reverse the situation. The habitats within the survey area are suitable for eel. Results of the surveys only found one European Eel in the Woodbrook Stream (Site 1) and 6 eels in the Glounatouig (Site 5). The remaining sites were too small or had insufficient flow to support fish species.

Brown Trout (*Salmo trutta*)

Brown trout are considered an important game fish in Irish rivers and lakes but are not protected under European legislation. They are widely distributed in small streams. All three streams exhibit fair habitat features capable of supporting this species. On the Donnybrook Stream, Brown trout were detected at the site lowest in the catchment where flows were more substantial (Site 2). On the Glounatouig Stream Brown Trout were recorded on the main channel (Site 5).

Other Species/Habitats

Conditions are unsuitable for other Annex II species (e.g. White-clawed crayfish, freshwater pearl mussel) or Annex I habitats (i.e. Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation-maintain or Rivers with muddy banks with *Chenopodion rubri* p.p. and *Bidention* p.p. vegetation).

10.3.6 Species of Conservation Value within the Marine Environment

Lough Mahon transitional water body was surveyed by IFI in October 2010[30]. A total of 23 fish species were recorded. European eel (N=2) was the only Red Data Book (Kind *et al.,* 2011) species recorded. No Atlantic salmon or lamprey species were recorded during the survey.

North Channel Great Island TWB was surveyed by IFI in October 2010[31]. A total of 23 fish species were recorded. European eel (N=2) was the only Red Data Book (Kind *et al.,* 2011) species recorded. No Atlantic salmon or lamprey species were recorded during the survey.

[30] http://www.wfdfish.ie/wp-content/uploads/2011/11/Greater_Cork_Harbour_estuary_report_2010.pdf
[31] http://www.wfdfish.ie/wp-content/uploads/2011/11/Greater_Cork_Harbour_estuary_report_2010.pdf

10.3.7 Ecological Valuation of Aquatic Receptors

A total of nine Aquatic Ecological Receptors (ERs) were recorded within the ZoI of the proposed road project. **Table 10.12** provides a description of these aquatic ERs. They include sites designated for nature conservation both at a National (pNHA) and International (SPAs) & (SACs) level and also aquatic ecological receptors of local importance. The Aquatic Ecological Receptor valuation system follows the NRA Geographic Context for Determining Value set out in the *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (NRA, 2009). In the context of national road projects, ecological resources of below 'Local Importance (higher value)' should not be selected as 'Key Ecological Receptors' (KERs), for which detailed assessment is required. Sites 2 and 3 - Ephemeral Streams are therefore not identified as 'Aquatic Ecological Receptors' as they merited only **Local Importance (lower value)**.

The Conservation Services 2006 survey also classed Woodbrook, Donnybrook and Glounatouig streams as being of **High Local Value** as per *Ecological Valuation Criteria* adapted from NRA guidelines (2009) (**Table 10.3**). This was assigned on the basis that all three streams exhibited good salmonid habitat and both the Donnybrook and Glounatouig had populations of brown trout.

Table 10:12: Summary of Aquatic ERs within the ZoI of the Study Area

Aquatic Ecological Receptor	Survey Site No.	Location within Study Area	Habitat Assessment Summary or Habitat Description	Fisheries Survey / WFD Fisheries Summary	Biological Survey/WFD Ecological Status	Protected Habitats or Species	Ecological Value
ER 1 Woodbrook Stream	Site 1	Rises c.2km south of the Douglas River Estuary and flows to the estuary. Located at the northern end of the proposed road project	Consists of mostly riffle over cobble, bedrock and gravel with a few small cascading sections.	Poor-Fair 1 European eel found during survey	Q3 (Poor status)	None observed during survey. No annexed habitats or species were observed during aquatic.	*Local Importance* *(Higher Value)*
ER 2 Donnybrook Stream	Site 4 Site 5 Site 6	Intersected by the proposed road project at Carr's Hill	Mixture of riffle and glide over substrates of cobble, gravel, sand and mud.	Fair - Good Poor – Fair None - Poor Brown trout found during survey	Q4 (Good status) Q3-4 Q3-4 (Moderate status)	None observed during survey. No annexed habitats or species were observed during aquatic surveys.	*Local Importance (Higher Value)*
ER 3 Glounatouig Stream	Site 7 Site 8 Site 9	Second Order tributary impacted by proposed road project running south towards Hilltown	Clean, fast flowing stream with good salmonid habitat value and a population of Brown Trout.	Fair Fair – Good Fair	Q3-4 (Moderate status) -	None observed during survey. No annexed habitats or species were observed during aquatic surveys.	*Local Importance (Higher Value)*

Aquatic Ecological Receptor	Survey Site No.	Location within Study Area	Habitat Assessment Summary or Habitat Description	Fisheries Survey / WFD Fisheries Summary	Biological Survey/WFD Ecological Status	Protected Habitats or Species	Ecological Value
				Brown trout and eel found during survey	Q4 (Good status)		
ER 4 Lough Mahon TWB / Douglas River Estuary pNHA	N/A	Located northwest of the study area and running east towards Lough Mahon. Connectivity with the study area via the Donnybrook and Woodbrook streams.	Mudflats, shingle and saltmarsh areas supporting viable roosting and feeding habitat for avifauna. The far eastern end of the TWB is also included in the Great Island Channel SAC.	16 species recorded by IFI in 2010, including red data book listed eel and flounder. Other species include sprat, sand goby, two-spotted goby and cod.	Moderate status	Partially contained within Cork Harbour SPA (see ER 7).	*Douglas River pNHA - National Importance* *Cork Harbour SPA – International Importance*
ER 5 Raffeen Coastal Lagoon CWB	N/A	Located at Shanbally and north of the proposed route. The lagoon is hydrologically linked to Cork Harbour CWB and Cork Harbour SPA.	Coastal lagoon (artificial), with salinity levels of approx. 33psu.	-	Not currently monitored by the EPA.	Currently not designed as a priority I habitat under the Habitat Directive. Part of Cork Harbour SPA (see ER 7)	*Local Importance (Higher Value)*
ER 6 Monkstown Creek pNHA	N/A	Connectivity with the study area via the	Comprised of intertidal mudflats and sand flats providing high quality	-	Good status	Part of Cork Harbour SPA (see ER 7)	*pNHA National Importance*

Aquatic Ecological Receptor	Survey Site No.	Location within Study Area	Habitat Assessment Summary or Habitat Description	Fisheries Survey / WFD Fisheries Summary	Biological Survey/WFD Ecological Status	Protected Habitats or Species	Ecological Value
		Glounatouig stream to the east.	foraging habitat for over-wintering fauna associated with the SPA region.				*Cork Harbour SPA – International Importance*
ER 7 Cork Harbour CWB / Cork Harbour SPA	N/A	Located north of the study area at Douglas River Estuary and located southeast extending from Monkstown Creek	Cork Harbour SPA and is comprised of intertidal mudflats and sand flats providing high quality foraging habitat for over-wintering fauna associated with the SPA region.	-	Good status	The site is of major international importance for waders and wildfowl regularly supporting in excess of 20,000 wintering waterfowl, which are supported by the presence of extensive mudflats around Lough Mahon (ER 4), the Douglas River Estuary (ER 4) and the North Channel, Lough Beg, Saleen, Rostellan and Whitegate.	*International Importance*
ER 8 Lough Beg pNHA	N/A	South of the proposed road project at Lough Beg.	Mudflats, shingle and saltmarsh areas supporting viable roosting and feeding habitat for avifauna	-	Good status	Park of Cork Harbour CWB. Lough Beg pNHA supports an assemblage of wetland terrestrial and intertidal habitats. The site intersects Cork Harbour SPA and its intertidal habitats such as mudflats and sandflats provide good quality feeding ground for overwintering avifauna associated with Cork Harbour SPA. The site is also likely to be of local importance for otter, a species listed on Annex II of the EU Habitats Directive.	*National Importance*
ER 9 Great Island Channel SAC / pNHA	N/A	Located north and northeast of the study area and connected to the study area	Mudflats and sand flats not covered by seawater at low tide Atlantic salt meadows (Glauco-Puccinellietalia	23 species recorded by IFI in 2010 including the red data book species European eel. Sand goby	Good / Moderate status	The site is an integral part of Cork Harbour which is a wetland of international importance. The site is of major importance for the two habitats listed on Annex I of the E.U. Habitats Directive, as well as for its important	*International Importance*

Aquatic Ecological Receptor	Survey Site No.	Location within Study Area	Habitat Assessment Summary or Habitat Description	Fisheries Survey / WFD Fisheries Summary	Biological Survey/WFD Ecological Status	Protected Habitats or Species	Ecological Value
		remotely via Lough Mahon.	maritimae)	was the most abundant species followed by common goby, sand melt and thick-lipped grey mullet.		numbers of wintering waders and wildfowl. It also supports a good assemblage invertebrate fauna.	

10.4 POTENTIAL IMPACTS

The potential impacts of the proposed M28 Road Project on aquatic biodiversity are considered in this section, in the absence of mitigation measures. This section has been informed by and uses the terminology from EPA, 2015(a) (Section 3.7.7 Definitions of impacts), and also having regard to CIEEM (2016), Section 5 Impact Assessment, specifically characterising ecological impacts.

The potential significant impacts from the construction and operation/maintenance of the proposed road project are:-

- Pollution of watercourses with mobilised suspended solids due to run-off from excavation activities, and from instream works related to culvert installation/extensions and stream diversions;
- Pollution of watercourses with other substances such as spillages of fuels, lubricants, hydraulic fluids, anti-freeze, concrete, wastewater, wood preservatives from timber fencing, materials spread during gritting and de-icing etc.;
- Permanent loss of habitat and disturbance to species where permanent stream diversions are required;
- Impacts on habitats and disturbance to species where temporary stream diversions are required;
- Obstruction of upstream movement of fish (distribution and extent of anadromy[32] / percentage of river accessible) due to construction of new culverts, upgrade of culverts, or temporary and permanent stream diversions;
- Relevant pollutants and sediments discharging from the new or upgraded sections of road during routine run-off from the operational phase of the proposed M28 Road Project;
- Pollution from pumped discharges during dewatering of sections of streams to facilitate diversions;
- Water abstraction, leading to reduced flows instream;
- Changes in hydrology: flow velocities (peak and minimum) and erosional and depositional patterns; and
- Pollution of transitional and coastal waters from construction and operational phases of the proposed Service Area.

TII (2015[33]) states that pollution from road drainage can arise from a variety of sources including: collisions, general vehicle and road degradation, incomplete fuel combustion, leaks of oil, fuel or other pollutants, fires and atmospheric deposition. Other sources include herbicide/salt application. Pollution may be diffuse, acute, chronic or routine in nature. Road run-off can contain relevant pollutants, and their respective concentrations can contribute to deterioration within receiving watercourses. While road run-off is an intermittent discharge, the impacts from such discharges are not necessarily picked up in the frequency of water quality monitoring undertaken as part of the WFD national monitoring programme. However under the WFD, there can be no deterioration in either the ecological status or the chemical status of a water body.

[32] The migration of fish from saltwater to freshwater as adults.
[33] http://www.tiipublications.ie/library/DN-DNG-03065-02.pdf

The potential impacts are described under two headings:-

- Assessment of impacts to aquatic receptors during the construction phase; and
- Assessment of long-term impacts to aquatic receptors during the operational/maintenance phase.

10.4.1 Construction Phase Impacts

10.4.1.1 Suspended Solids Pollution

The potential for pollution with suspended solids will be an issue within the proposed road project at all points where:-

- The new road is constructed close to or will intersect watercourses;
- New culverts are constructed within a watercourse, or where existing culverts are extended;
- Permanent or temporary stream diversions are required;
- Under-bridges are constructed and are in close proximity to watercourses;
- Overbridges are constructed and are in close proximity to watercourses;
- Demolition works are undertaken;
- The site compound will be temporarily established;
- Construction site drainage takes place;
- Permanent drainage features are constructed;
- Permanent hard surfaces are constructed;
- Blasting and drilling takes place in close proximity to watercourses;
- There are outfalls into the freshwater and marine environment, and
- Earthworks (cut/fill) occurs.

Sediment laden run-off from construction areas and introduction of fine sediments can pose adverse impacts to aquatic life in watercourses resulting in the following range of impacts:-

- Reduction of visibility in the stream, impairing foraging ability for fish;
- Settled sediments can smother and displace aquatic organisms such as macroinvertebrates, reducing the amount of food items available to fish;
- Suspended solids particles can clog or damage the gills of salmonid fish;
- The settlement of suspended solids particles on spawning areas can smother the eggs in the gravel;
- Higher concentrations of suspended solids may also serve as a sink or carrier for toxins/ chemicals; and
- Water with higher concentration of solids retards photosynthesis.

In the absence of mitigation, suspended solids impacts would be expected to be moderately negative on a local scale with short term impacts during the construction phase for freshwater receptors ER 1 to ER 3 - the Woodbrook, Donnybrook and Glounatouig streams. This is based on the reduced capacity of these streams to sustain further sedimentation, which would further reduce

their water quality status. Both the Woodbrook and Glounatouig streams are failing to meet their good status objective under the WFD, while sections of the Donnybrook Stream are also failing to achieve good status.

For marine receptors, ER 4, ER 6 to ER 8, the impacts would be slight, negative, local scale and short term on the basis of the large extent of Cork Harbour, the short length of proposed road to be constructed, the limited area associated with the Service Area, and the short duration of the construction phase. For ER 5 Raffeen coastal lagoon and ER 9, Great Island Channel SAC, the impacts would be not significant given that there will be no direct connectivity between the works areas and these ERs, and that indirect impacts are unlikely to be significant given the large size of Cork Harbour relative to the confined location of the proposed road project works.

10.4.1.2 Pollution with Other Substances Associated with the Construction Process

There is potential for a range of pollutants to enter watercourses during the construction of the proposed road project such as stream diversion works, activities at site compounds and satellite offices/welfare facilities, construction of new overbridges, under-bridges and culverts and during site works at the Service Area. The following will have harmful effects on fish, plants and invertebrates if allowed to enter the freshwater or marine environment:-

- Raw or uncured concrete and grouts;
- Excessive dust emissions from excavation and transportation of materials can potentially dissipate to nearby watercourses;
- Wash down water from exposed aggregate surfaces, cast-in-place concrete and from concrete trucks; and
- Fuels, lubricants and hydraulic fluids for equipment used for construction purposes.

In the absence of mitigation, contaminated substances released to the environment during the construction phase would be expected to be significant, negative, on a local scale with medium term impacts for freshwater receptors ER 1 to ER 3 - the Woodbrook, Donnybrook and Glounatouig streams due to the toxic nature of the inputs e.g. concrete, and the already reduced fisheries potential within these watercourses which require significant protection in order to restore overall habitat potential for the species, and

For marine receptors, ER 4, and ER 6 to ER 8, the impacts would be moderate, negative, local and short term again given the toxic nature of the substances involved, and the potential to create local water quality impacts. For ER 5 and ER 9, the impacts would be not significant given the lack of a pathway for pollutants from the site of the proposed works and ER 5, and the distance between the site of the proposed works and ER 9.

10.4.1.3 Construction of Culverts and Stream Diversions

- The Woodbrook, Donnybrook and Glounatouig Streams are currently culverted at a number of locations where the watercourses cross the existing N28. A number of culvert extensions and new culverts are now proposed together with both permanent and temporary stream diversions to facilitate the construction of the proposed road project.

- The primary impacts associated with these activities on aquatic receptors are the potential for the obstruction of the passage of fish and aquatic fauna. Salmonids (Brown trout in the case of the study area concerned), and the effect of a particular culvert on salmonids will depend on water depth, speed and volume, length of culvert, type of culvert, species of fish, size and condition of fish, etc. Physical alteration of stream channel can result in altered hydraulic characteristics and changes in stream profile, particularly in width, depth, gradient and current speed. Above a critical flow velocity, fish can only sustain progress for a limited period of time without resting. The faster the current velocity above this critical speed, the shorter the distance the fish can travel against the current. The impact of a culvert on fish movement is therefore primarily due to changes in hydrological conditions. Other factors such as the length of the structure and light are commonly used as significant criteria in determining the fish passage capability of an installation.
- Aquatic Invertebrates may travel long distances within a stream by their own power in the case of snails, amphipods, crayfish and other crustaceans. As many of these species are confined to the water, any barrier to their dispersal impacts their populations. By eliminating the natural aquatic vegetation and its associated invertebrate fauna, culverts can result in a significant reduction in invertebrate drift downstream which constitutes a significant food source for salmonid fish.

In the absence of mitigation, culvert and stream diversion impacts would be expected to be moderate, negative, on a local scale and permanent for freshwater receptors ER 1 to ER 3 - the Woodbrook, Donnybrook and Glounatouig streams, given the existing physical alterations on these streams which are already leading to a barrier to fish migration, and the existing stream flow conditions noted during survey. Notwithstanding this, the project has taken cognisance of the future potential for rehabilitation of these streams, and has therefore designed culverts to be passable for fish.

For marine receptors ER 4 Lough Mahon TWB, ER 7 Cork Harbour and ER 8 Lough Beg pNHA, there will be some physical alteration required to facilitate outfall construction. The associated impacts will be slight, negative, local and permanent. The outfalls to the marine environment are few in number and will require a small footprint, leading to slight alteration to the hydromorphology of the coastline at those locations. For other marine receptors, there will be no impact.

10.4.1.4 Hydrological Changes

As stated above, stream diversions, if designed inappropriately, have the potential to alter stream hydraulic characteristics such as current speed, current preferential flow paths etc. with consequential impacts such as alteration to the erosional and depositional nature of the existing watercourse.

The pattern of road run-off and the location of outfalls to both the freshwater and marine environment can also lead to localised scouring and increased flow rates during rainfall events, in particular peak events. Contaminant run-off to the aquatic environment at the proposed outfall locations may lead to localised point source loading of relevant pollutants and suspended solids.

Increases in hard standing and new road areas can alter surface water infiltration rates and flow paths. The creation of impermeable surfaces will alter drainage patterns in the immediate vicinity of the proposed road and Service Area and may lead to localised surface water flow path preferences.

In the absence of mitigation, hydraulic impacts would be expected to be moderate, negative, on a local scale and permanent for freshwater receptors ER 1 to ER 3 - the Woodbrook, Donnybrook and Glounatouig streams given the existing flow conditions of the streams as observed during habitat assessments, and the permanent physical changes to the streams as a consequence of the construction / upgrade of culverts and associated stream diversions.

For marine receptors ER 4 Lough Mahon TWB, ER 7 Cork Harbour and ER 8 Lough Beg pNHA, the localised physical alteration associated with outfall construction would lead to slight, negative, local scale and permanent hydraulic changes due to the localised construction of the outfall, in light of the short length of road involved, small footprint of the Service Area, and large volume associated with Cork Harbour. There will be no impacts for other marine receptors.

10.4.1.5 Compound Areas Including Office and Welfare Facilities

There is potential for site disturbance during the setup and utilisation of compound areas to facilitate the works. Compound areas located close to watercourses have the potential to impact stream/river riparian corridors, and alter surface water attenuation and flow paths. Vehicle movements, refuelling etc., can all create potential for spillages and leakage which may enter nearby watercourses.

The construction of site compounds will require the removal of wastewater from toilets and domestic water from washing facilities which will require treatment and safe disposal to a suitable location. Inadequate treatment of on-site toilets and washing facilities has the potential to cause faecal contamination.

A site compound has been identified and is set back from watercourse and ERs (Refer to **Chapter 3: Description of the Proposed Road Development**), therefore there will be no impact on surface waters.

10.4.1.6 Environmental Incidents and Accidents

An environmental incident or accident during the construction phase e.g. a large scale spillage of a contaminant such as diesel or cement, which could enter local streams or the marine environment, would have a negative impact on the aquatic environment.

In the absence of mitigation, impacts would be expected to be significant, negative, on a local scale and long-term for freshwater receptors ER 1 to ER 3 - the Woodbrook, Donnybrook and Glounatouig streams given their small nature and at times poor flow conditions and lack of assimilative capacity. Spillages of contaminants, depending on their concentration and volume, could lead to a toxic reaction within the streams, with further impacts on an already degraded fisheries habitat, with consequences for the chemical status of the watercourse as per WFD environmental quality standards.

For marine receptors, impacts would be expected to be significant, negative, and medium to long term for ER 4 to ER 8 given the sensitivity of Cork Harbour SPA (ER 7) and its associated bird population, and the existing good chemical status for Cork Harbour CWB (ER 7). Depending on the timing of the incident, ER 6 Monktown Creek pNHA would be adversely affected largely in winter time due to the over-wintering fauna associated this this region (also part of ER 7). For ER 9, Great

Island Channel SAC, the impact would be slight, based on water body tidal conditions between Lough Mahon and the North Channel Great Island.

10.4.2 Operational Phase Impacts

10.4.2.1 Pollution with Contaminated Water Run-off During Operation

Run-off from the existing N28 is primarily over embankments to fields which eventually discharge to existing watercourses. There are currently no formal treatment or attenuation measures in place to control run-off from the existing N28 or proposed Service Area site. At present, surface water run-off generated as a result of rainfall at the site of the proposed Service Area discharges directly to Cork Harbour via overland flow or by infiltration to ground, while for the proposed road, surface water run-off which is not infiltrated to ground, will eventually discharge to water courses in the vicinity i.e. the Woodbrook, Donnybrook and Glounatouig stream, Lough Mahon TWB and Cork Harbour.

A broad range of potential pollutants are associated with the routine run-off from roads. TII (2015) identify the sources for such pollutants as combustion products of hydrocarbons, fuel and fuel additives, catalytic converter materials, metal from friction and corrosion of vehicle parts, lubricants, and materials spread during gritting and de-icing. Particulate contaminates originating from vehicles and vehicle related activities include carbon, rubber, plastics, grit, rust and metal filing.

Most organic compounds have very low solubility in water. Such compounds can occur in routine run-off and include a wide range of polycyclic aromatic hydrocarbons (PAHs). Other materials may be deposited on road surfaces such as wind-blown soils from adjacent land.

A number of UK based studies show that routine road run-off contains both dissolved and particulate contaminants. These studies have investigated the concentrations of contaminants in road run-off for a variety of road types in a number of countries. Research into the concentrations of contaminants in road run-off shows a large variation in concentrations of those contaminants detected. Applied road salt may also enhance the release of toxic metals from silts and sludge.

The UK Highways Agency has undertaken research to improve the reliability and extent of existing data for pollutants and their concentrations found in road run-off from non-urban trunk roads and motorways. The results identified a list of significant pollutants that are routinely found in road run-off and which pose a risk of short-term acute impacts (from soluble pollutants) and/or long-term chronic impacts (from sediment-bound pollutants) on ecosystems.

A significant pollutants list was agreed upon for the UK. No such list is available for Ireland, however TII (2015) state that this list can also be considered relevant and applicable in the Irish context as the pollutants and their concentrations will be similar or even conservative compared with the UK scenario due to Ireland's lower average traffic volumes. The significant pollutants identified were: total copper, zinc, cadmium, pyrene, flouranthene, anthracene and total PAHs.

Following construction, the Service Area will be covered by hard-standing areas. Surface water run-off from hardstanding areas can affect the quality of receiving watercourses. It can contain suspended solids, oil, organic solids, chloride, metals and hydrocarbons. If the intensity of a storm event is sufficient, insoluble pollutants can be mobilised from the surface and potentially run off to the harbour area. Due to the presence of the refuelling activities and heavy commercial vehicles

(HCVs) and coach parking facilities, there is potential for the surface water run-off to become contaminated.

In the absence of mitigation, impacts would be expected to be significant, negative, on a local scale and continuous for freshwater receptors ER 1 to ER 3 - the Woodbrook, Donnybrook and Glounatouig streams given the small size of the streams and the limited assimilation capacity they can provide for relevant pollutants, and their already degraded state (below good status).

For marine receptors ER 4 and ER 6 to ER 8, impacts will be moderately, negative, on a local scale and continuous based on the greater assimilation capacity available in Cork Harbour, and the input volumes expected. For ER 5 and ER 9, impact would be expected to be not significant.

10.4.2.2 Hydrocarbons Run-off

Hydrocarbons in motorway run-off are generally derived from crankcase oil, lubricating oils and fuels. Hydrocarbons are of major concern because they are responsible for the larger percentage of toxicity to freshwater organisms.

The main impacts of hydrocarbons in watercourses are the following:-

- Prevention of gaseous exchange at the water surface, leading to reduced dissolved oxygen in the underlying water, and
- The gills of fish can become contaminated reducing their respiratory capacity.

In the absence of mitigation, impacts would be expected to be moderate, negative, on a local scale and continuous for freshwater receptors ER 1 to ER 3 - the Woodbrook, Donnybrook and Glounatouig streams again due to the small size and limited assimilation capacity within these streams, and

For marine receptors ER 4 and ER 6 to ER 8, impacts will be slight, negative, local and continuous given the large assimilation capacity of Cork Harbour and its current good status. For ER 5 and ER 9, impact would be expected to be not significant as there is no direct discharge to either ER, while indirect impacts would also be not significant given the limited tidal interactions west to east across the harbour.

10.4.2.3 Hydrology Changes

If the rate of discharge from the proposed road exceeds that of the existing catchment area then it is possible that overloading of the existing watercourses could occur, causing localised flooding or erosion of watercourse banks within the catchment.

Major changes in hydrology reflected in significant changes in peak and minimum flows would have significant effects on instream flora and fauna, both directly and indirectly through the effects of changed erosional and depositional dynamics as a result of permanent stream diversions and the construction of culverts and outfalls. Changes in stream depth, channel hydromorphology and substrate type can lead to impacts to the aquatic flora and fauna within streams.

Development of the proposed Service Area has the potential to create flood risk from local surface water flooding due to an increase in the area of impermeable ground. Local surface water flooding may arise from rainwater falling onto a site where there is poor infiltration or where the finished ground levels do not facilitate run-off into Cork Harbour.

In the absence of mitigation, impacts would be expected to be moderate, negative, on a local scale and continuous for freshwater receptors ER 1 to ER 3 - the Woodbrook, Donnybrook and Glounatouig streams given the short length of the streams and the limited assimilation capacity they provide as a result.

For marine receptors ER 4, ER 6 to ER 8, impacts will be slight, negative, local and continuous given the volume of runoff expected versus the assimilation capacity of Cork Harbour. For ER 5, there will be no impact as there is no hydrological connectivity between the works areas and this ER. For ER 9, impact would be expected to be not significant given the distance from the site of the proposed works, and the Great Island Channel SAC.

10.4.2.4 Environmental Incidents and Accidents

An environmental incident or accident during the operational phase of the proposed road project e.g. significant accident with release of polluting substances such as diesel, concrete etc. which could enter local streams or the marine environment, would have significant negative impacts on the aquatic environment.

In the absence of mitigation, impacts would be expected to be significant, negative, on a local scale and long-term for freshwater receptors ER 1 to ER 3 - the Woodbrook, Donnybrook and Glounatouig streams given their small nature and at times poor flow conditions and lack of assimilative capacity. Spillages of contaminants, depending on their concentration and volume, could lead to a toxic reaction within the streams, with further impacts on an already degraded fisheries habitat, with consequences for the chemical status of the watercourse as per WFD environmental quality standards.

For marine receptors, impacts would be expected to be significant, negative, and medium to long term for ER 4 to ER 8 given the sensitivity of Cork Harbour SPA (ER 7) and its associated bird population, and the existing good chemical status for Cork Harbour CWB (ER 7). Depending on the timing of the incident, ER 6 Monktown Creek pNHA would be adversely affected largely in winter time due to the over-wintering fauna associated this this region (also part of ER 7). For ER 9, Great Island Channel SAC, the impact would be slight and temporary, based on water body tidal conditions between Lough Mahon and the North Channel Great Island.

10.4.3 Summary of the Potential Impacts in the Absence of Mitigation Measures

Table 10.13 and **Table 10.14** below provide a summary of the potential for impacts from the proposed M28 Road Project in the absence of adequate mitigation, using terminology from EPA (2015a), and characteristics of ecological impacts from CIWEM (2016).

Table 10:13: Summary of Significance of Potential Impacts during Construction of the Proposed M28 Road Project in the Absence of Mitigation Measures

Aquatic Ecological Receptors	Suspended Solids Pollution	Pollution by Other Substances	Construction of Culverts / Stream Diversions	Hydrological Changes	Environmental Incidents and Accidents
ER 1 Woodbrook Stream	Moderately negative on a local scale, short term	Moderately negative on a local scale, medium term	Moderately negative on a local scale, permanent	Moderately negative on a local scale, permanent	Significantly negative on a local scale, long-term
ER 2 Donnybrook Stream	Moderately negative on a local scale, short term	Moderately negative on a local scale, medium term	Moderately negative on a local scale, permanent	Moderately negative on a local scale, permanent	Significantly negative on a local scale, long-term
ER 3 Glounatouig Stream	Moderately negative on a local scale, short term	Moderately negative on a local scale, medium term	Moderately negative on a local scale, permanent	Moderately negative on a local scale, permanent	Significantly negative on a local scale, long-term
ER 4 Lough Mahon TWB / Douglas River Estuary pNHA	Slight, negative at a local scale, not at an international scale, short term	Moderately negative on a local scale, not at an international scale, short term	Slight, negative at a local scale, not at an international scale, permanent	Slight, negative at a local scale, not at an international scale, permanent	Significantly negative on a regional/international scale, medium to long-term
ER 5 Raffeen Coastal Lagoon CWB	Not significant	Not significant	No impact	No impact	Significantly negative on a regional scale, medium to long-term
ER 6 Monkstown Creek pNHA	Slight, negative at a local scale, not at an international scale, short term	Moderately negative on a local scale, not at an international scale, short term	No impact	No impact	Significantly negative on a regional scale, not at an international scale, medium to long-term
ER 7 Cork Harbour CWB / Cork Harbour SPA	Slight, negative at a local scale, short term	Moderately negative on a local scale, short term	Slight, negative at a local scale, permanent	Slight, negative at a local scale, permanent	Significantly negative on a regional scale, medium to long-term
ER 8 Lough Beg pNHA	Slight, negative at a local scale, not at an international scale, short term	Moderately negative on a local scale, not at an international scale, short term	Slight, negative at a local scale, not at an international scale, permanent	Slight, negative at a local scale, not at an international scale, permanent	Significantly negative on a regional scale, not at an international scale, medium to long-term
ER 9 Great Island Channel SAC	Not significant	Not significant	No impact	No impact	Significantly negative on a regional scale, not at an international scale, medium to long-term

Table 10:14: Summary of Significance of Potential Impacts during Operation of the Proposed M28 Road Project in the Absence of Mitigation Measures

Aquatic Ecological Receptors	Pollution by Contaminated Water	Hydrocarbons Run-off	Hydrology Changes	Environmental Incidents and Accidents
ER 1 Woodbrook Stream	Significantly negative on a local scale, continuous	Moderately negative on a local scale, continuous	Moderately negative on a local scale, continuous	Significantly negative on a local scale, medium-long term
ER 2 Donnybrook Stream	Significantly negative on a local scale, continuous	Moderately negative on a local scale, continuous	Moderately negative on a local scale, continuous	Significantly negative on a local scale, medium-long term
ER 3 Glounatouig Stream	Significantly negative on a local scale, continuous	Moderately negative on a local scale, continuous	Moderately negative on a local scale, continuous	Significantly negative on a local scale, medium-long term
ER 4 Lough Mahon TWB / Douglas River Estuary pNHA	Moderately negative on a local scale, not at an international scale, continuous	Significantly negative on a local scale, not at an international scale, continuous	Slightly negative on a local scale, not at an international scale, continuous	Significantly negative on a local scale, not at an international scale, medium-long term
ER 5 Raffeen Coastal Lagoon CWB	Not significant	Not significant	Not significant	Significantly negative on a local scale, medium-long term
ER 6 Monkstown Creek pNHA	Moderately negative on a local scale, not at an international scale, continuous	Slight negative on a local scale, not at an international scale, continuous	Slightly negative on a local scale, not at an international scale, continuous	Significantly negative on a local scale, not at an international scale, medium-long term
ER 7 Cork Harbour CWB / Cork Harbour SPA	Moderately negative on a local scale, continuous	Slight negative on a local scale, continuous	Slightly negative on a local scale, continuous	Significantly negative on a local scale, medium-long term
ER 8 Lough Beg pNHA	Moderately negative on a local scale, not at an international scale, continuous	Slight negative on a local scale, not at an international scale, continuous	Slightly negative on a local scale, not at an international scale, continuous	Significantly negative on a local scale, not at an international scale, medium-long term
ER 9 Great Island Channel SAC	Not significant	Not significant	Not significant	Slight, temporary

10.4.4 Do-Nothing Scenario

If the proposed M28 Road Project does not proceed, ongoing activities would continue within the study area and likely include further increase in traffic, pastoral farming, localised quarrying and the potential progression of residential, commercial and industrial developments. These activities would be likely to result in localised and small scale cumulative negative impacts to the various aquatic ecological receptors within the study area. The surface water drainage network on the existing N28 is limited to the area at Bloomfield/ Rochestown with drainage provided at the existing roundabouts along the route. Currently surface water run-off generated predominately is discharged over the existing embankments and eventually makes its way to existing surface watercourses nearby.

If the proposed Service Area did not proceed at Ringaskiddy, ongoing activities would continue within the proposed area and its surrounding environs. The harbour area at Ringaskiddy supports vast shipping and transport navigation and large scale industrial activity. It is likely that this sheltered marine habitat has experienced cumulative pressures from ongoing local activities. The environmental pressures associated with these industries are likely to continue without the proposed Service Area in place. In the absence of a proposed Service Area, trucks will continue to park in unauthorised, non-designated parking areas located near the adjacent marine habitat. Such ongoing activity will continue to potentially pose an increased pressure on the marine environment, e.g., increased risk of hydrocarbons run-off, fuel run-off, etc. in an un-attenuated manner.

10.5 MITIGATION MEASURES

This section prescribes mitigation measures that will be implemented to avoid, reduce or remedy potential impacts identified above in **Section 10.4** above.

10.5.1 Mitigation Measures for Aquatic Receptors during the Construction Phase

The measures described below will serve to ensure that any potential impacts on aquatic ecological receptors and the qualifying features of Cork Harbour SPA and by extension, Great Island Channel SAC, from sedimentation or pollution during both the construction and operational phases are avoided or mitigated.

The mitigation measures for each of the construction impacts should be read in conjunction with the drainage design principles adopted during the design of the proposed road project (**See Chapter 9: Hydrology and Drainage** and **Section 3.13** Environmental Management during the Construction Phase which outlines guidelines/measures during all construction works).

10.5.1.1 Suspended Solids Pollution

The following measures for erosion and sediment control shall be adhered to by the Contractor:-

- Sediment traps or settlement ponds shall be provided for all watercourses during construction (See **Section 3.6** of **Chapter 3: Description of the Proposed Road Development** and **Chapter 9: Hydrology and Drainage**) and will adhere to IFI (2016) Guidelines;

- The level of suspended solids in any discharges to fisheries waters (Woodbrook, Donnybrook and Glounatouig streams) as a consequence of construction works shall not exceed 25 mg/l[34] nor result in the deposition of silts on gravels or any element of aquatic flora and fauna (as per IFI (2016) guidelines);
- Topsoil stripping in proximity to any watercourses will be undertaken in dry weather conditions and all stockpiles will be located greater than 100m from a watercourse. Stockpiles within 200m of a watercourses will be covered (refer to **Section 3.12.1.4**);
- Stripped areas will be revegetated, particularly cut and fill slopes and disturbed slopes as soon as possible, e.g., by use of hydroseeding (larger areas), replacement of turves (smaller areas) etc. Mulches or other organic stabilisers will be used to minimise erosion until vegetation is established on sensitive soils. Hydroseeding shall not be carried out in close proximity to water and these areas will be seeded by hand or placement turves used;
- Run-off velocities and erosive energy will be minimised by maximising the lengths of flow paths for precipitation run-off, constructing interceptor ditches and transport, and lining unavoidably steep interceptors or conveyance channels with low gradients to minimise secondary erosion, and ditches with filter fabric, rock or polyethylene lining to prevent channel erosion;
- The crossing of watercourses at natural fords will not be permitted due to the uncontrolled sedimentation that can be generated,
- The creation of fords on streams and rivers through the introduction of stone shall be prohibited,
- There will be designation of appropriate locations set back from watercourses and methods for stockpiling soil, aggregates, chemicals, etc.,
- Heavy vehicular movements will be restricted adjacent to watercourse and tidal areas in order to avoid inputs;
- Run-off from stockpiles will be collected via a shallow toe drain which will discharge to a settlement pond. Settlement ponds will be designed and sized to adequately attenuate suspended solid run-off from stockpile areas'. Sediment build-up will be removed at regular intervals by manual means only and will be treated at an appropriately authorised waste management facility;
- Existing and proposed surface water drainage and discharge points shall be mapped on a site plan including the location of existing and proposed measures such as monitoring points, sediment traps, settlement lagoons and hydrocarbon separators, and
- Excavations for foundations and piles will be carried out so as to minimise sediment run off.
- **Chapter 9: Hydrology and Drainage** provides further specification for suspended solid control.

10.5.1.2 Pollution with Other Substances

The following guidelines based on Chilibeck *et al* (1992) and NRA (2005) shall be followed for the protection of all watercourses from pollution with other substances:-

- The storage of oils, fuel, chemicals, hydraulic fluids, etc. will not occur within 100m of all watercourses and will be undertaken in accordance with current best practice for oil storage (Enterprise Ireland, BPGCS005) on an impervious base within a bund and appropriately secured;
- All machinery operating in these locations will be steam-cleaned in advance of works and routinely checked to ensure no leakage of oils or lubricants occurs;

[34] The standard is expressed as an average concentration over a period of 12 months and does not apply to suspended solids with harmful chemical properties. http://www.irishstatutebook.ie/eli/1988/si/293/made/en/print

- All fuelling of machinery will be undertaken at least 100m set-back from all watercourses;
- Raw or uncured waste concrete will be disposed of by removal from the site;
- Wash down water from exposed aggregate surfaces, cast-in-place concrete and from concrete trucks will be trapped on-site to allow sediment to settle out and reach neutral ph before clarified water is released to the stream or drain system or allowed to percolate into the ground;
- Any spillage of fuels, lubricants or hydraulic oils will be immediately contained and the contaminated soil removed from the site and properly disposed of;
- Oil booms and oil soakage pads will be kept on site to deal with any accidental spillage; and
- Prior to any instream works, the Contractor will ensure that all construction equipment is mechanically sound to avoid leaks of oil, fuel, hydraulic fluids and grease.

10.5.1.3 Use of Concrete

The use and management of concrete, which has a deleterious effect on water chemistry and aquatic habitats and species, in or close to watercourses shall be carefully controlled to avoid spillage. Alternate construction methods have been proposed to ensure avoidance of contamination with concrete, e.g. use of pre-cast units, stream diversions to undertake works in the dry, and permanent formwork. All avoidance measures will reduce the risks associated with concreting works. Where the use of concrete near water cannot be avoided, e.g. for in situ stitching, the following control measures will be employed:-

- When working in or near the surface water and the application of in-situ materials cannot be avoided, the use of alternative materials such as biodegradable shutter oils shall be used;
- Any plant operating close to the water will require special consideration of the transport of concrete from the point of discharge from the mixer to final discharge into the delivery pipe (tremie). Care will be exercised when slewing concrete skips or mobile concrete pumps over or near surface waters;
- Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works;
- There will be no hosing of concrete, cement, grout or similar material spills into surface water drains. Such spills shall be contained immediately and runoff prevented from entering the watercourse;
- Concrete waste and wash-down water will be contained and managed on site to prevent pollution of all surface watercourses;
- On-site concrete batching and mixing activities will not be allowed and will be specifically prohibited in the contract documents;
- Washout from concrete lorries, with the exception of the chute, will not be permitted on site and will only take place at the batching plant (or other appropriate facility designated by the manufacturer);
- Chute washout will be carried out at designated locations only. These locations will be signposted. The concrete plant and all delivery drivers will be informed of their location with the order information and on arrival on site;
- Chute washout locations will be provided with appropriate designated, contained impermeable area and treatment facilities including adequately sized settlement tanks, and

- The clear water from the settlement tanks shall be pH corrected prior to discharge (which shall be by means of one of the construction stage settlement facilities) or alternatively disposed of as waste to a licensed facility.

10.5.1.4 Construction of Culverts

The proposed M28 Road Project will necessitate a number of culvert extensions and new culverts to be installed, 7 of which are required at water courses - - 1 no. crosses the Woodbrook Stream, 1 no. crosses the Donnybrook Stream and 5 no. cross the Glounatouig Tributary. The remaining culverts are located at interceptor ditches. Culverts have been designed in accordance with the requirements of the OPW, the statutory authority responsible for arterial drainage, IFI (2016) Guidelines and the NRA's DMRB. **Chapter 9**, **Table 9.7** indicates the locations and lengths of proposed culverting of watercourses. **Chapter 9** and the Drainage Design Drawing DR001-DR007 in **Volume 5** details the locations of proposed culverts.

The proposed M28 Road Project has been designed and will be constructed in such a way as to ensure that the Woodbrook, Donnybrook and Glounatouig streams remain passable for fish where this is currently possible, and other aquatic fauna. This will be achieved by providing 'natural' rough substrates which will slow currents near the bottom of the culvert and create flow refuges enabling invertebrates and juvenile fish to migrate upstream in otherwise impassable water velocities. All watercourse crossing works will be supervised by a suitably trained Ecological Clerk of Works.

For the culvert proposed on the Donnybrook Stream at the Carr's Hill interchange, concerns expressed by IFI were taken on board and an alternative stream diversion and culvert designed. The stream will now be diverted at a right angle and then carried in open channel (newly constructed to fishery design specification) to the west of the proposed new carriageway.

The construction of the proposed culverts will be carried out in line with the guidelines and standards of TII and IFI.

At minimum, new culverts along the proposed road will achieve the following:

- The 1 in 100 year flood flow rate generated within the upstream catchment;
- An increase of 20% on the 1 in 100 year flood flow to allow for climate change effects;
- The culvert shall be capable of operating under the above conditions while maintaining a freeboard of at least 300 mm, and
- The proposed culverts have been designed in consultation with IFI to minimise any negative effect they may have the aquatic environment.

During the construction phase the Contractor shall ensure that:

- Instream works, where required, shall be undertaken during the period 1st May to 30th September as required by IFI to avoid accidental damage or siltation of spawning beds. This shall include preparatory work such as piling or rock blasting in the vicinity of all watercourses. Bank works shall not interfere with migrating fish from March to June and spawning fish migration from October to February;
- Where bank protection works may be required (i.e. upstream and downstream of new structures, to ensure no undercutting or destabilisation of either the structure or riparian bank

areas occurs) large enough boulders shall be selected by the Contractor and strategically positioned, to ensure they cannot be undercut;

- If rock armour is required, the height to which this is built shall take account of the riparian zone, and if relevant, where protection of bird species is required. The Contactor shall adhere to IFI (2016) guidelines; and
- Bridge and culvert design has avoided impacting on flow regimes and river bed profiles upstream and downstream of the structure and has allowed for unimpeded movement of fish by ensuring a minimum depth of water within the structure. The Contractor shall ensure that flow regimes for all crossings identified as supporting salmonids, particularly Donnybrook and Glounatouig streams which exhibited best salmonid potential, shall allow for the unimpeded passage of fish upstream and downstream by having the invert buried 500m below bed level.

10.5.1.5 Stream Diversions

The existing watercourses will need to be modified by the construction of a number of new sections of open channel in order to interface with the drainage system and the alignment. There are 7 no. stream/spring diversions proposed, 3 no. of Donnybrook Stream, 2 no. of Woodbrook Stream, 1 no. at a land drain to the Glounatouig Stream. The 7th location is a diversion of Loughbeg Spring; see **Table 9.6** - **Summary of Stream Diversions**. DR001-DR007 Drainage Design Drawings in **Volume 5** details the locations and lengths of proposed stream diversions.

Mitigation as per IFI (2016) guidelines was adhered to in the design of permanent and/or temporary stream diversions.

During construction, the Contractor shall ensure that:-

- Permanent stream diversions within the Woodbrook, Donnybrook and Glounatouig streams will only be carried out in consultation with IFI;
- Detailed designs for realignments are submitted for approval to IFI, including the approach and departure channels to link back into the natural streams. This may include the need for bends and meanders to be incorporated, and if possible, the improvement of existing stream conditions if warranted (through river enhancement). The designs shall take into consideration the sinuosity and riffle ratio of the existing river and provide details of the substrate composition for the reconstructed channel. Realignments shall reflect the natural river systems in both plan and profile, and be compatible with the upstream and downstream sections of the existing channel. Landscaping along realigned sections of watercourse will aim to recreate riparian habitats using exclusively appropriate native species;
- Permanent stream diversions shall be completed as far in advance as possible. The channel will be constructed in such a way as to minimise suspended solids released when the river is rerouted, and to replicate existing upstream and downstream channel conditions as regards width, depth, gradient and instream material. These should also be sized to accommodate flood events;
- New stretches of watercourse on realignments shall be completed and have vegetation established prior to connecting to the original watercourse. Abandoned stretches shall be electro-fished by suitably qualified personnel (under licence) or by IFI (if agreed) to salvage fish stocks that were identified as occurring or having the potential to occur. If electrofishing is undertaken by IFI, they will be suitably reimbursed for the cost of fish removal and replacement;

- Temporary stream diversions within the Woodbrook, Donnybrook and Glounatouig streams will only be carried out in consultation with IFI;
- The diversions shall be excavated in isolation of stream flow e.g. through the use of coffer dams or other such techniques, starting from the bottom end of the diversion channel and working upstream to minimise sediment production. The temporary channel will be constructed in such a way as to minimise suspended solids being released when the river is re-routed. Upon completion, the river bank shall be stabilised around the temporary diversion;
- Silt curtains derived from Terram or other similar material will be placed along the stream banks to avoid sedimentation to the channel. These would need to be checked on a regular basis with the heavy material removed from the first silt curtain thereby keeping it functional;
- Works will be carried out during low flow periods to minimise silt disturbance and during the specified timeframes allowed by IFI (1st May to 30th September);
- Temporary silt traps will be installed downstream of works;
- Riparian plants, trees and instream material(s) as necessary, will be transferred to the newly created channel and carried out under IFI's direct supervision;
- Gravels and stones removed from the dried out river channels will be securely stored for re-use in the newly created river channel;
- Once constructed, to allow the new channel to stand with water – which will give time for planted vegetation to become established before water flows through the diversion and this will, in turn, provide protection for new earthworks, and
- Newly constructed river and stream channels shall have banks battered to a finished angle of not greater than 45o on one bank and not greater than 30o on the opposite banks, (to allow for maintenance of a low flow channel, and overflow and a flood flow channel). Banks shall be top soiled and seeded so as to ensure the growth and development of a broad range of local grasses and shrubs thereby facilitating development of stable bank root structures. Broadleaves shall, where prescribed by IFI, be planted along newly created channel so as to provide a mixture of dapple and shade conditions. Planting shall be a minimum of 5m from the watercourse channel.

There shall be maintenance of good site management at all times and all site personnel will be made aware of the importance of the freshwater environment and the requirement to avoid pollution of all types, throughout all stages of the construction phase of the proposed M28 Road Project.

10.5.1.6 Environmental Incidents and Accidents

- An emergency-operating plan shall be established to deal with incidents or accidents during construction that may give rise to pollution within any watercourse. This shall include means of containment in the event of accidental spillage of hydrocarbons or other pollutants (including oil booms, soakage pads, etc.) (refer to **Section 3.13** of **Chapter 3: Description of the Proposed Road Development**);
- Throughout all stages of the construction phase of the proposed road project the Contractor shall ensure that good housekeeping is maintained at all times and that all site personnel are made aware of the importance of the freshwater environments and the requirement to avoid pollution of all types.
- All hazardous materials on site will be stored within secondary containment designed to retain at least 110% of the storage contents;
- Temporary bunds for oil/diesel storage tanks will be used on the site during the construction phase of the project as appropriate;

- Safe handling of all potentially hazardous materials will be emphasised to all construction personnel employed during this phase of the project and an emergency response plan shall be in place, in case of accidental spillage;
- Raw or uncured waste concrete will be disposed of by removal from the site;
- Any spillage of fuels, lubricants or hydraulic oils will be immediately contained and the contaminated soil removed from the site and properly disposed of, and
- There shall be no discharge of un-attenuated water to the adjacent marine environment.

10.5.1.7 Dust Suppression and Water Abstraction

Abstraction from local water courses for use as dust suppression will not take place. Wheel washes will be self-contained systems that do not require discharge of the wastewater to water bodies and water misting or sprays shall be used as required if particularly dusty activities are necessary during dry or windy periods (See **Chapter 13: Air and Climatic Factors**). Site roads shall be regularly cleaned and maintained as appropriate. Hard surface roads shall be swept to remove mud and aggregate materials from their surface while any un-surfaced roads shall be restricted to essential site traffic only. Any site roads with the potential to give rise to dust will be regularly watered, as appropriate, during dry and/or windy conditions (also applies to vehicles delivering material with dust potential). Stockpiling of materials shall be designed and laid out to minimise exposure to wind.

10.5.1.8 Hydrology Changes

In order to maintain flow velocities and existing channel morphology, the construction of culverts and stream diversions will be carried out in line with the guidelines and recommendations of TII, the OPW and IFI. A number of new sections of open channel will be constructed. These open channels will be sized to accommodate the 1 in 100 year flood flow plus an allowance of 20% to account for climate change in line with the requirements of the OPW and TII requirements.

The OPW recommends a minimum culvert dimension of 900mm for any culvert in order to reduce the likelihood of blockage with debris during high flows. New culverts for this route have been designed to accommodate 1 in 100 year flood flows plus 20% for climate change without heading up at the upstream end. In general, culverts will be constructed along the line of the existing watercourse and where possible to a similar width to that of the natural low-flow channel. However, this will have to be balanced with the need to keep culvert lengths to a minimum to allow sufficient natural light to reach the water. Larger culverts will have their invert buried to a depth of 500mm to simulate a natural stream bed. Heading up is undesirable in culverts and a clear head room of 300mm over the level of the 1 in 100 year design flow will be maintained. For minor water courses or drains that are normally dry in the absence of rainfall, a minimum culvert dimension of 900mm will be used. For more substantial watercourses which are in constant flow a minimum clear opening dimension of 1,200mm is considered more appropriate. Concrete shall not be used to prevent erosion of stream beds and banks where a softer option is available.

Further details are provided in **Chapter 9: Hydrology and Drainage.**

10.5.1.9 Invasive Species Measures

Invasive species can be introduced into a location by contaminated vehicles and equipment, in particular tracked vehicles, which were previously used in locations that contained invasive species.

- An Outline Invasive Species Management Plan (**Appendix 12C**) has been prepared for the proposed Road Project and this should be implemented by the Contractor.

10.5.1.10 Timing of Instream Works

There are significant variations in the timing and duration of salmonid (salmon and trout) spawning activity throughout the Republic of Ireland (IFI, 2016). To minimise adverse impacts on the fisheries resource, instream works will be carried out between 1st May and 30th September as agreed with IFI. Given the presence of brown trout in the Donnybrook and Glounatouig streams, consultation will be undertaken with IFI prior to the scheduling of instream works including all culvert design and installation and temporary and permanent stream diversions.

10.5.2 Operational Phase

10.5.2.1 Surface Water Drainage Design

Measures to attenuate and treat carriageway run-off have been incorporated into the drainage design of the proposed M28 Road Project – see **Chapter 9: Hydrology and Drainage** in accordance with TII standards. The proposed M28 Road Project involves the construction of a new surface water drainage system for the proposed road including new outfalls to existing watercourses or existing surface water drainage networks. Furthermore, the proposed road project will cross a number of local watercourses, necessitating stream realignments, new culvert crossings and extensions to existing culverts. The stream diversions, culverts, surface water drainage network, and catchment run-off interceptors have been designed so as to minimise the potential impact on the receiving watercourses.

Attenuation measures in the form of attenuation tanks/ ponds and grassed swales are proposed to reduce the rate of run-off discharged to the receiving watercourses.

In order to minimise the risk of overloading the receiving streams/ rivers and existing surface water drainage networks, it is proposed to limit the rate at which flow is discharged from the attenuation tanks and ponds to the 'greenfield' or pre-development run-off rate from that catchment area.

While the primary purpose of the attenuation ponds, tank and swales is to reduce the risk of flooding in the receiving watercourse/ networks, they will also contribute to improved water quality by facilitating settlement and deposition of sediment and contaminants carried through the pipe network from the carriageway.

The surface water drainage network will discharge run-off from the mainline of the road to ground, watercourses, existing surface water drainage networks or onto the foreshore. A total of 13 no. outfall locations are proposed for the mainline road drainage.

Where no surface water course or existing drainage network is available, it is proposed to provide soakaways which will discharge run-off to ground.

The proposed surface water drainage system includes measures to reduce the concentrations of pollutants that are routinely found in road run-off and which pose a risk of short-term acute impacts (from dissolved/ soluble pollutants) and/ or long-term chronic impacts (from sediment bound pollutants on receiving waters). As part of the proposed surface water drainage design, a Class I by-pass hydrocarbon interceptor will be provided upstream of each proposed outfall.

The hydrocarbon interceptors incorporated within the design of the proposed surface water drainage network are primarily aimed at removing hydrocarbons from run-off. However, in order to ensure that the concentrations of other types of pollutants, e.g. heavy metals and sediment are reduced to an acceptable level, the following which have been incorporated within the surface water drainage network, will contribute to the treatment of surface water run-off from the proposed M28 Road Project:

- Filter Drains,
- Grassed Swales,
- Infiltration Trenches,
- Retention Ponds,
- Class I forecourt interceptor and Class I By-Pass Separator at the Service Area, and
- The details on the proposed drainage measures are outlined in **Chapter 9: Hydrology and Drainage.**

10.5.2.2 Environmental Incidents and Accidents

The surface water drainage system (**Chapter 9: Hydrology and Drainage**) has been designed to limit the potential for contaminated surface water run-off to reach the surface water during the operational and construction stage. All run-off from the fuel filling areas will be collected within a closed drainage system which will pass through a closed tank interceptor before being discharged to the main surface water drainage system. The drainage system has been designed such that all surface water run-off from potentially contaminated areas, including roadways, car-parks and the fuel filling station (following initial treatment) will pass through an attenuation and treatment system which has been designed to treat water to achieve a hydrocarbon concentration of less than 5mg/l. The retention/interceptor system within the fuel filling area has been designed to contain the maximum contents of a tanker delivering fuel at the site. Refer to **Chapter 9: Hydrology and Drainage** for details of the guidelines and mitigation that will be implemented for the proposed road project in order to avoid impacts to surface water and groundwater.

10.6 RESIDUAL IMPACTS

The significance of impacts remaining from the proposed road project, with the implementation of mitigation measures, are summarised in **Table 10.15** and **Table 10.16** below.

Table 10:15: Residual Impacts during Construction Phase of the Proposed M28 Road Project on Aquatic Ecological Receptors

Aquatic Ecological Receptors	Suspended Solids Pollution	Pollution by Other Substances	Construction of Culverts / Stream Diversions	Hydrological Changes	Environmental Incidents and Accidents
ER 1 Woodbrook Stream	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant
ER 2 Donnybrook Stream	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant
ER 3 Glounatouig Stream	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant
ER 4 Lough Mahon TWB / Douglas River Estuary pNHA	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant
ER 5 Raffeen Coastal Lagoon CWB	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant
ER 6 Monkstown Creek pNHA	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant
ER 7 Cork Harbour CWB / Cork Harbour SPA	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant
ER 8 Lough Beg pNHA	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant
ER 9 Great Island Channel SAC	Not Significant	Not Significant	Not Significant	Not Significant	Not Significant

It is determined that the residual impacts remaining from the proposed M28 Road Project during the construction phase, will be not significant.

Table 10:16: Residual Impacts during the Operational Phase of the Proposed M28 Road Project on Aquatic Ecological Receptors

Aquatic Ecological Receptors	Pollution by Contaminated Water	Hydrocarbons Run-off	Hydrology Changes	Environmental Incidents and Accidents
ER 1 Woodbrook Stream	Not Significant	Not Significant	Not Significant	Not Significant
ER 2 Donnybrook Stream	Not Significant	Not Significant	Not Significant	Not Significant
ER 3 Glounatouig Stream	Not Significant	Not Significant	Not Significant	Not Significant
ER 4 Lough Mahon TWB / Douglas River Estuary pNHA	Not Significant	Not Significant	Not Significant	Not Significant
ER 5 Raffeen Coastal Lagoon CWB	Not Significant	Not Significant	Not Significant	Not Significant
ER 6 Monkstown Creek pNHA	Not Significant	Not Significant	Not Significant	Not Significant
ER 7 Cork Harbour CWB / Cork Harbour SPA	Not Significant	Not Significant	Not Significant	Not Significant
ER 8 Lough Beg pNHA	Not Significant	Not Significant	Not Significant	Not Significant
ER 9 Great Island Channel SAC	Not Significant	Not Significant	Not Significant	Not Significant

The residual impacts remaining from the proposed M28 Road Project during the operational phase will not be significant. It is however anticipated that there will be an overall improvement in water quality in general from the proposed road project because there is currently no formal treatment or attenuation measures in place to control run-off from the existing N28 or proposed Service Area site. Following construction of the proposed road project, the surface water drainage system will reduce the concentrations of pollutants that are routinely found in road run-off and which pose a risk of short-term acute impacts (from dissolved/ soluble pollutants) and/ or long-term chronic impacts (from sediment bound pollutants). All of the potentially significant impacts of the proposed M28 Road Project have been avoided through the design process, or reduced through specified mitigation.

Therefore, with best practice design which has been built into the proposed M28 Road Project and the implementation of specified mitigation measures, the impact of the proposed M28 Road Project is considered to be not significant.

10.7 MONITORING

It is proposed that monitoring of surface water quality at a number of locations on the Woodbrook, Donnybrook and Glounatouig streams, and downstream of attenuation elements e.g. retention ponds, is undertaken in order to provide empirical evidence that the drainage system as specified is operating to the indicative treatment efficiencies as specified in TII DN-DNG-03022 (see **Chapter 9: Hydrology and Drainage, Table 9.4**). The drainage design has been determined using a conservative approach and best practice design to ensure that concentrations of pollutants that are routinely found in road run-off are attenuated. Monitoring of the outfalls from e.g. grassed swales, retention ponds etc., will provide the evidence base required to ensure, that the operational phase of the project is actually achieving its drainage design objectives, and that any potential for risk of contamination to designated sites, or risk to the achievement or maintenance (in the case of Cork Harbour CWB) of WFD good status, is negligible. The monitoring will begin 6 months prior to the commencement of works to determine background water chemistry conditions; will continue for the duration of the works, and for a period post construction completion.

The monitoring period prior to construction commencement will collate data from both storm events (peak flows) and low flow events in order to accurately capture the minimum, maximum, means and ranges of suspended solids and other chemicals within watercourses and transitional / coastal areas. Such monitoring coupled with flow measurement, will allow contaminant loading to surface waters to be quantified, and percentage treatment efficiencies downstream of attenuation elements to be verified (indicative efficiencies as per **Chapter 9: Hydrology and Drainage, Table 9.4**) together with optimisation of the drainage elements, should it be required.

Monitoring during the construction phase is required to demonstrate effective implementation of mitigation measures proposed such as suspended solids management, and to provide evidence that the salmonid suspended solids limit of 25mg/l average concentration over a period of 12 months, is not breached as a consequence of the works within the Woodbrook, Donnybrook and Glounatouig streams relative to background levels established pre-construction.

It is also proposed that macroinvertebrate Q-value assessments are undertaken, once prior to construction, once annually during the construction phase and once post construction. While water chemistry monitoring provides a quantitative estimate of the concentration of a range of substances in the water column at a given point in time, biological monitoring such as Q value assessments, provide a better assessment of the overall ecological health or river health, based on the presence or absence of the animals that live in the water over the preceding number of weeks and months, and therefore is a more holistic assessment of the ERs.

Table 10.17: Proposed Surface Water Monitoring Programme

Water Body	Frequency	Recommended Locations	Parameters	Rationale
Donnybrook Stream	Pre-Construction: Monthly for 6 months During Construction: Bi monthly Post Construction: Quarterly for 1 year & Annually for 2 years	Carr's Hill - at Outfall No. 5 Ch.2200	Visual inspection, Total Suspended Solids, pH, Dissolved Oxygen, BOD and Temperature, water hardness, metals, total phosphorus, petroleum hydrocarbons, PAH. Flow monitoring.	Due to proximity of Construction works
Woodbrook Stream	Pre-Construction: Monthly for 6 months During Construction: Bi monthly Post Construction: Quarterly for 1 year & Annually for 2 years	Outfall No. 2 Ch. 500	Visual inspection, Total Suspended Solids, pH, Dissolved Oxygen, BOD and Temperature, water hardness, metals, total phosphorus, petroleum hydrocarbons, PAH. Flow monitoring.	Due to proximity of Construction works
Glounatouig Stream	Pre-Construction: Monthly for 3 months During Construction: Bi monthly Post Construction: Quarterly for 1 year & Annually for 2 years	At Hilltown Bridge, at Ch.6050 and downstream of Outfall No. 10 (Ch. 7350) at Raffeen Bridge	Visual inspection, Total Suspended Solids, pH, Dissolved Oxygen, BOD and Temperature, water hardness, metals, total phosphorus, petroleum hydrocarbons, PAH. Flow monitoring.	Due to proximity of Construction works
Douglas River Estuary	Pre-Construction: Monthly for 3 months During Construction: Bi monthly Post Construction: Quarterly for 1 year & Annually for 2 years	At Outfall No. 1 Ch.100	Visual inspection, Total Suspended Solids, pH, Dissolved Oxygen and Temperature, metals, total phosphorus, TON/DIN petroleum hydrocarbons, PAH	Due to the Sensitivity and ecological importance of the Douglas River Estuary
Loughbeg Estuary	Pre-Construction: Monthly for 3 months During Construction: Bi monthly Post Construction: Quarterly for 1 year & Annually for 2 years	Outfall No. 12 Ch.11250	Visual inspection, Total Suspended Solids, pH, Dissolved Oxygen and Temperature, metals, total phosphorus, TON/DIN petroleum hydrocarbons, PAH	Due to the Sensitivity and ecological importance of the Loughbeg Estuary
Cork Harbour	Pre-Construction: Monthly for 3 months During Construction: Bi monthly Post Construction: Quarterly for 1 year & Annually for 2 years	Outfall No. 13 Ch.12450	Visual inspection, Total Suspended Solids, pH, Dissolved Oxygen and Temperature, metals, total phosphorus, TON/DIN petroleum hydrocarbons, PAH	Due to the proximity of the Proposed Service Area.

11. SOILS, GEOLOGY & HYDROGEOLOGY

11.1 INTRODUCTION

This chapter examines the soils, geology and hydrogeology along the proposed M28 Road Project. A description of the proposed road project is outlined and presented in **Chapter 3: Description of the Proposed Road Development.**

This chapter provides a description of the existing environment under the headings of soils, geology and hydrogeology. This chapter includes an assessment of groundwater vulnerability to identify the impacts of the proposed M28 Road Project on the underlying aquifers and also any potential impacts on public/private water abstractions/wells. Potential impacts on the geological heritage of the area have also been assessed. Where potential impacts have been identified mitigation measures have been proposed. Any residual impacts related to the proposed road project on the soils, geology and hydrogeology of the area have been identified.

11.2 METHODOLOGY

The assessment has been based on a review of the available geological and hydrogeological information including published maps, reports and information held by the Geological Survey of Ireland (GSI). Walkover field surveys were carried out along the proposed road project and consultation was carried out with the GSI. The following data sources were consulted:-

- Geological Survey of Ireland (www.gsi.ie) maps;
- Irish Geological Heritage Programme;
- OS survey vector and 'discovery' series mapping;
- Cork County Council;
- The Office of Public Works (OPW);
- Environmental Protection Agency (EPA);
- Previous reports prepared within the study area;
- John A. Wood Ltd. Raffeen Quarry EIS (2006); and
- Field Assessments.

Information on the soils and geology of the study area has been obtained from the GSI website (www.gsi.ie). Information on the extent of the public water supply schemes within the study area was obtained from Cork County Council.

The results of the preliminary ground investigations have been included in the assessment. The site investigation (SI) work has been carried out in a number of phases. Preliminary ground investigations were carried out by Priority Drilling Ltd. between July and November 2006 and between March and May 2008. Additional SI was carried out in 2014 by Priority Geotechnical Ltd. Copies of the logs of the boreholes, trial pits and slit trenches referred to in this chapter are included in **Appendix 11A** contained in **Volume 4** of this **EIS.**

This chapter has regard to the guidelines set out in the following publications:-

- Geology in Environmental Impact Statements A Guide (IGI, 2002);
- Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2009);
- Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (IGI, 2013);
- Drainage Design for National Road Schemes- Sustainable Drainage Options, NRA (2014);
- TII Publication -Road Drainage and the Water Environment, DN-DNG-03065 (2015);
- NRA Project Management Guidelines (NRA, 2010);
- Draft Revised Guidelines on the Information to be contained in Environmental Impact Statements (EPA, 2015);
- Draft Advice Notes for Preparing Environmental Impact Statement (EPA, 2015);
- Guidelines on the information to be contained in Environmental Impact Statements (EPA, 2003);
- Advice Notes on current practice in the preparation of Environmental Impact Statements; (EPA, 2003); and
- Environmental Impact Assessment of National Road Schemes – A Practical Guide (NRA, 2008).

The EU Water Framework Directive (2000/60/EC) established a framework for the protection of both surface and ground waters. Transposing legislation 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 South West 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.

In accordance with EPA guidance, the impacts have been assessed as positive, neutral or negative while the magnitudes have been assessed in accordance with the EPA criteria as outlined in **Table 11.1.**

Table 11.1: Assessment of Magnitude of Impact

Magnitude 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.

The duration of the impacts has been assessed as follows:

- Temporary (construction related and lasting less than one year).
- Short-term (lasting 1 to 7 years).
- Medium-term (lasting between 7 to 15 years).
- Long-term (lasting 15 to 60 years).
- Permanent (lasting over 60 years).

11.3 RECEIVING ENVIRONMENT

A desk study review of the soils and geology information contained in the GSI's interactive mapping website (www.gsi.ie) has been undertaken.

The assessment covers a study area of 500m radius, measured from the centreline of the proposed M28 Road Project in accordance with *NRA Guidelines on procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*, 2009.

A wide range of data is now available to view online through the groundwater public viewer on the GSI website and includes the following: bedrock geology map, aquifer maps, vulnerability map, subsoil data (Teagasc), karst features, aggregate potential, geological heritage and well database.

11.3.1 Bedrock Geology

The bedrock within the study area comprises Devonian and Lower Carboniferous age rocks. The Devonian rocks form the bedrock in the northern portion of the study area while the Lower Carboniferous rocks are concentrated in the low lying ground in the area between Shannonpark and Ringaskiddy. Information on the rock formations has been obtained from the Bedrock Geology 1:100,000 Map Series "*Geology of South Cork Sheet 25*" (GSI, 1995) and is presented in **Figure 11.1**. Information on the mapped outcrops of bedrock has been obtained from the 1:10,560 field sheets for the study area and the site investigation data.

The structural geology of the study area is characterised by the presence of rocks folded along east to west trending fold axes. The main fold axes within the study area are the Cloyne Syncline, the Ringaskiddy Anticline and the Lough Beg Syncline. Within the study area the limestone bedrock tend to form the underlying geology in the low lying areas with the sandstones and mudstones forming the bedrock on the higher ground. The bedrock is cross cut by a series of north to south trending faults. Highly fractured rock core was picked up during site investigation in BH's RC1005, Ch. 950 which correlates with the north-south trending faults in this area. In BH/RC1025, Ch. 5,100 there is a very high persistence of fracturing; this borehole is located in close proximity to a mapped north-south trending fault. The locations of BH's RC1005 and BH/RC1025 are indicated on **Figure 11.1.** Borehole logs for RC1005 and BH/RC1025 can be found in **Appendix 11A,** contained in **Volume 4** of this EIS.

Secondary permeability is developed in the bedrock aquifers in the area due to fracturing associated with folding and faulting of the bedrock. In addition the permeability of the limestone units has been enhanced by the chemical solution of the limestone and the development of karst conduits.

Figure 11.1: M28 Cork to Ringaskiddy Project – Bedrock Geology

Devonian Old Red Sandstone

There are two bedrock formations of Devonian age within the study area, these being the Gyleen Formation and the Ballytrasna Formation. The proposed road project is located within the area of Devonian Old Red Sandstone between Ch. 650.5 (boundary of Old Head Formation and Gyleen Formation at the north of the study area) and Ch. 5,350 (boundary of Gyleen Formation and Old Head Formation between Ballinrea and Hilltown).

The Gyleen Formation (GY) forms the bedrock in the extreme north of the study area in the Rochestown and Douglas area and also outcrops to form the bedrock further south in the townlands of Ballinrea and Raheenering. The Gyleen Formation is described as comprising sandstone with mudstone and siltstone.

The Ballytrasna Formation (BS) forms the bedrock in the northern part of the study area. It forms the bedrock in the area from where the ground elevation starts to rise i.e. in the area south of Rochestown and extends as far south as the Five Mile Bridge area. This formation comprises purple mudstone with some sandstone.

Cork Group (Upper Devonian and Lower Carboniferous Rocks)

The Cork Group is a group of marine rocks that were deposited during the late Devonian and early Carboniferous. There are two formations from the Cork Group within the study area these being the Old Head Sandstone Formation (OH) and the Kinsale Formation (KN).

The Old Head Sandstone Formation (OH) comprises rippled (flaser bedded) grey sandstone and minor mudstone. Thin exposures of this rock formation occur within the study area along a line extending from Carrigaline across Cork Harbour to Whitegate.

The Kinsale Formation (KN) is subdivided into a number of members (based on local features) but generally comprises mud dominant rocks including grey mudstones and sand lensed mudstones with rippled (flaser bedded) sandstones.

The individual members from the Kinsale Formation that have been mapped by the GSI within the study area include the Castle Slate Member (KNcs), the Cuskinny Member (KNcu), the Pig's Cove Member and the Courtmacsherry Formation (KNcy).

The Castle Slate member is described as a grey mudstone. The Cuskinny Member is described as a rippled (flaser bedded) sandstone and mudstone. While the Pig's Cove Member is described as a mudstone which contains sand lenses. The Courtmacsherry Formation is composed of mainly grey calcareous mudstones with subsidiary limestones.

The various members of the Kinsale Formation form the bedrock within the northern section of the study area in the area between Rochestown and Lough Mahon and south of Hilltown in the area extending southwards to Ballynametagh and extending east towards Raffeen.

The proposed M28 Road Project is mapped as being underlain by the Cork Group rocks between Ch. 125 and Ch. 675 in the northern portion of the study area. In the southern portion of the study area they lie between Ch. 5,350 and Ch. 6,150, Ch. 8,450 to Ch. 10,900 and Ch. 11,250 to Ch. 12,250 (in the vicinity of the Martello Tower).

Carboniferous Limestones

There are three rock formations from the Carboniferous period outcropping within the study area; the Ballysteen Limestone Formation, the Waulsortian Limestone Formation and the Little Island Formation. Overall the proposed M28 Road Project is located within the area of Carboniferous Limestones between Ch. 0 - Ch. 125, Ch. 6,180 - Ch. 8,450, Ch. 10,900 - Ch. 11,300 and Ch. 12,250 to the proposed Service Area in the southern portion of the study area.

The Ballysteen Limestone Formation (BA) is described as a dark grey limestone composed of fragmented fossil material (bioclastic) which becomes increasingly muddy in the upper beds. This is mapped in the area to the north of the Martello Tower at Ringaskiddy and in an area to the north of Shanbally.

The Waulsortian Limestone Formation (WA) is composed of massive pale grey fine grained clean fossiliferous limestones that were formed in mound structures. This formation forms a significant portion of the bedrock in the area from Shannonpark to Ringaskiddy, including the proposed Service Area. The 6 inch field sheet for the area covering the proposed Service Area is annotated with 'flaggy nodular limestone' in this area. The nearest boreholes from the proposed Service Area site, 250m to the south (BH1059 and BH1059A) were shallow (<1m) and did not encounter bedrock. Boreholes BH/RC1058 and BH/RC1057 are located further south but provide the closest depth to bedrock and bedrock type information. Bedrock was met at 1.3mbgl (metres below ground level) in RC1058 and comprised weathered mudstone with orange discolouration and clay smearing. Bedrock was met at 1.95mbgl in RC1057 and comprised purple mudstone with clay smearing. Boreholes BH/RC1058 and BH/RC1057 were drilled in an area of higher elevation than the low lying ground at the proposed Service Area site. Borehole logs for RC1058 and BH/RC1057 and BH/RC1025 can be found in in **Appendix 11A**. The locations of BH's RC1058 and BH/RC1057 are indicated on **Figure 11.1**. There are no swallow holes within 1km of the proposed Service Area, a karst feature 940m to the south west was the closest feature identified (see **Figure 11.6**).

During 2011 as part of a Priority Geotechnical Investigation for the Marine Energy Research Centre, limestone bedrock was encountered at four test locations (immediately south of Paddy's Point, see **Figure 11.1**) at depths of between 5.6mbgl and 10.0mbgl and it was described as moderately strong. The Little Island Formation (Ll) is composed of a thick succession of mainly mudbank limestones. This formation outcrops in a very localised area south of Carrigaline Town centre outside the study area.

Rock Strength

The area mapped as Waulsortian Limestone Formation comprises bedrock of alternating weathered limestone and siltstone. Outside of the limestone the bedrock comprises predominantly of an upper layer of weathered mudstone overlying stronger mudstone with fracturing. Stronger sandstone was found to be encountered at depth. At the north of the study area the rock is predominantly moderately weak mudstone overlying moderately strong mudstone (Cuskinny Member). Further south in the rock comprising the Gyleen Formation, rock strength is described as moderately strong (mudstone). In the area around Ch. 3,350 the rock strength is moderately weak sandstone overlying moderately strong sandstone. In the area around Hilltown in BH/RC1028 the rock (Cuskinny Member) is moderately weak mudstone overlying moderately weak sandstone. The limestone around Ballyhemiken is mainly moderately strong. In the area around Barnahely at the boundary of the limestone and Cuskinny Member the rock is described as moderately weak siltstone to moderately strong siltstone.

The stability of the rock will depend on the slope of the proposed face and the inclination of any fractures encountered. No orientated coring was carried out during the site investigation; however it was expected that rock faces cut at more than 1:1 would not be safe.

Table 11.2: Summary of the Bedrock Geology along the Proposed M28 Road Project

Approximate Chainage	Expected Geological Formation	Site Investigation Data
Ch. 650 - Ch. 1,150 and Ch. 4,600 - Ch. 5,350	Gyleen Formation Devonian ORS	Bedrock is described as weathered mudstone, with weathered rock encountered from approx. slightly >1m bgl. A deeper fractured zone is indicated between 16mbgl and 30mbgl. Depth to bedrock varied from 1.3mbgl at BH/RC 1005 to 2.5mbgl at BH1063. The overburden deposits are described as clay overlying gravel.
Ch. 1,150 - Ch. 4,600	Ballytrasna Formation Devonian ORS	Depth to bedrock ranged from 1.15mbgl to 8.35mbgl. Bedrock comprised of a top layer of weathered siltstone or mudstone overlying stronger sandstone or shale at approx. 10mbgl. Water was encountered at 5.1mbgl in BH1022.
Ch. 12,400 - Roundabout & North of Shanbally (off Chainage)	Ballysteen Formation Carboniferous Limestone	No information on bedrock from SI, only shallow cable tool boreholes were excavated here which did not encounter bedrock. Water was encountered at 2.9mbgl in BH1059B. Stability was marked as poor in TP2036.
Ch. 0- Ch. 125 (Northern extremity) Ch. 6,180 - Ch. 8,500 Ch. 10,900 - Ch. 11,280 Ch. 12,250 - Ch. 12,400 Raffeen Quarry Ch. 7,450 - Ch. 7,750	Waulsortian Formation Carboniferous Limestone	In the area south of Raffeen Bridge (Ch. 7,350 - Ch. 7,800) bedrock was encountered close to the surface at 0.7mbgl at the boundary of the quarry. Bedrock was encountered at depths of 9mbgl to 16.5mbgl just to the north of the quarry and comprised of alternating weathered siltstone and limestone. Broken cobbles of limestone rock encountered at 9mbgl. Limestone cobbles were encountered in Trial Pit TP02 (Ch. 11,100) at 2.1mbgl. SI around the edges of the quarry indicates shallow depth to bedrock of between 0.7mbgl (RC102) and 1.7mbgl (RC103). The lithology is described as grey limestone with clay bands in RC102 and slightly weathered siltstone in RC104.
Ch. 550 - Ch. 675 in the Northern half of the Study Area. Ch. 5,350- Ch. 5,500 (southern half)	Old Head Formation Cork Group Sandstone	Depth to bedrock is 5.4mbgl in the vicinity of Hilltown at Ch. 5,500. Rock is described as weathered mudstone bedrock overlying stronger mudstone at 8mbgl.
Ch. 125 - Ch. 5,75 (Douglas) Ch. 5,500 - Ch. 6,200 (Hilltown) Ch. 8,480 - Ch. 10,750 (Barnahely) Ch. 11,275 - Ch. 12,250 (Ringaskiddy)	Cuskinny Member Cork Group Sandstone & Mudstone	At Douglas depth to bedrock is 3.8mbgl to 7.8mbgl, weathered weak mudstone to stronger mudstone at approx. 10mbgl. At Hilltown depth to bedrock is 5.5mbgl approx., weak weathered mudstone overlying stronger mudstone. Strong sandstone encountered at 14.7mbgl in BH1036. Groundwater encountered at approx. 2.5mbgl. Presumed limestone bedrock was encountered at 3.59mbgl in TP2016 (close to the mapped boundary with the Waulsortian Limestones). At Barnahely siltstone bedrock encountered at 1.2mbgl & 2.5mbgl. Poor stability in trial pits walls. Bedrock encountered at approx. 1.5mbgl comprising weathered mudstone or siltstone. This upper weathered portion

Approximate Chainage	Expected Geological Formation	Site Investigation Data
		overlies stronger mudstone and siltstone between 7mbgl & 9mbgl. At Ringaskiddy depth to bedrock is shallow <2mbgl, strong mudstone in BH/RC1057 and weathered/weak mudstone encountered in BH/RC 1058. Possible siltstone bedrock encountered at 0.9mbgl in trial pits (good stability indicated). In RC06 bedrock was described as weathered shale.
Proposed Service Area	Waulsortian Formation Carboniferous Limestone	The nearest boreholes from the proposed Service Area are 250m to the south (BH1059 and BH1059A) and were shallow (<1m) and did not encounter bedrock. Bedrock comprising 'flaggy nodular limestone' is noted on the 6 Inch field sheet for the area. The GSI geotechnical viewer indicated that depth to bedrock is between 2mbgl and 5.2mbgl.

11.3.2 Soils and Subsoil Geology

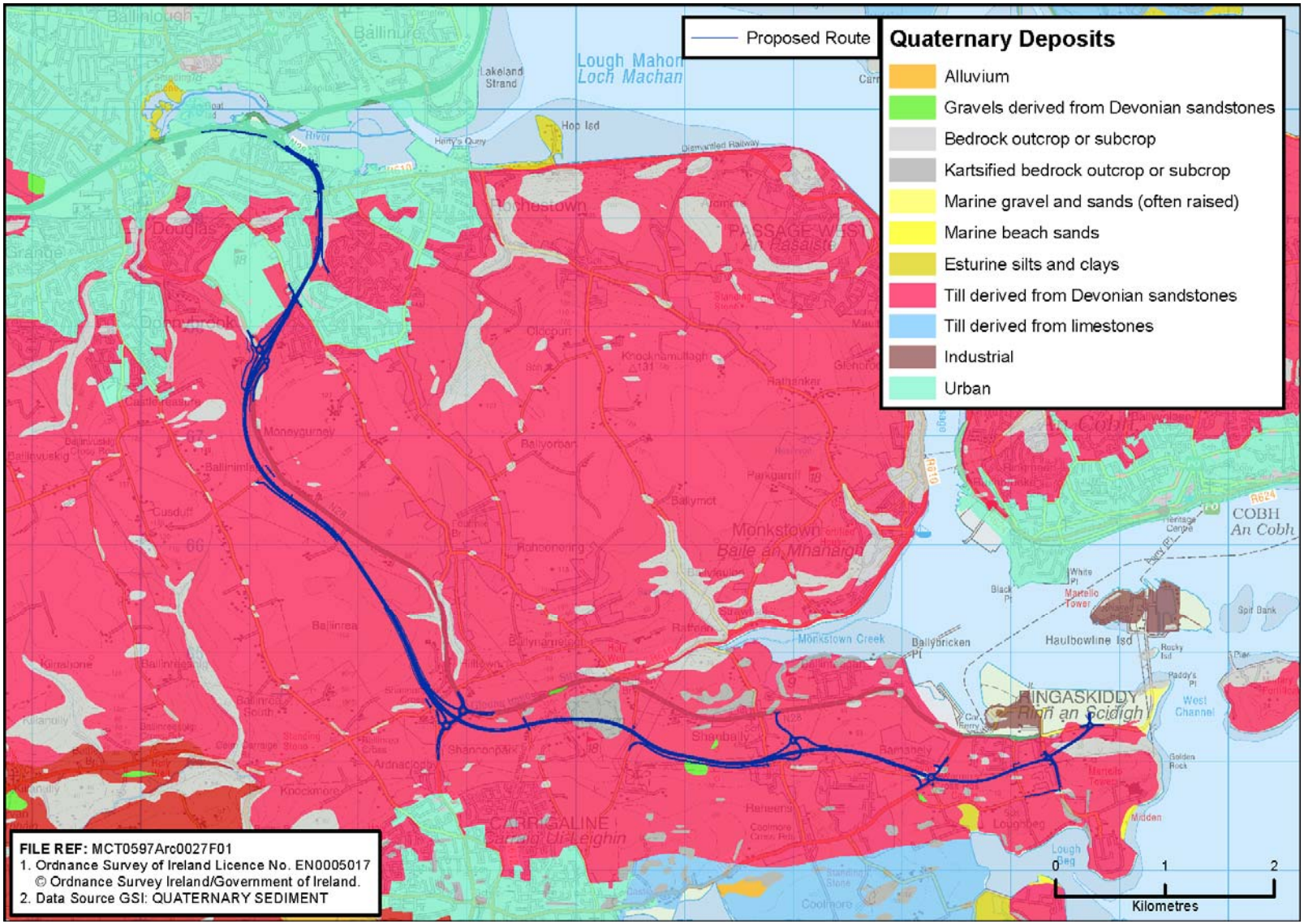
Information on the subsoil geology of the study area has been obtained from the GSI website. The online GSI subsoil data has been based on the mapping undertaken by Teagasc. The subsoil data for the study area is illustrated on **Figure 11.2.**

The data indicates the following overburden types within the study area:-

- TDSs (red areas) - till derived chiefly from Devonian Sandstones;
- Made Ground (green- urban and brown- industrial areas);
- Rck - bedrock outcrop and subcrop (grey areas); and
- KaRck - Karstified Limestone bedrock at surface (dark grey areas).

The northern portion of the study area is underlain by till derived chiefly from Devonian Sandstones (TDSs). Due to the shallow nature of the overburden deposits there are many areas of outcropping bedrock. The SI indicates possible weathered bedrock at one borehole location (BH1008) close to the surface at 0.3mbgl. Otherwise bedrock is encountered between 1.3mbgl and 8.35mbgl below the surface in the northern portion of the study area (up to BH1026).

Figure 11.2: M28 Cork to Ringaskiddy Project – Soils and Subsoils Geology



Between Shannonpark and Ringaskiddy a significant portion of the study area is underlain by till derived chiefly from Devonian Sandstones (TDSs). There are also areas where rock is at or close to the surface in this area. In this area the SI indicates that bedrock is between 1.m and 3.5m below the surface. The proposed M28 Road Project also crosses a minor area of overburden described as gravels derived from Devonian sandstones (GDSs). The deposit underlies the proposed M28 Road Project at approximate Ch. 8,450 to Ch. 8,650 in the vicinity of the sports field at Shanbally. The closest SI to the deposit are TP2020 and BH/RC1041. The overburden is described as alternating layers of clay, silt and sand to a depth of 13mbgl. At 13mbgl sandstone and mudstone gravel is encountered, described as predominantly coarse angular to sub-angular with rare mudstone cobble. The thickness of this deposit is at least 5m as the borehole BH/RC1041 was completed at 18m in depth. The large area of karstified bedrock outcrop or subcrop (KaRcK) intersecting the proposed M28 Road Project in **Figure 11.2** above is Raffeen Quarry. Raffeen Quarry lies between Shanbally and Shannonpark between Ch. 7,450 and Ch. 7,750 of the proposed M28 Road Project. The quarry contains exposed calcareous rock and limestone cliffs. SI around the edges of the quarry indicates shallow depth to bedrock of between 0.7mbgl (RC102) and 1.7mbgl (RC103). Open bore drilling described gravely clay overburden or boulder clay.

There are limited alluvium deposits within the study area and the most recent GSI map indicates these deposits are limited to the vicinity of the Owenboy River in the south west portion of the study area. The SI did not encounter any significant thickness of alluvium deposits.

A variable thickness in overburden deposits is expected in the southern and south eastern portion of the study area where karstified bedrock is present. In the area south of Raheens (illustrated as blue in **Figure 11.2**) an area of till derived chiefly from limestone (TLs) has been mapped. No SI was carried out in the limestone to the south of Raheens. The old 6 inch maps indicate fragments of shale and limestone around Coolmore. The nearest SI boreholes in this area are RC1045 and BH1046 to the north of Raheens in the Cuskinny Member where depth to bedrock was 1.5mbgl. The overburden comprised clay with cobbles in RC1045 and silt with cobbles overlying sandy gravel in BH1046.

There is an area of marine/estuarine silts and clays in the vicinity of and to the west of Curraghbinny.

The subsoil data (Teagasc data) does not indicate any significant areas of soft ground such as peat or marsh. There is one area of marine/estuarine silts and clays in the area to the west of Curraghbinny and soft deposits would be expected in the infilled area at Ringaskiddy. In the area south of Ferry View (Ch. 11,100 to Ch. 11,550), soft ground comprised of sandy gravel was encountered in TP01 and TP02 to depths of 2.5mbgl. In TP03 dynamic probes exhibited values of 2 to 3 indicative of soft deposits to a depth of 1.4mbgl and becoming firmer below this. Loose soils were also found in this area to a depth of 4.55mbgl in BH1049 and 11.3mbgl in BH1054. The loose soil comprised sandy gravel and sandy silt.

The online GSI Quaternary viewer does not have a classification for the site of the proposed Service Area as it is land reclaimed from the sea. The closest SI locations to the site of the proposed Service Area- BH1059 & BH1059A & ST6023 - indicate tar and hardcore overlying sandy gravelly clay with cobbles and rock. Boreholes on the GSI's geotechnical viewer indicate an overburden thickness of 2m to 4.9mgl. SI by Glover Site Investigations Ltd in 2006 for the Port of Cork Strategic Development Study indicated made ground to a depth of 4.6mbgl underlain by sand to 10mbgl. The made ground was composed of limestone quarry fill underlain by sand with occasional shells. **Table 11.3** summarises the overburden geology along the proposed M28 Road Project

Table 11.3: Summary Overburden Geology for the proposed M28 Road Project

Approximate Chainage	Expected Overburden Type	SI Data
Ch. 600 - Ch. 1,400	Made Ground	Predominantly topsoil (approx. 0.2 to 0.4m) overlying clay or gravel with cobbles. BH1004; overburden comprised tar & hardcore to 0.5m overlying gravel.
Ch. 1,400 - Ch. 1,430	Bedrock at Surface	N/A – 30m stretch of the proposed M28
Ch. 1,430 - Ch. 1,500	Made Ground	N/A– 70m stretch of the proposed M28
Ch. 1,500 - Ch. 1,520	Bedrock at Surface	N/A– 20m stretch of the proposed M28
Ch. 1520 - Ch. 1600	Made Ground	0.2m of topsoil overlying 0.5m of fill material, overlying clay to 1.15mbgl where bedrock was encountered (BH/RC 1009).
Ch. 1,600 - Ch. 2,200	Sandstone Till	0.3m to 0.6m of topsoil (hardcore & fill alternatively) overlying clay and/or gravel to approx. 3mbgl.
Ch. 2,200 - Ch. 2,300	Bedrock at Surface	No SI
Ch. 2,300 - Ch. 7,350	Sandstone Till	0.4m of topsoil overlying clay or silt with angular cobbles.
Ch. 7,350- Ch. 7,850 Raffeen Quarry Ch. 7,450 and Ch. 7,750	Karstified Limestone Bedrock	Approx. 8-9m of gravelly, sandy clay overlying clay with cobbles or boulders. 0.7-1.7m of boulder clay (gravelly clay).
Ch. 7,850 - Ch. 10,650	Sandstone Till	Sandy gravelly clay with increasing cobble content with depth. TP2021 & TP2022 encountered 0.3m of topsoil at surface.
Ch. 8,450 - Ch. 8,650	Gravels derived from Devonian Sandstones (GDSs)	Alternating layers of clay, silt and sand to a depth of 13mbgl overlying at least 5m of sandstone and mudstone gravel, described as predominantly coarse angular to sub-angular with rare mudstone cobble.
Ch. 10,650 - Ch. 10,750	Bedrock at Surface	0.3m of topsoil overlying sandy gravelly clay- bedrock encountered at 1.5mbgl.
Ch. 10,750 - Ch. 12,130	Sandstone Till	<3m of very sandy gravel or silt with occasional cobbles.
Ch. 12,130 - Ch. 12,300	Bedrock at Surface	0.3m of topsoil overlying clayey, sandy or silty gravel with cobbles. BH/RC1057- bedrock encountered at 1.95mbgl just to the north of Martello Tower.
Ch. 12,300 - Ch. 12,450	Sandstone Till	0.3m of topsoil overlying sandy, gravelly clay or silt with cobbles.
Ch. 00 - Ch. 25 (Side road to the west of Martello Tower)	Glacial deposits derived from Sandstone Till	RC06 encountered made ground comprising 0.2m of topsoil underlain by clay to 10.2mbgl. Slit trenches ST01 to 03 comprised a bituminous surface underlain by shale bedrock at 0.35mbgl to 0.4mbgl. Groundwater was encountered in BH1059B at 2.9mbgl.
Proposed Service Area	Made Ground/ Reclaimed land	The closest drilling locations BH1059 & BH1059A & ST6023 indicate tar and hardcore overlying sandy gravelly clay with cobbles and rock.

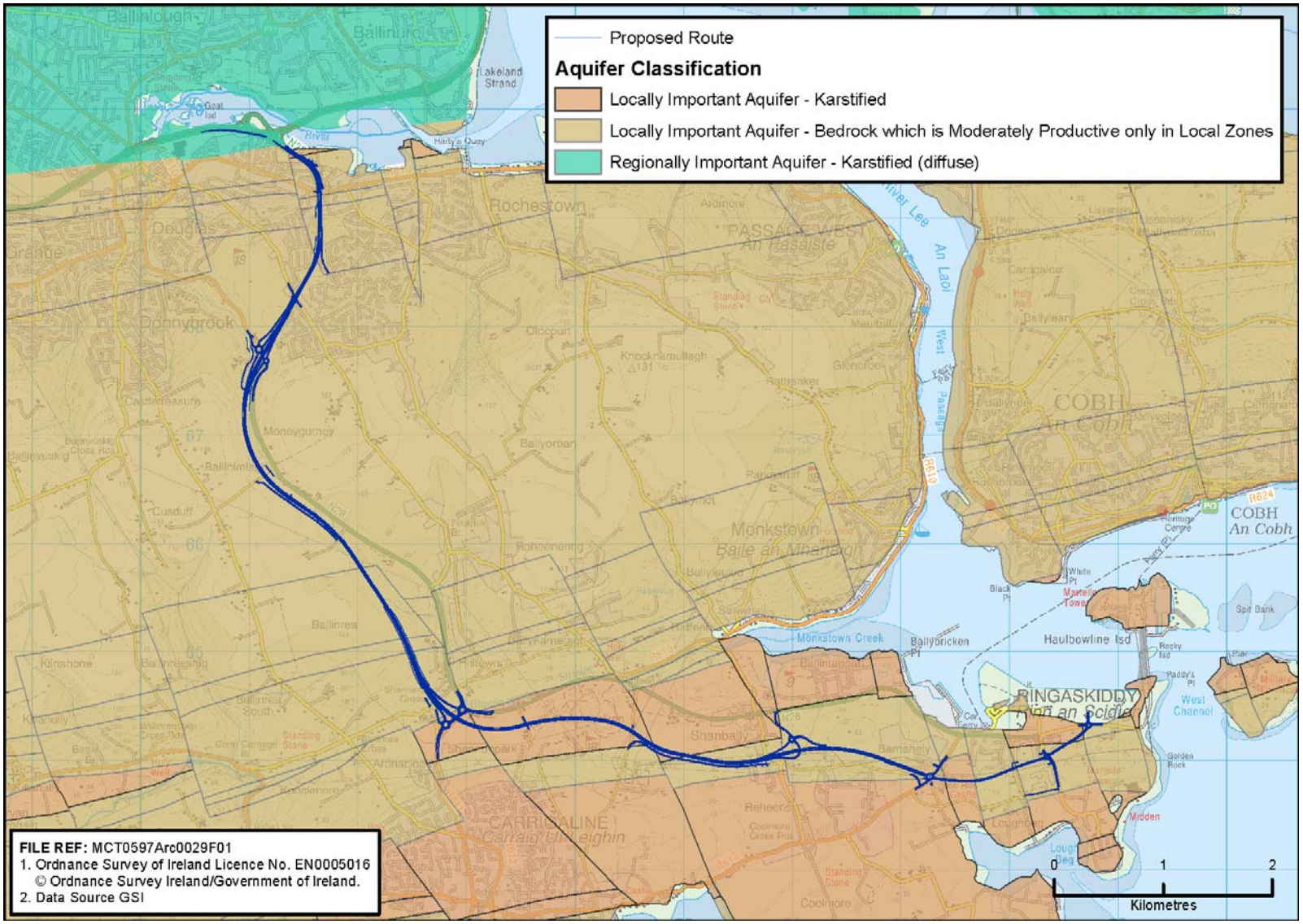
11.3.3 Hydrogeology

Information on the hydrogeology of the area has been obtained from the GSI online mapping and the ground investigations carried out by Priority Geotechnical Ltd in 2006, 2008 and 2014. The available information includes the aquifer classification data, well data, groundwater vulnerability classification, groundwater body description, groundwater body status, karst features and source protection data.

Aquifer Classification

Hydrogeological information has also been obtained from the *South Cork Groundwater Protection Scheme Report* (GSI, 2002) and accompanying maps. However, it should be noted that the aquifer classifications outlined in the *South Cork Groundwater Protection Scheme Report* maps have been revised since its publication in 2002. The most up to date information for the area is available to view online through the GSI website and has been used in the current EIS. The Aquifer Classification along the proposed road project is illustrated in **Figure 11.3.**

Figure 11.3: M28 Cork to Ringaskiddy Project – Aquifer Classification



Previously the area of Waulsortian Limestone to the north of Shanbally was classed as a Regionally Important Aquifer karst with good development potential (Rk). The area of Waulsortian Limestone extending from Carrigaline to Raheens to Loughbeg was also previously classed as a Regionally Important Karst Aquifer (Rkd). Both of these areas of Waulsortian Limestone are now reclassified by the GSI as Locally Important Karst Aquifer (LK).

Information on the well yields in the area is available from the South Cork Groundwater Protection Scheme. Three excellent yielding wells (yield > 400m^3/d) are indicated in the northern area of Waulsortian Limestone, to the north of Shanbally school. While a good yielding well is indicated in Waulsortian Limestone, in the area west of Coolmore Cross Roads.

In relation to the groundwater resource potential within the study area there are no locally or regionally important sand and gravel deposits. Apart from a small area adjacent to the Bloomfield Interchange at the first 600m of mainline chainage which is classified as Rkd, the proposed road project is underlain by bedrock which has been classed as forming a Locally Important Aquifer which is moderately productive only in Local Zones (Ll).

In the south and south eastern portion of the study area the limestone bedrock aquifers are also classed as only being Locally Important Karst aquifer (Lk). While the groundwater potential within the Waulsortian Limestone formation is good, the limited areal extent of the aquifer prevents the aquifer being classed as a Regionally Important Karst Aquifer (Rk). In general the GSI classification scheme is on the basis that Regionally Important Aquifers would be capable supporting a large number of yields in excess of 400m^3/d while Locally Important Aquifers would be capable of having moderate well yields (100-400m^3/d) and poor aquifers would be capable of having low yielding wells (< 100m^3/d).

In the area between Shannonpark and Ringaskiddy the proposed road project passes through two areas of Locally Important Karst Aquifer between Ch. 6,200 to Ch. 8,500 in the area west of Shanbally and between Ch. 11000 to Ch. 11,300 in the vicinity of Warren's Cross Roads.

There is one further area of Locally Important Karst Aquifer north of Martello Tower (Ch. 12,250 to Ch. 12,400) east of Ringaskiddy however the proposed road project is located mainly on Locally Important Aquifer (Ll) between Ch. 8,500 to Ch. 12,450.

Aquifer Vulnerability

The GSI have completed the aquifer vulnerability map for the area which is available to view and download through the GSI website (www.gsi.ie) and **Table 11.4** contains the GSI's vulnerability mapping guidelines. The vulnerability data along the proposed road project is illustrated in **Figure 11.4.** The GSI data for the study area indicates that the vulnerability over the study area ranges predominantly from extreme to high (see **Table 11.5**). This indicates a shallow depth to bedrock across the full study area.

Table 11.4: GSI Vulnerability Mapping Guidelines

Vulnerability Rating	Hydrogeological Conditions				
	Subsoil Permeability (Type and Thickness)			Unsaturated Zone	Karst Features
	High Permeability (sand/gravel)	Moderate Permeability (e.g., sandy subsoil)	Low Permeability (e.g., clayey subsoil, clay, peat)	(Sand/gravel aquifers only)	(<30m radius)
Extreme (E)	0 – 3.0m	0 – 3.0m	0 – 3.0m	0 - 3.0m	-
High (H)	>3.0m	3.0 – 10.0m	3.0 – 5.0m	>3.0m	N/A
Moderate (M)	N/A	>10.0m	5.0 – 10.0m	N/A	N/A
Low (L)	N/A	N/A	>10.0m	N/A	N/A

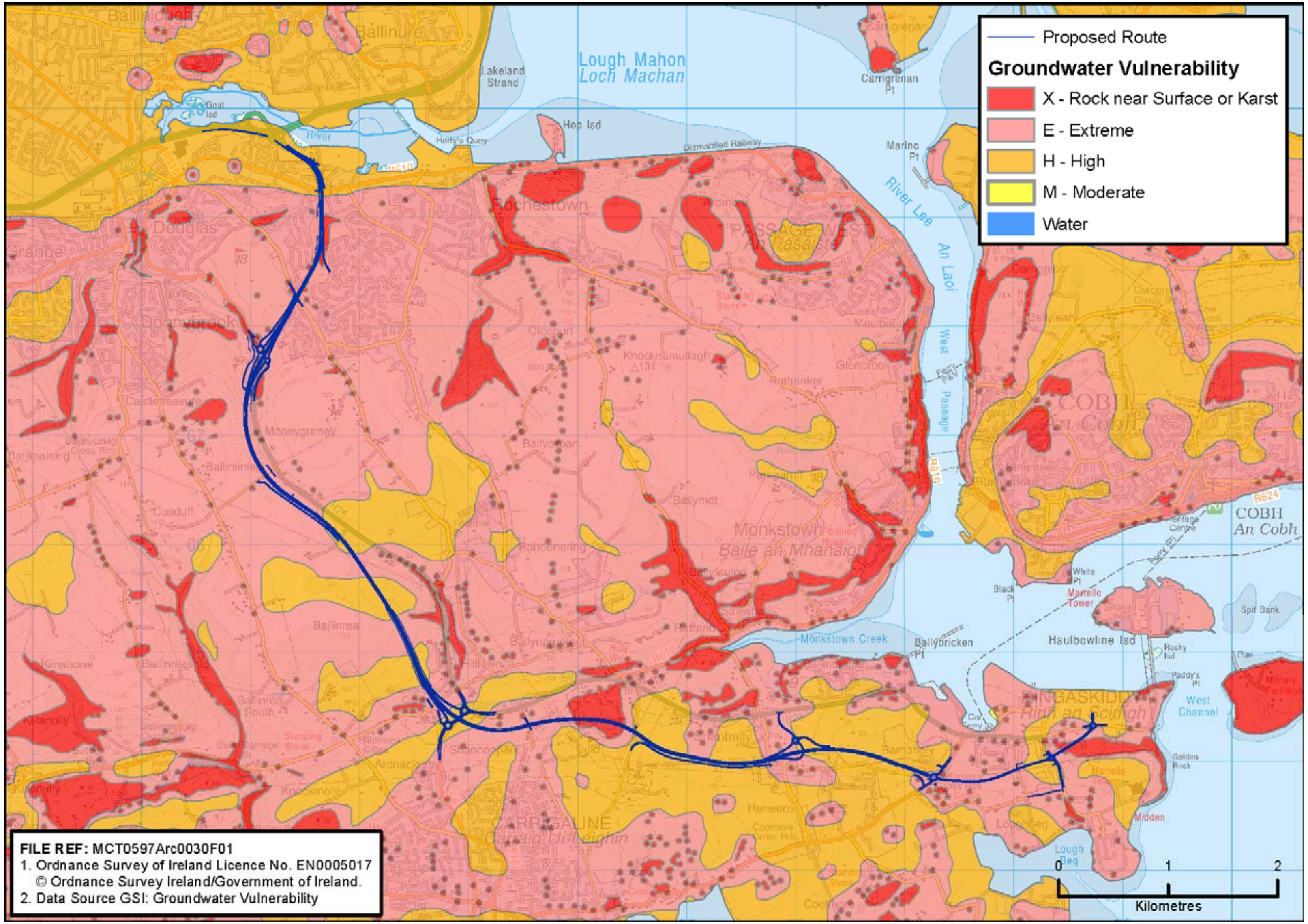
In the northern section between the area north of Ballinrea to Bloomfield Interchange (Ch. 600 to Ch. 4,050), the vulnerability has been mapped by the GSI as Extreme. Bedrock is seen to outcrop in a number of areas including Moneygourney, Hilltown, Ballyhemiken and east of Loughbeg interchange. SI data indicated depth to bedrock of between 1mbgl and 1.1mbgl in the vicinity of Moneygourney, 0.7mbgl to >4.4mbgl at Hilltown, bedrock was encountered close to the surface - 0.7mbgl in RC102 at Ballyhemiken at the edge of the quarry. Depth to bedrock from the SI indicated depth to bedrock is 1.3mbgl in the area to the east of Loughbeg Interchange.

Excavation and removal of overburden material may result in a change in the aquifer vulnerability in the area. There are a number of areas of proposed cut as summarised in **Table 11.5**. This has been assessed in terms of the available SI information and an assessment of the change made to the aquifer vulnerability rating made.

Table 11.5: Summary GSI Aquifer Classification & Aquifer Vulnerability

Approximate Chainage	Aquifer Classification	Aquifer Vulnerability
Ch0 - 600	Rkd	Low
Ch. 600 - Ch. 6,200 Ch. 8,500 - Ch. 10,900 Ch. 11,300 - Ch. 12,250 Ch. 12,400 -C Ch. 12,450	LI	Predominantly Extreme to High
Ch. 6,200 - Ch. 8,500 Ch. 10,900 - Ch. 11,300 Ch. 12,250 - Ch. 12,400	Lk	Predominantly X - (Rock at or near surface) to E (Extreme)
Proposed Service Area	No Aquifer Classification-reclaimed land.	Extreme - High

Figure 11.4: M28 Cork to Ringaskiddy Project – Aquifer Vulnerability



Groundwater Body (GWB)

The proposed road project will extend through 3 groundwater bodies including:-

- Cork City 3 Groundwater Body in the northern area between Ch. -20 to Ch. 3,050;
- Ballinhassig _1 Groundwater Body in the central area between Ch. 3,050 to Ch. 6,200; and
- Ringaskiddy Groundwater Body in the area from Shannonpark to Ringaskiddy Ch. 6,200 to Ch. 12,450.

The northern part of the study area falls within the Cork City 3 Groundwater Body. There is no groundwater body description available on the GSI website but as the rock formations are either the same or similar to the Ballinhassig Groundwater Body (see below), similar hydrogeological features are expected.

The central portion of the study area is located within the Ballinhassig Groundwater Body. This groundwater body is composed of the lower permeability sandstones and mudstones and experiences higher run-off from the ridges and higher ground. The bedrock forms a Locally Important Aquifer which is moderately productive only in local zones (Ll). Folding and faulting within the bedrock results in zones of enhanced permeability in the mudstones and sandstones. Permeability decreases rapidly with depth. Groundwater flow paths are expected to be short (30m to 300m) with groundwater discharging to small springs or streams. There may be cross flow from the aquifers in this groundwater body to the adjacent karstic groundwater bodies.

The southern section of the study area comprises groundwater resources from the Ringaskiddy Groundwater Body which are expected to be good and several high yielding wells are reported to have been drilled on the Pfizer site. The general lack of surface water drainage features in the area between Shannonpark and Ringaskiddy indicates high permeability in the bedrock. There are also reported to be springs in the area ranging from small to large with reliable discharges. There is expected to be a high degree of interconnection between the groundwater and surface water in the area with groundwater being discharged to springs and to rivers in the area.

Information on the groundwater body status for the study area is available to view on the EPA website. Information from the EPA viewer indicates the WFD Status for both 2007 to 2009 and 2010 to 2015 for the groundwater bodies along the proposed M28 Road Project has been classed as good status.

Groundwater Fed Natural Features

A number of springs have been identified within the study area during the desk study phase as shown in **Figure 11.5**. One pond and 3 springs were also identified during the ecological survey undertaken in the past.

A number of water dependent sites were identified as part of the ecological surveys including: Lough Beg pNHA, a wetland habitat of grassland and marsh, which is reported to be supported by a mix of groundwater spring, rainfall and tidal water:

- The Douglas River Estuary pNHA, a small impounded tidal wetland;

- Raffeen Quarry, a spring-fed wetland with marsh habitat and small areas of standing water; and
- A wet woodland fringing the Donnybrook and Glounatouig streams.

No further Ground Water Dependent Terrestrial Ecosystems (GWDTE) such as springs, fens, flushes, etc., were identified within the footprint or the environs of the proposed road project during the RPS field investigations.

There are few true wetland habitats within the footprint of the proposed road project. There is an artificial wetland/pond habitat at Raffeen Quarry that is likely to be fed to some extent by groundwater. Some of the species recorded there suggest a brackish element to this waterbody. A visit by a local ecologist as part of a local community group on July 3rd 2016 concluded that the quarry supports a diverse flora with 79 species and habitats of national conservation concern. The Assessment Screening carried out as part of the above mentioned habitat mapping classify the site as Locally Important (Higher value) in terms of ecological significance.

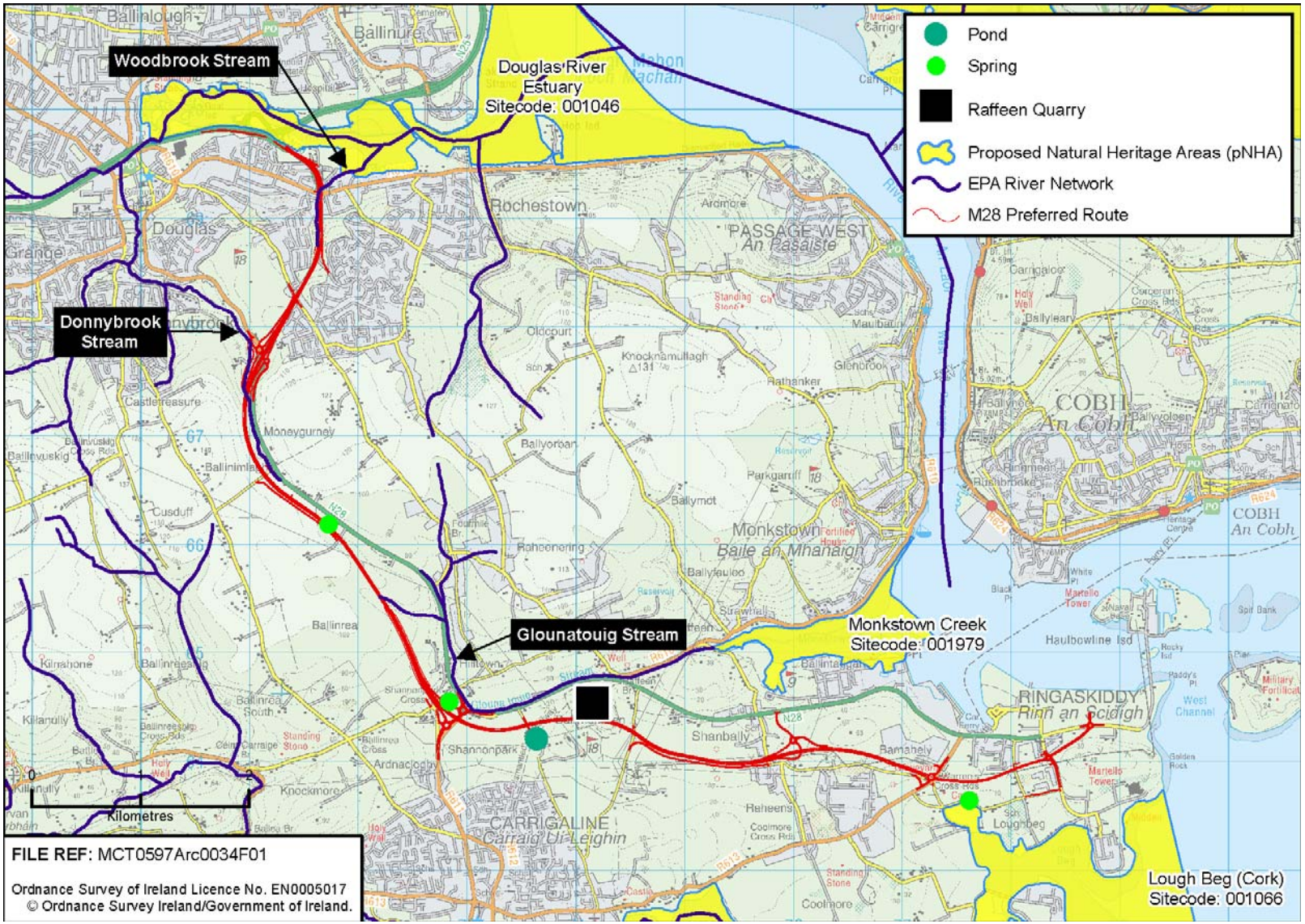
There is a marsh situated on the northern margins of Loughbeg but this seems to be influenced by tidal regimes rather than upwelling of groundwater. The proposed M28 alignment will not impact the integrity of this wetland habitat via hydrogeological pathways.

Figure 11.5 illustrates the location of the water dependent habitats identified within the footprint of the proposed M28 Road Project. There is potential for presence of karts features to be intersected and in particular the Waulsortian Limestone Formation has the potential for development of karst. A significant portion of the study area has an Extreme vulnerability rating with rock at or close to the surface and these areas would be more vulnerable to pollution from road run-off than areas classified as High vulnerability. A number of springs have been identified in the area south of Rochestown, near Monkstown Creek and near the reservoir north west of Raffeen.

Groundwater-Surface Water Linkages

The karstified bedrock of the Ringaskiddy GWB in the area from Shannonpark to Ringaskiddy represents the main groundwater pathway between the proposed road project footprint and surface water features identified in **Figure 11.5**. Between Shannonpark and Ringaskiddy there is expected to be a high degree of interconnection between the groundwater and surface water in the area with groundwater being discharged to springs and to the Glounatouig Stream and to the sea in Cork Harbour. Lough Beg pNHA lies within the Ringaskiddy GWB and is reported to be supported by a mix of groundwater spring, rainfall and tidal water. Evidence of ground water discharge to the surface was seen as water bubbling from Loughbeg Spring during the walkover field surveys. The lack of surface drainage in this GWB indicates that potential recharge readily percolates into the groundwater system.

Figure 11.5: M28 Cork to Ringaskiddy Project – Water Dependent Features



Karst Features

The proposed M28 Road Project crosses the Ringaskiddy Groundwater Body between Shannonpark and Ringaskiddy. The Ringaskiddy Groundwater Body description provides information on the karst features in the area. It reports that there are numerous surface karst features including swallow holes, collapse features and closed depressions and extensive cave systems within the pure unbedded limestones in South Munster.

Within the vicinity of the proposed road project there is a record of one karst feature at Shanbally Cave (1705NWK002) and karstification was also recorded at a borehole within the Pfizer Site (1705NWK001). There is also a karst spring at the coast indicated in the area south of Ballybricken Point. These features are indicated on **Figure 11.6** as Karst Features GSI.

Karst features are developed within the limestone bedrock in the south and south east of the study area. The karst features which are known to be present are shown on **Figure 11.6**. These include a cave, springs and a swallow hole. Within the study area the development of karst features is expected to be concentrated in the Waulsortian Limestone Formation (WA) however the *South Cork Groundwater Protection Scheme Report* (2002) does indicate that a few karst features (i.e. 2 or 3) have also occurred within the Little Island Formation (Ll).

During 2004, a magnetic survey was undertaken by ArchaeoPysica Ltd. adjacent to the castle ruins at Warren's Crossroad at Barnahely. An anomaly was interpreted as a 'chain of sinkholes' along with pronounced geological features aligned parallel to the 'sink holes'. Additional karst features were identified during a geophysical survey undertaken by Apex Geoservices in 2006. Three of the karst features identified by Apex coincide with the 'chain of sinkholes' as described by ArchaeoPysica Ltd. These previously identified karst features have been included on **Figure 11.6** together with the GSI reported karst features. In 2010 there were reports of a swallow hole 'slogaire' appearing at Shanbally which was subsequently filled in by the landowner. This swallow hole was located along the proposed road project at approximate Ch. 9,150m (location NGR 175,680, 64,008). The approximate location of this swallow hole is also included in **Figure 11.6**.

From a review of the previous geophysical survey carried out by Apex in 2006 (refer to **Appendix 11B**), it is estimated that there are 10 karst subsidence features within the vicinity of the proposed road project with 2 of the estimated 10 potential karst features situated along the corridor of the proposed road project **Figure 11.6**. These features comprise karst feature No. GIK3 (Ch. 6,500) and karst feature No. GIK4 (Ch. 7,000) east of the proposed Shannonpark Underbridge.

No further karst features were identified in the 2014 SI works, review of aerial photography or site walkover surveys undertaken by RPS. There was no reference to karstification during the ground investigations.

Groundwater Levels

In general, within the Ballinhassig Groundwater Body, groundwater flow is expected to be concentrated in the uppermost 15m of the aquifer, although deeper inflows along fault zones and connected fractures can be expected. The water table can be encountered from a few metres up to 10m below ground. In the Ringaskiddy Groundwater Body, groundwater flow occurs in the upper weathered layer of a few metres and in a deeper fissured zone not more than 15m from top of rock. The water table is generally within 10m of the surface.

The results from SI indicate that groundwater was obtained at depths of 2mbgl to 5.1mbgl within the overburden deposits and at depths of 8.2mbgl to 16.1mbgl in the bedrock. Groundwater level data was obtained from the boreholes installed during the intrusive site investigation as detailed in **Table 11.6**. During the 2014 SI no standpipes were installed for groundwater monitoring. Borehole logs and location maps are included in **Appendix 11A**.

Table 11.6: Groundwater Level Data

BH Code	Date	Water Level (mbgl)
RC01	12/11/2014	2m
RC01	13/11/2014	2m
RC02	17/11/2014	3m
RC02	20/11/2014	4m
RC03	21/11/2014	3.5m
RC110	09/04/2015	8.2m
RC110	10/04/2015	9.8m
RC110	20/04/2015	16.1m
RC112	02/04/2015	12.6m
RC112	03/04/2015	14.2m
BH1001	07/09/2006	3.0m
BH1012A	19/09/2006	4.5m
BH-1014	14/09/2006	4.5m
BH-1020	19/09/2006	4.4m
BH-1022	25/09/2016	5.1m
BH-1031	04/10/2006	4.5m
BH-1033	05/10/2006	2.5m
BH-1053	19/10/2006	0.2m
BH-1059B	23/10/2006	2.9m
BH-1060	02/11/2006	3.6m
BH-1061A	31/10/2006	9.5m
BH1068	27/03/2008	3.9m
BH1071	02/04/2008	12.5m

Water Supply & Private Wells

The study area is well served by the County Council mains water supply. There may also be a small number of private houses, farms or industries supplied from private wells. The location of private wells within the study area based on the GSI database are shown on **Figure 11.6**. It should be noted that the GSI database may not represent all private wells within the study area.

The identification of private wells for industrial supplies and domestic and farm supplies can be identified and confirmed through a well survey. A well survey carried out in 2009 identified 40 groundwater fed private supplies in the area through a combination of the GSI well database, consultation with landowners and agricultural survey work. The GSI database does not indicate any source protection zones within the study area. There are no public water supply schemes in the area sourced from groundwater.

11.3.4 Geological Heritage

Information on the geological heritage areas is now available to view online through the GSI website. The mapping indicates there is 1 feature located within the study area (Golden Rock - designated for its exposure of Lower Carboniferous Bedrock Geology) with an additional feature located in close proximity to the study area but outside of the boundary (Loughbeg). The locations of the Geological Heritage Features are illustrated on **Figure 11.6**. The Lough Beg Lower Carboniferous Coastal Section and armour stone which is located in the Loughbeg area to the south of Ringaskiddy is located 0.6km from the proposed M28Road Project at its closest point. The site at Golden Rock Ringaskiddy is located at a minimum distance of 0.4km from the proposed road project. These two geological features are also included on the list of Areas of Geological Interest in the Cork CDP 2014-2020.

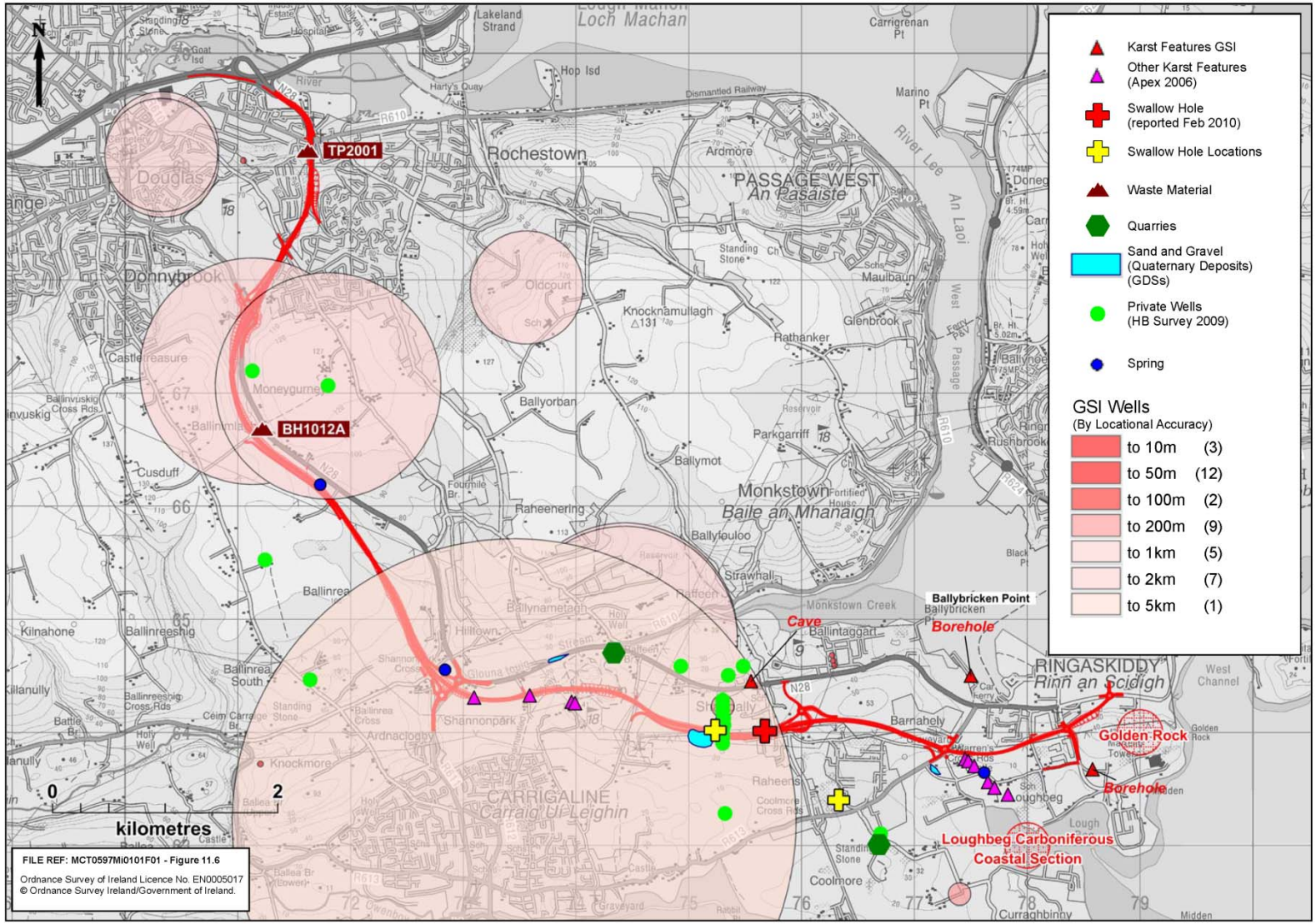
11.3.5 Quarries Minerals and Mines / Economic Geology

Based on a desk study review of the GSI Aggregate Potential Map, GSI Active Quarries Directory 2014 and Cork County Council Index of Quarry Registration the locations of identified quarries in the area are illustrated on **Figure 11.6**.

Within the study area there are a number of quarries mainly producing limestone and sandstone crushed rock aggregate. Information from the Cork County Council Index of Quarry Registration includes the following John A Woods Quarries: Coolmore, Ballygarvan (x 2) and Raffeen. The quarries at Ballygarvan are located outside of the study area. The quarries at Coolmore and Raffeen are illustrated on **Figure 11.6**.

A number of small sand and gravel pits are shown on the GSI Quaternary Geology Map for the area. These are illustrated on **Figure 11.6** however all of these are denoted as being “disused”. There are no active sand and gravel pits indicated in the area. Based on the Teagasc subsoil map there does not appear to be potential for sand and gravel deposits along the proposed road project. There are no metallic mineral locations indicated within the study area on the GSI website.

Figure 11.6: M28 Cork to Ringaskiddy Project - Geological & Hydrogeological Features



11.3.6 Contaminated Land

There are no known significant areas of contaminated land within the study area however some minor areas of fill material were encountered during the site investigations and have been summarised in **Table 11.7**. The results of the ground investigations indicate the presence of waste material in made ground in BH1012A (Ch. 3,350) and TP2001 (Ch. 8,950) as depicted on **Figure 11.6** above. If this material is to be excavated it will require disposal at a suitably licensed facility. The disused sand and gravel pits mentioned in the previous section could also potentially represent areas of contaminated land as frequently in the past illegal dumping has taken place within former sand and gravel pits or former rock quarries.

Table 11.7: Summary of Fill Material Encountered

SI Location	NGR	Description	Chainage
BH1009	171419E 68304N	Stiff clay & fill encountered from 0.2mbgl to 0.7mbgl	Ch. 1,500
BH1012	171215E 66678N	Stiff clay & fill encountered from 0.2mbgl to 0.7mbgl	Ch. 3,350 at Carr's Hill
BH1012A	171216E 66680N	1.7m of made ground consisting of slightly sandy, slightly gravelly clay with plastic and concrete	Ch. 3,350 at Carr's Hill
BH/RC1013	171106E 67775N	0.6m of stiff clay and shaley rock described as probable fill	Carr's Hill Interchange
BH1060	172762E 64884N	0.3m of hardcore overlying fill described as clay, cobbles and boulders to a depth of 1.6m.	Ch. 5,750 (around Hilltown)
TP-2001	171619E 69137E	Made ground at 0.25mbgl to 0.4mbgl comprising brown, slightly sandy, slightly gravelly clay with occasional angular to sub-rounded cobbles, concrete and glass	Ch. 650
TP-2013	172780E 64896N	Fill encountered at 0.10mbgl to 0.3mbgl described as soft, slightly sandy, slightly gravelly clay with occasional cobbles. Fill from 0.3mbgl to 2.7mbgl described as soft, slightly sandy, slightly gravelly Clay with occasional cobbles	Ch. 5,650 (around Hilltown)
TP-2021	175497E 63979N	Fill underlying topsoil encountered at 0.3mbgl, described as firm, brown, slightly sandy, slightly gravelly clay with occasional cobbles	Ch. 8,950 between Shanbally & Raheens
Service Area	178819E 64541N	Fill material comprising limestone quarry fill underlain by sand with occasional shells.	N/A

11.4 POTENTIAL IMPACTS

The potential impacts are described under two headings:-

- during Construction; and
- during Operation.

The potential impacts from the proposed road project are described under soils, geology and hydrogeology. A summary of the potential impacts in the absence of mitigation during construction is provided in **Table 11.8.** A summary of the potential impacts in the absence of mitigation during operation is provided in **Table 11.10.** Mitigation measures for the impacts are discussed separately in **Section 11.5.**

11.4.1 Construction Phase

Soils & Geology

Excavation of Unconsolidated Material: The proposed M28 Road Project will require the excavation of materials to varying depths along the proposed route where the proposed road project is to be constructed at grade. There is the potential for erosion of soil and excess sediments reaching watercourses. Any localised 'soft' spots (depressions or voids in the bedrock or loose unconsolidated overburden material) will have to be excavated and replaced with suitable fill. Excavation of subsoil will be required for the construction of works for the installation of foundations for a new pole sett and two new towers to facilitate a diversion of overhead power lines at Shanbally. These works will result in permanent removal of subsoil at excavated locations. Management of this additional material on site is described under **Section 11.5.1** Construction Phase Mitigation Measures.

The construction activities at the site of the proposed Service Area will involve the excavation of overburden deposits to accommodate the construction of foundations, piles, the installation of the underground storage tanks and the laying of services. There is the potential for erosion of soil and excess sediments reaching Cork Harbour. These are unavoidable aspects of the proposed road project that will potentially result in an impact to the soil and geology environment. In the absence of mitigation, the net impact of soil removal is therefore likely to be slightly negative of temporary duration. Construction activities also have the potential for soil compaction or soil erosion due to disturbance of soil and surface water run-off.

Earthworks Operations: Earthworks operations for the proposed M28 Road Project will require the placing of materials in embankments, which may result in slope instability and the excavation of materials in areas of cut. At the site of the proposed Service Area it will be necessary to provide temporary site access roads to facilitate the movement of plant and machinery to and from the site and the delivery of construction materials. There is potential for compaction and erosion of soil under the proposed access roads. This is considered to be a slightly negative impact of temporary duration. The earthworks balance along the mainline of the proposed M28 Road Project indicates that there is an overall minor deficit of material that will be required to be sourced elsewhere. The total fill required is approximately 2.2million m^3. The general fill and selected granular material requirements are to be predominantly sourced from suitable material from the proposed M28 itself. Materials will be sourced from the various earthworks cut zones. In total, it is anticipated that 1.15million m^3 of material will be re-used from material arising from rock excavated from mainline cuttings for the project with the majority located between Ch. 4,670m and Ch. 6,000m (Cut 1-Shannonpark). Side road construction, particularly at Carr's Hill is anticipated to yield further volumes of rock. This material will need to be processed and/or tested prior to re-use on site. Based on the ground investigation information and testing, the glacial till overburden deposits indicate good potential for reuse as general fill.

It is therefore anticipated that there will be a deficit of 1.05million m^3 of material required to construct the proposed M28. It is envisaged that the majority of this material will be sourced from the Raffeen Quarry under its current planning permission (Planning Ref 06/10037 and PL. 04.225610). It is currently estimated that this quantity of material will be sufficient to supply the proposed road project in its entirety.

Earthworks operations will also require the removal of material which may result in slope instability of the exposed face of the cut section. At the proposed Service Area there will be approximately 22,300m^3 of excavated material that will need to be managed appropriately through disposal or recovery, as appropriate. At this stage, it is assumed that this material will not be suitable for reuse on site and will require transport off site. Resource requirements for earthworks are also outlined in **Chapter 3: Description of the Proposed Road Development.**

It will be necessary to provide temporary site access roads to facilitate the movement of plant and machinery to and from the proposed M28 Road Project and the delivery of construction materials. There is therefore potential for compaction and erosion of soil under the proposed access roads.

Without mitigation, the impact of earthwork operations is considered to be a slight negative impact of temporary duration. There are areas of cut proposed in a number of areas as shown on **Table 11.9**. The impact of earthwork operations on surface water quality is described in **Chapter 10: Aquatic Ecology.**

Removal of Waste Material: Isolated and minor amounts of waste material, as described under **Section 11.3.6 Contaminated Land,** were encountered during the preliminary ground investigations in BH1012A and TP2001 and will be removed to a suitably licensed facility. There is potential for the fill material to contain contaminated material. In 1995 the area adjacent to the site of the proposed Service Area was a green field site and between 2000 and 2005 it was used a car storage area. The fill material comprises limestone quarry fill underlain by sand with occasional shells (Port of Cork Strategic development Study – Glover Site Investigations Ltd 2006). In 2011 The Marine Energy Centre analysed soil samples (at a location immediately south of Paddy's Point) for metals, hydrocarbons and polycyclic aromatic hydrocarbons (PAHs) contaminants' and reported that the contaminant levels were low. The fill material will be subject to appropriate chemical testing to assess its contamination potential and determine an appropriate disposal route if this is necessary. The treatment or removal of potentially contaminated material will have a positive impact on soils by removing a potential source of contamination. This is considered a moderately positive impact of permanent duration.

Exposure of Features of Geological Importance: Consultation with the GSI and the Cork CDP 2014-2020 indicates that the site at Golden Rock is listed as a pNHA and a County Geological Site. The site at Golden Rock Ringaskiddy is located in close proximity to the proposed M28 Road Project, at a minimum distance of 0.4km from same. There is a potential for rock exposures or ground excavations to expose features of geological interest which would be a potentially significantly positive impact of permanent duration.

Accidental Spillages: There is potential for accidental spillage of diesel fuel and hydraulic oil from site machinery during the construction phase. Construction stage storage of fuels and hazardous materials has the potential to impact on soil quality if not stored correctly. The construction of a site compound will require the removal of waste water from toilets and domestic water from washing facilities which will require treatment and safe disposal to a suitable location, e.g., a direct

connection to the existing sewer network. Inadequate treatment of on-site toilets and washing facilities has the potential to cause faecal contamination of soil via surface water infiltration. In the absence of mitigation measures the impact to soils is considered to be a moderate negative impact of temporary duration.

Hydrogeology

Accidental Spillages: The potential exists for accidental spillages of oil, fuel and lubricants during the construction stage from site machinery to impact on groundwater resources. Construction stage storage of fuels and hazardous materials has the potential to impact on the groundwater or surface water if not stored correctly. The construction of a site compound will require the removal of waste water from toilets and domestic water from washing facilities which will require treatment and safe disposal to a suitable location via connection to the existing foul sewer network as opposed to a septic tank. The construction of on site toilet and washing facilities at the proposed Service Area will require the removal of waste water which will require treatment and safe disposal to a suitable location i.e. to the existing sewer network. Inadequate treatment of on-site toilets and washing facilities has the potential to cause faecal contamination of groundwater via surface water infiltration. In the absence of mitigation, this impact is considered to be a potential significant negative impact of temporary duration.

Impact to Aquifer Vulnerability: The proposed M28 Road Project has the potential to impact on groundwater quality as a result of the uncontrolled discharge of surface water run-off during the construction stage. As aquifer vulnerability is either Extreme or High, the discharge of surface water run-off from proposed bridges and access roads will be controlled in order to prevent the pollution of groundwater supplies (refer to **Chapter 3: Description of the Proposed Road Development**). The construction of the proposed Service Area will involve the construction of new sealed hardstanding; there is therefore the potential for a reduction in the amount of rainfall that will infiltrate the ground as the site is currently covered by rough scrubland. Piles will be required for the construction of the Service Area; this has the potential for the creation of a preferential pathway for near surface contamination to migrate to the bedrock aquifer. The removal of soil from the site will decrease the thickness of the material that overlies the bedrock, which will potentially increase the vulnerability of groundwater below the site. However, the treatment or removal of potentially contaminated material will have a positive impact on the hydrogeological environment by removing a potential source of contamination. The net impact of soil removal is therefore likely to be slight. In the absence of mitigation, the overall impact to aquifer vulnerability is considered to be slightly negative impact of a permanent duration.

Encountering of Karst Features: The discharge of surface water run-off from the proposed M28 Road Project, bridges and access roads will be controlled in areas where there is potential for karstification, e.g., in the vicinity of Shannonpark and Shanbally. The known karst features are located at Ch. 6,500m, Ch. 7,000m and Ch. 9,150m where the proposed M28 Road Project construction will involve fill works and therefore no impact is expected here on the groundwater flow regime. The potential for encountering unknown karst features has been taken into account during the design of the road by the geotechnical team as they represent a potential risk of collapse during both the construction stage and the operational stage. There is also the potential for karst features to become conduits for pollutants released during construction to reach groundwater fed natural features and Glounatouig River. In the absence of mitigation, the impact of encountering karst features is expected to be slightly negative of a temporary duration.

Dewatering*:* It is likely that groundwater will be intercepted at the cutting at Carr's Hill. There is only one private well (P01) in the immediate vicinity of the cutting at Carr's Hill (Ch. 2,500) therefore it is considered that the impact would be low. From the available SI information it is considered likely that groundwater will be intercepted between in the major cutting proposed at Ch. 5,200 to Ch. 6,000 at Shannonpark, however there are no private wells in the immediate vicinity of this cutting. There are no published public groundwater source protection areas within the study area. The locations of private wells within the study area based on the GSI database are shown on **Figure 11.6**. Through a combination of the GSI well database, consultation with landowners and agricultural survey work up to 40 groundwater fed private supplies are known to occur in the area. These wells may potentially be impacted by uncontrolled run-off during the construction stage. At the site of the proposed Service Area, no information is available on the depth of groundwater in this area; however, where dewatering is required for the installation of fuel storage tanks, this will temporarily lower the shallow water table via pumping, below the site. In the absence of mitigation, this impact is considered to be an imperceptible negative impact of temporary duration.

Table 11.8: Summary of Sensitive Receptors during Construction along the proposed M28 Road Project without Mitigation

Construction Activity	Receptor Type	Receptor Location	Magnitude of Impact Without Mitigation
Excavation of Unconsolidated Material	Topsoils and Subsoils	Throughout the proposed M28 Road Project	Slightly negative impact of temporary duration
Earthworks Operations	Topsoils and Subsoils	Throughout the proposed M28 Road Project	Slightly negative impact of temporary duration
Removal of Waste Material	Topsoils and Subsoils	BH1012A and TP2001	Moderately positive impact of permanent duration
Exposure of Features of Geological Importance	Geological Heritage	Adjacent to the proposed M28 Road Project (0.4km)	Significantly positive impact of permanent duration
Accidental Spillages	Groundwater, Topsoils & Subsoils	Throughout the proposed M28 Road Project	Moderate negative impact of temporary duration Significant negative impact of temporary duration at proposed Service Area
Impact to Aquifer Vulnerability	Groundwater	Vulnerability rating likely to change: Ch. 4,880 to Ch. 5,000 and Ch. 5,550 to Ch. 5,800 (refer to **Table 11.9**) Ch.5,240- Ch.5,920 (groundwater close to surface) Ch.7,350 to Ch.7,825 (X Vulnerability)	Slightly negative impact of permanent duration
Encountering of Karst Features	Groundwater	Location of known karst features along route: Ch. 6,500, Ch. 7,000 & Ch. 9,150	Slightly negative impact of a temporary duration
Dewatering	Groundwater	Adjacent to the proposed M28 Road Project	Imperceptible negative impact of temporary duration

11.4.2 Operational Phase

Soils & Geology

Embankment Settlement: Potential impacts with regard to embankments include settlement of the existing ground profile and slope instability of the constructed embankments post construction. In the absence of mitigation, this impact is considered to be a slightly negative impact of temporary duration.

Accidental Spillages: There is potential for spillage of diesel fuel and hydraulic oil from maintenance vehicles and daily commuting vehicles/HGVs to effect soil and subsoil quality. This is considered a moderate negative impact of temporary duration. At the proposed Service Area, there is potential for spillage during operational activities and delivery operations to the fuel storage tanks and potential for leakage from the underground storage tanks during the operational stage which could potentially impact on the soil quality in the vicinity of the site. Without mitigation, this is considered to be a significant negative impact of temporary duration.

Hydrogeology

Impact to Aquifer Vulnerability: Excavation and removal of overburden material will result in a change in the aquifer vulnerability from High to Extreme at the area of cut in the vicinity of Shannonpark. The most significant cuttings on the proposed M28 Road Project are listed below in **Table 11.9**.

Table 11.9: Summary of Cut Areas

Location Chainage	Description	Site Investigation Information	Impact on Vulnerability Rating
Two side roads adjacent to the mainline at Ch. 2,500 Carr's Hill North and Central Link	A significant cut section is proposed on two side roads adjacent to mainline at Ch. 2,500. The maximum depth of cut is approx. 17.5m bgl.	Ground investigation data suggests rock is encountered between 1.0 – 2.6m bgl. Bedrock comprises weak weathered mudstone, siltstone and shale.	Vulnerability already Extreme so will likely remain unchanged.
Ch. 4,640 to Ch. 5,960 Shannonpark	The maximum depth of cut is approx. 19.5mbgl at Ch. 5,380. Cut > 5m over most of length. Cut > 10m over 800m between Ch. 4,880 to Ch. 5,000 and between Ch. 5,240 to Ch. 5,920.	Additional site investigation works were carried out here on behalf of RPS in 2014. It was noted that in the area between Ch. 5,200m and 6,000m where a significant cut is proposed, rock was encountered at 2.4 - 4.0mbgl. Rock was found to be slightly weathered, moderately weak siltstone/mudstone. Overburden in the area was generally gravelly, sandy clay with boulders.	Vulnerability between Ch. 4,880 to Ch. 5,000 and Ch. 5,550 to Ch. 5,800 is High and is likely to change to Extreme.
Ch. 7,340 to Ch. 7,470 Raffeen	The maximum depth of cut is approx. 11.5mbgl	Depth to bedrock is shallow. Depth to limestone bedrock at RC102 is 0.7mbgl. Drilling records show that bedrock in the area is moderately strong, slightly weathered limestone.	Vulnerability in this area is X (rock at or close to surface) to E (Extreme) so unlikely to change.

Location Chainage	Description	Site Investigation Information	Impact on Vulnerability Rating
Ch. 9,540 to Ch. 10,900 Shanbally to Barnahely	The maximum depth of cut is approx. 5.0mbgl	Ground investigation data suggests mudstone/siltstone is encountered between 1.0mbgl - 4.0mbgl.	Vulnerability is classified as High in this area but with shallow cuttings the vulnerability is unlikely to change.
Ch. 12,020 TO Ch. 12,450 Loughbeg to East of Ringaskiddy Port	The proposed M28 Road Project here will require significant cutting into the existing hill side. The maximum depth of cut depth is approx. 12m bgl.	Rotary coring in the area carried out in 2014 has indicated weathered rock within 0.4m of the surface. Rock was recovered as shale with siltstone beds and some quartz veins.	Vulnerability in this area is extreme so is unlikely to change.

There is one minor area of regionally important aquifer at the extreme north of the proposed M28 Road Project at Bloomfield Interchange (Ch. 0 - Ch. 600). The remaining area is classified as a Locally Important Aquifer. There will be a reduction in the depth of overburden present in the proposed cut areas while this will reduce the thickness of protective cover material, the vulnerability category will remain unchanged where the rating is already Extreme. In relation to changes in vulnerability there is potential for a reduction in the vulnerability rating from High to Extreme in the following areas: Ballinrea Ch. 4,700 to Ch. 5,100 (BH/RC1063 indicated a depth to bedrock of 4.1mbgl) and at Hilltown Ch. 5,500 to Ch. 5,800. In the absence of mitigation, this impact is considered a slightly negative impact of permanent duration.

Following construction the proposed Service Area will be covered by hard-standing areas. The presence of the hardstanding will reduce the potential for contaminants at the surface entering the groundwater system. Surface water run-off can affect the quality of groundwater and subsoil. It can contain suspended solids, oil, organic solids, chloride, metals and hydrocarbons. If the intensity of a storm event is sufficient, insoluble pollutants can be mobilised from the surface and potentially result in a short or long-term moderate to significant impact on the surface water environment, depending on the severity of the storm event. Due to the presence of the refuelling activities and car parking facilities there is potential for the surface water run-off at the site to be contaminated with suspended solids, hydrocarbons, metals and chloride (from de-icing operations). It is proposed that the surface water will discharge to the harbour and therefore there is no potential/low potential for the contamination of groundwater via surface water. In the absence of mitigation, the impact to aquifer vulnerability is considered to be an imperceptible negative impact of permanent duration

Impact of Karst Features: A number of karst features have been identified and in addition there is potential for karst features to develop in the areas of limestone bedrock in particular in the area underlain by the Waulsortian Limestone Formation. There is potential for the development of subsidence features as a result of the uncontrolled discharge of drainage in karst areas during the construction or operational phase. In addition the potential exists for the de stabilisation of karst features during the construction or operational stage which could lead to ground instability or collapse. The three known karst features on the proposed M28 Road Project do not coincide with the above areas of proposed cut therefore, in the absence of mitigation; this is considered to be a slightly negative impact of permanent duration.

Impact to Private Wells: The major cuttings have the potential to alter the natural groundwater flow patterns. Given that only one private well (P01) was identified in the immediate vicinity it is

concluded that the significance of any impact here would be low. In the absence of mitigation, the overall impact on private wells is considered an imperceptible negative impact of temporary duration.

Accidental Spillage: The potential exists for accidental spills to impact groundwater quality during the operational phase of the proposed road project from normal traffic movements and accidents. In the absence of mitigation this impact is considered to be a moderate negative impact of temporary duration. At the proposed Service Area there is potential for spillage during delivery operations to the fuel storage tanks, refuelling activities and potential for leakage from the underground storage tanks during the operational stage which could potentially impact on the groundwater and surface water in the vicinity of the site. In the absence of mitigation this impact is considered to a significant negative impact of temporary duration.

Surface Water Run-off: 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. There is the potential for these pollutants to be transported in surface water run-off and enter the aquifer via the road drainage system. An intense rainfall event has the potential to mobilise insoluble pollutants which can potentially enter the groundwater environment via surface water run-off. The impact will depend on the volume of traffic and the sensitivity of the receiving watercourse.

Carriageway stormwater run-off can impact on receiving groundwater in two ways:

- Rate of discharge – if the rate of discharge from the proposed M28 Road Project exceeds that of the existing "greenfield" catchment area then it is possible that an increased infiltration rate could occur, causing localised groundwater flooding. In order to minimise the risk of overloading the existing receiver to which the carriageway run-off 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 run-off rate to the flows that were present in the existing scenario without the proposed M28 Road Project.
- Quality – carriageway run-off can contain pollutants from the carriageway because of the traffic loading on the carriageway. **Section 10.4** in **Chapter 10: Aquatic Ecology** outlines the impact of heavy metal run-off, hydrocarbon run-off and de-icing activity as a result of carriageway run-off.

In the absence of mitigation, this impact is considered to an imperceptible negative impact of permanent duration.

At the site of the proposed Service Area, foul water drainage from toilets and washroom facilities has the potential to cause faecal contamination of groundwater via surface water infiltration unless managed effectively. In the absence of mitigation this impact is considered to be a slight negative impact of permanent duration to Cork Harbour**.**

Climate Change: According to the IPPC (Intergovernmental Panel on Climate Change) temperature increase has already caused a sea level rise of 18.5cm over the last 100 years and is predicted to lead to an additional rise of 10cm to 59cm over the next 100 years. Ireland will experience significant changes in rainfall characteristics and increased sea levels around the coast. Increased sea levels will increase the risk of coastal flooding and also lead to higher water levels upstream in river estuaries.

Implications for hydrogeology include a reduction in the thickness of the unsaturated ground below percolation areas as the sea level and water table rise. The result will be less opportunity for breakdown of the effluent before it reaches the water table. Higher recharge rates into karst limestone aquifers have the potential to re-flood the upper karst conduits that had been depleted along road cuttings, affecting the capacity of SuDS system and causing flooding. Without mitigation the impact of climate change would be a significant negative impact of permanent duration.

Table 11.10: Summary of Sensitive Receptors during Operation along Proposed M28 Road Project without Mitigation

Operational Element	Receptor Type	Receptor Location	Magnitude of Impact Without Mitigation
Embankment settlement	Topsoils and Subsoils	Throughout the proposed M28 Road Project	Slightly negative impact of temporary duration
Accidental Spillages	Groundwater, Topsoils &Subsoils	Throughout the proposed M28 Road Project	Moderate negative impact of temporary duration at proposed M28 road Significant negative impact of temporary duration at proposed Service Area
Impact to Aquifer Vulnerability	Groundwater	Vulnerability rating likely to change: Ch. 4,880 to Ch. 5,000 and Ch. 5,550 to Ch. 5,800 (refer to **Table 11.9**) Ch.5,240- Ch.5,920 (groundwater close to surface) Ch.7,350 to Ch.7,825 (X Vulnerability)	Slightly negative impact of permanent duration at proposed M28 road Imperceptible negative impact of permanent duration at proposed Service Area
Impact of Karst Features	Groundwater	Locations of known karst feature along route: Ch. 6,500, Ch. 7,000 & Ch. 9,150	Slightly negative impact of permanent duration
Impact to Private Wells	Groundwater	One private well (P01) in the immediate vicinity of the cutting at Carr's Hill (Ch. 2,500)	Imperceptible negative impact of temporary duration
Surface Water Run-off	Groundwater	Throughout the proposed M28 Road Project	Imperceptible negative impact of permanent duration at proposed M28 road Slightly negative impact of permanent duration at proposed Service Area
Climate Change	Groundwater	Throughout the proposed M28 Road Project	Significant negative impact of permanent duration

11.5 MITIGATION MEASURES

Mitigation measures are described under two headings:-

- during Construction; and
- during Operation.

The potential impacts from the proposed road project are described under soils and geology and separately under hydrogeology. A summary of sensitive receptors during construction with mitigation is provided in **Table 11.13.** A summary of sensitive receptors during operation with mitigation is provided in **Table 11.14.**

11.5.1 Construction Phase

Soils & Geology

Excavation of Unconsolidated Material: Virtually every form of construction development requires soil removal; as a result soil removal during the construction phase of the project will be unavoidable. Removed soil will be reused on site subject to testing. Chemical analysis will be carried out to assess whether the fill material presents a risk to human and/or environmental receptors and to determine a suitable on-site or off-site disposal route.

The following sediment erosion techniques will be implemented during the construction stage in order to prevent soil erosion and excess sediments or other material from reaching the receiving watercourses. The measures will include:-

- The designation of appropriate locations and methods for stockpiling soil, aggregates, chemicals, etc. Restrictions that apply to stockpiling of material are outlined under **Section 3.12.1.4** of **Chapter 3: Description of the Proposed Road Development;**
- Restricting vehicular movement to prevent unnecessary erosion;
- Revegetating exposed areas as soon as practicable;
- Use of temporary sediment trapping devices (e.g., silt fences, hay bales, etc.); and
- Routing flows from the site through settlement ponds or filter channels.

Erosion control and sediment control measures to prevent sediment washing into the watercourses are outlined in **Chapter 9: Hydrology and Drainage** and **Chapter 10: Aquatic Ecology.**

Earthworks Operations: The materials balance as discussed in the geotechnical report outlines that the material excavated in cuttings will be used to construct the embankments.

There is a need to import selected granular materials for fill, capping and drainage stone. It is anticipated that approximately 40% of general fill material requirements will be sourced from the siltstones and limestones of Raffeen quarry. The quarry overburden materials will be suitable as general fill material. The glacial till overburden deposits indicate good potential as general fill, however where clay and moisture content is high they present as unsuitable. The initially unsuitable glacial till materials can be easily processed by drying out to reduce the moisture content to allow for suitable compaction and placement to occur.

There is potential for compaction and erosion of soil under the proposed access roads to facilitate the movement of plant and machinery to and from the proposed M28 Road Project and the delivery of construction materials. In order to mitigate against compaction and erosion of soil, the topsoil will be removed and stored. Following the removal of the access road upon completion of the construction phase, the soil surface will be scarified and the topsoil replaced and reseeded.

Removal of Waste Material: There were some minor areas where waste material was encountered during the site investigation. Waste material excavated during the construction works will be removed to a suitably licensed facility (refer to **Chapter 17: Material Assets** and **Appendix 17A: Outline Construction and Demolition Waste Management Plan**).

Exposure of Features of Geological Importance: No mitigation required.

Accidental Spillages: The proposed road project has been designed to prevent and avoid any potential for significant effects on soils from spillages (refer to **Chapter 9: Hydrology and Drainage**).

To prevent accidental spillages it is proposed that no hydrocarbons or toxic chemicals are stored within 100m of a watercourse. All oils, solvents and paints used during construction will be stored within temporary bunded areas or stored in purpose designed double bunded tanks. The design (volume and construction) of all bunds will conform to standard bunding specifications.

The retention capacity of bunded areas will be as follows:-

- To a volume not less than 25% of the total volume of substance which could be stored within the bunded area.
- All hazardous materials on site will be stored within secondary containment designed to retain at least 110% of the storage contents.
- Temporary bunds for oil/diesel storage tanks will be used on the site during the construction phase of the project as appropriate.
- Safe materials handling of all potentially hazardous materials will be emphasised to all construction personnel employed during this phase of the project and an emergency response plan will be in place, in case of accidental spillage.

In the event that a spillage does occur it is proposed that containment methods and emergency procedures are in place to deal with such spillages. An emergency plan to deal with accidental spillages will be kept on site during the construction period. The pollution control methods are to be agreed with Cork County Council prior to the commencement of the works. Spill kits will be retained on site to ensure that any spillages or leakages are dealt with immediately.

All dispensing of fuels and hazardous materials will occur over areas of concrete hardstanding with surface water run off directed to a hydrocarbon separator. All associated waste residuals will also be stored within temporary bunded storage areas prior to removal by an appropriate waste disposal contractor for off-site treatment/recycling/disposal. Any other building waste will be disposed of to on-site skips for removal by a licensed waste disposal contractor. Mitigation measures are further outlined in **Chapter 3: Description of the Proposed Road Development** in **Section 3.13 Environmental Management during the Construction Phase** and **Section 9.5.1** of **Chapter 9: Hydrology and Drainage**.

Hydrogeology

Accidental Spillages: The potential impact of run-off on groundwater quality will be mitigated through the development of containment methods and emergency procedures to deal with accidental spillages. Measures will include that fuel is to be stored/stocked within containment bunds within the site to prevent release into the ground. Where it is necessary to refuel machinery on site, this will be done in a carefully managed manner. An emergency plan to deal with accidental spillages will be drafted and kept on site during the construction period. The pollution control measures are outlined in **Chapter 3: Description of the Proposed Road Development, Section 3.13 Environmental Management during the Construction Phase** and **Section 9.5.1** of **Chapter 9: Hydrology and Drainage** and these measures must be adhered to during construction works. To minimise any impact on the underlying subsurface strata from material spillages all oils, solvents and paints used during construction will be stored within temporary bunded areas or stored in purpose designed double bunded tanks. Safe materials handling of all potentially hazardous materials will be emphasised to all construction personnel employed during this phase of the project and an emergency response plan will be in place, in case of accidental spillage. The design (volume and construction) of all bunds will conform to standard bunding specifications.

The retention capacity of bunded areas will be as follows:-

- To a volume not less than 25% of the total volume of substance which could be stored within the bunded area; and
- 110% of the capacity of the largest tank or drum to be stored within the bunded area.

Spill kits will be retained on site to ensure that any spillages or leakages are dealt with immediately. All dispensing of fuels and hazardous materials will occur over areas of concrete hardstanding with surface water drainage directed to a hydrocarbon separator. All associated waste residuals will also be stored within temporary bunded storage areas prior to removal by a licenced waste disposal contractor for off-site treatment/recycling/disposal. Any other building waste will be disposed of to on-site skips for removal by a licensed waste disposal contractor. An emergency plan to deal with accidental spillage will form part of the EOP to be drafted and kept on site during the construction period (refer to **Chapter 3: Description of the Proposed Road Development, Section 3.13 Environmental Management during the Construction Phase**).

Impact to Aquifer Vulnerability: Areas where groundwater vulnerability is classified as X (rock at or near surface) or E (Extreme) will require protection from surface water run-off and will include mitigation measures such as those outlined below, which will follow the guidelines set out in the following publications; *Drainage Design for National Road Schemes - Sustainable Drainage Options,* NRA (2014) and Method C – Groundwater Protection Response (GWPR) for the Use of Permeable Drain Systems on Road Schemes as detailed in the TII Publication - *Road Drainage and the Water Environment, DN-DNG-03065*.

The Groundwater Protection Response (GWPR) assessment was carried out as follows:-

- Step 1: Calculation of the site specific vulnerability based on information taken from SI data i.e. the thickness and type of overburden material encountered.
- Step 2: Determination of the aquifer classification e.g. Lk or LI.
- Step 3: Determination of groundwater level from SI data.
- Step 4: Identification of areas of karst and receptors such as public wells.
- Step 5: Selection of an appropriate response classification from the GWPR matrix.
- Step 6: Establish if permeable drainage is suitable and/or if mitigation is required based on the response classification.

Following application of the GWPR Matrix (see **Table 11.11** below) for the use of permeable drains in road schemes, the following conclusion were arrived at:

Groundwater protection response R4 applies for the area of cut between Ch. 7,340 to Ch. 7,470 at Raffeen Quarry. Vulnerability here (Ch.7,340 - Ch.7,825) is classified as X (with rock at or near the surface or karst) and the Aquifer Classification is Lk, which equates to Rk, for the purposes of applying the matrix. Response classification R4 states that a permeable drainage system in this area is not acceptable.

Between Ch. 12,020 to Ch. 12,450 the proposed M28 Road Project will require significant cutting into the hillside. In the absence of 1m of unsaturated clay or 2m of unsaturated silt, sand or gravel, the GWPR matrix requires the drainage system to have a minimum consistent unsaturated thickness of 1m of 'appropriate material' either natural or man-made beneath the invert level of the point of discharge.

In the area of Extreme vulnerability (Ch. 4,880 to Ch. 5,920) at the major cut at Shannonpark (Ch. 4,640-Ch. 5,920 see **Table 11.9**), the groundwater protection response matrix when applied yields response classification R2(2). In this area a permeable drainage system is acceptable as the requirements, as set out in the GWPR, meet the minimum design standards of the TII .i.e. a minimum thickness of 1m unsaturated subsoil classed as clay or 2m of unsaturated subsoil classed as sand, gravel or silt. However, where the protective overburden material may be removed and the base of the cutting may be below the existing groundwater table (between Ch. 5,240 to Ch. 5,920 where groundwater was encountered at 2mbgl and 3mbgl, see RC01 and RC02 in **Table 11.6**), a closed drainage system is provided in the design, please refer to **Chapter 9: Hydrology and Drainage**.

In the cuttings between Ch. 7,340 to Ch. 7,470 where permeable drainage is not acceptable and in other cuttings where the protective overburden material may be removed and the base of the cutting may be below the existing groundwater table, a closed drainage system is provided in the design. This permits free drainage of sections in cutting and the road surface without allowing the run-off to percolate into the groundwater, thus eliminating a potential pollution hazard. A summary of results from the Groundwater Risk Assessment is included in **Table 11.12.**

The geotechnical assessment indicated the need for drainage measures for cuttings in the glacial till such as side slope drains or drainage blanket. The drainage system for the alignment will consist of edge drainage of the carriageway and link roads, cut-off/interceptor drains at the head of cuttings and at the toe of embankments, outfall channels/pipes and attenuation facilities where required. While the primary purpose of the attenuation ponds is to reduce flood risk they will also contribute to improved water quality by facilitating settling and detention of sediments and contaminants carried through the pipe network from the carriageway.

Groundwater vulnerability is classified as Extreme at the Service Area therefore where the protective overburden material is removed and the base of the cutting may be below the existing groundwater table, a closed drainage system will be adopted which will pass through a hydrocarbon separator before being discharged to the main surface water drainage system. The treatment or removal of potentially contaminated material will have a positive impact on the hydrogeological environment by removing a potential source of contamination.

Details of the drainage design are outlined in **Chapter 9: Hydrology and Drainage**.

Table 11.11: Groundwater Protection Response Matrix for the Use of Permeable Drains in Road Schemes (TII Publication, DN-DNG-03065)

Vulnerability rating	Source protection area	Resource protection area (aquifer category)							
		Regionally Important Aquifer			Locally Important Aquifer			Poor aquifer	
		Rk*	Rf	Rg	Lg	Lm	Ll	Pl	Pu
Extreme: Rock near Surface or karst (X)	R4	R4	R4	R3(2)	R3(2)	R3(1)	R3(1)	R3(1)	R3(1)
Extreme (E)	R4	R2 (3)	R2 (2)	R3(2)	R3(2)	R2 (2)	R2 (2)	R2 (1)	R2 (1)
High (H)	R3(2)	R2 (2)	R2 (2)	R2(2)	R2(2)	R2 (2)	R2 (2)	R2 (1)	R2 (1)
Moderate (M)	R3(1)	R2 (1)	R2 (1)			R2 (1)	R2 (1)	R1	R1
Low (L)	R3(1)	R1	R1			R1	R1	R1	R1

* A small proportion of the country (~0.6%) is underlain by locally important karstic aquifers (Lk); in these areas, the groundwater protection responses for the Rk groundwater protection zone shall apply.

Table 11.12: Summary of Results of Groundwater Risk Assessment

Location	Site Specific vulnerability	Aquifer Type	Response Category	Permeable Drainage System	Assessment Result
Ch0 to Ch. 4,880:	E	LI	R2 (2)	Suitable	No risk to groundwater
Ch. 4,880 to Ch. 5,920	E	LI	R2 (2)	Suitable with mitigation	Between Ch.5,240- Ch.5,920 water at this location is too high to maintain an unsaturated zone of the required thickness, this indicates that this area is not suitable for permeable drainage, therefore a closed drainage system will be adopted here.
Ch. 5,920 to Ch.6,200	E	LI	R2 (2)	Suitable	No risk to groundwater
Ch. 6,200 to Ch.7340	E	LK	R2(3)	Suitable with mitigation for the presence of known karst features	Where possible drainage must be 15m away from known karst features at Ch.6,500 and Ch.7,000.
Ch. 7,340 to Ch.7,825	X	Lk	R4	The Vulnerability here is X making permeable drainage in this area Not acceptable.	Closed Drainage
Ch.7,825 to Ch.7,900	E	Lk	R2(3)	Suitable with mitigation for the presence of karst features	Particular attention is to be made to the presence of karst features; where possible drainage must be 15m away from such features and particular attention must be made to the possibility of instability
Ch.7,900 to Ch. 8,450	H	Lk	R2(2)	Suitable	No risk to groundwater.
Ch. 8,450 to Ch. 10,900	E	LI	R2(2)	Suitable with mitigation for the presence of known karst features	Where possible, drainage must be 15m away from swallow hole. at Ch.9,150.
Ch.10,900 to Ch.11,300	E	Lk	R2(3)	Suitable with mitigation for the presence of karst features	Particular attention is to be made to the presence of karst features; where possible, drainage must be 15m away from such features and particular attention must be made to the possibility of instability.

Location	Site Specific vulnerability	Aquifer Type	Response Category	Permeable Drainage System	Assessment Result
Ch.11,300 to Ch. 12,450	E	LI	R2(2)	Suitable with mitigation	Area of significant cut between Ch.12,020 – Ch.12,450 will require a minimum consistent thickness of 1m of either natural or man-made material beneath the invert level of the point of discharge.

Encountering of Karst Features: Potential karst features were previously identified during the geophysical investigations carried out by Apex Geoservices in 2006 (refer to **Appendix 11B** for a copy of the Geophysical Survey Report). No further karst features were identified during the 2014 site investigation works. The swallow hole at Shanbally was discovered in 2010. The potential for encountering unknown karst features has been taken into account by the geotechnical team as they represent a potential risk of collapse during both the construction stage and the operational stage.

These features will require protection from surface water run-off and will include mitigation measures as set out below and in accordance with the guidelines in the following publications; *Drainage Design for National Road Schemes - Sustainable Drainage Options*, NRA (2014) and Method C – Groundwater Protection Response (GWPR) for the Use of Permeable Drain Systems on Road Schemes as detailed in the TII Publication - *Road Drainage and the Water Environment, DN-DNG-03065:-*

- The GWPR Matrix requires that in aquifers classified as Lk or Rk particular attention is to be made to the presence of karst features; where possible drainage must be 15m away from such features and particular attention must be made to the possibility of instability.
- The lining of attenuation ponds with a suitable membrane, where there is less than 1.5m of low permeability soils beneath the base of the pond and the top of the groundwater table.
- Where rockhead is exposed during construction any fissures or cavities encountered will be cleaned of loose soils and backfilled with granular fill material in order to maintain the flow path to rock and to support the road pavement.
- Where an embankment is to be created, the placing of a geotextile at the base to prevent sudden, catastrophic failures. This geotextile is intended to span any potential voids that could develop in an area of cutting. It is practice to “proof-roll” the area; this involves traversing the area with a large vibratory roller and checking for any localised collapse of the ground.

Mitigation measures against the presence of karst will be accurately assessed in detailed SI works prior to the construction stage to adequately manage the risk. To determine the extent of karstification, a geophysical survey, incorporated into the further detailed site investigations works prior to construction, will be required so that the risk can be adequately managed. **Chapter 3: Description of the Proposed Road Development, Section 3.6** and **Chapter 9: Hydrology and Drainage, Section 9.3.7.13** details the measures incorporated into the drainage design in order to control the discharge of surface water run-off.

Dewatering: As most of the road involves at grade construction or fill an impact on groundwater levels will occur only in close proximity to areas of proposed cut. There will be minimal change to current drainage levels and therefore wells and septic tank percolation areas will not be impacted.

It is proposed that a monitoring programme will be implemented to monitor the impact of the areas of cut on groundwater levels in private wells in the area. The monitoring programme will be carried out prior to, during and post construction to demonstrate that construction of the road is not impacting on the groundwater levels and to monitor seasonal low and high water table levels.

Existing private wells identified in a well survey that are within 300m of areas of road cutting > 5m will be monitored. It is not considered necessary to monitor areas where < 5m as these will be within the natural seasonal variation. It is also proposed to monitor water quality for colour, turbidity, odour, pH, conductivity, nitrate, nitrite, ammonium, aluminium, iron, manganese, hardness, total hydrocarbons, and microbiological quality. If the groundwater quality or groundwater level at individual wells is identified as having been impacted a new well will be provided in agreement with the well owner.

Where dewatering is required at the proposed Service Area a suitably designed groundwater dewatering system will be incorporated into the design. The potential impacts of dewatering associated with settlement of subsoils will be managed by the use of appropriate engineering methods such as cut off walls.

Table 11.13: Summary of Sensitive Receptors during Construction along the Proposed M28 Road Project with Mitigation

Construction Activity	Receptor Type	Receptor Location	Summary of Proposed Mitigation	Magnitude of Impact With Mitigation
Excavation of Unconsolidated Material	Topsoils and Subsoils	Throughout the proposed M28 Road Project	Sediment erosion prevention techniques	Imperceptible negative of temporary duration
Earthworks Operations	Topsoils and Subsoils	Throughout the Proposed M28 Road Project	Excavated cuttings will be reused in embankments, use of local quarry overburden material, topsoil to be removed and stored.	Imperceptible negative of temporary duration
Removal of Waste Material	Topsoils and Subsoils	BH1012A and TP2001	Testing to determine a suitable on-site or off-site disposal route (**Chapter 17** and **Outline Construction and Demolition Waste Management Plan - Appendix 17A**).	Moderately positive of permanent duration
Exposure of Features of Geological Importance	Geological Heritage/ Golden Rock	Adjacent to the proposed M28 Road Project (0.4km)	N/A	Significantly positive of permanent duration

Construction Activity	Receptor Type	Receptor Location	Summary of Proposed Mitigation	Magnitude of Impact With Mitigation
Accidental Spillages	Groundwater, Topsoils & Subsoils	Throughout the proposed M28 Road Project	Construction Environmental Management measures listed in **Chapter 3** including containment measures and emergency procedures. Provision of spill kits & attenuation measures such as hydrocarbon separators (refer to **Chapter 9** and **Chapter 10**).	Imperceptible negative of temporary duration
Impact to Aquifer Vulnerability	Groundwater	Vulnerability Rating likely to change: Ch. 4,880 to Ch. 5,000 and Ch. 5,550 to Ch. 5,800 (refer to **Table 11.9)** Closed drainage at Ch.7,340 to Ch.7,825 and Ch.5,240- Ch.5,920	Appropriate drainage system e.g. closed drainage system, cut-off/interceptor drains, outfall channels, attenuation facilities, hydrocarbon separators.	Imperceptible negative of permanent duration
Encountering of Karst Features	Groundwater	Known karst features along route: Ch. 6,500, Ch. 7,000 & Ch. 9,150	Appropriate geotechnical design and control of surface water run-off (where possible, drainage at least 15m away from known karst features). Detailed SI to accurately assess extent of karst.	Imperceptible negative of temporary duration
De Watering	Groundwater	Private wells within 300m of road cuttings >5m	A well survey and monitoring programme. At the proposed Service Area; a suitably designed groundwater dewatering system and use of appropriate engineering methods such as cut off walls.	Imperceptible negative of temporary duration

11.5.2 Operational Phase Mitigation

Soils & Geology

Embankment Settlement: The use of stabilisation techniques such as rock bolting, rock netting, shotcrete are required as part of the detailed design stage for areas of slope instability on cut sections, particularly in the area between boreholes RC1064 and RC1025, (Ch. 5,000) where a disparity in rock quality suggests that there is a fault zone in close proximity to this cut (Ch. 4,640 to Ch. 5,960).

Accidental Spillages: Mitigation measures to prevent the potential for accidental spillages are outlined under **Chapter 3, Section 3.13 - Environmental Management during the Construction Phase** and **Section 9.5.1** of **Chapter 9: Hydrology** and **Drainage.**

At the proposed Service Area, the surface water drainage system has been designed to limit the potential for contaminated surface water run-off to reach the underlying soils, subsoils and bedrock as detailed below under the section on mitigation measures for hydrogeology. The majority of the site will be covered in hardstanding so as a result the Service Area will have little impact on the underlying soils, subsoils or bedrock during the operational phase.

Hydrogeology

Impact to Aquifer Vulnerability*:* Mitigation measures against the impact to aquifer vulnerability are outlined under construction phase mitigation measures in **Section 11.5.1** above.

The surface water drainage system has been designed to limit the potential for contaminated surface water run-off to reach the underlying soils and groundwater. At the proposed Service Area, all run-off from the fuel filling areas will be collected within a closed drainage system which will pass through a hydrocarbon separator before being discharged to the main surface water drainage system. The drainage system has been designed such that all surface water run-off from potentially contaminated areas, including roadways, car-parks and the fuel filling station (following initial treatment) will pass through an attenuation and treatment system which has been designed to treat water to achieve a hydrocarbon concentration of less than 5mg/l (as outlined in the Guidance document: *PPG3 Use and design of oil separators in surface water drainage systems*). The interceptor within the fuel filling area is capable of storing the maximum contents of a tanker delivering fuel at the site.

All clean uncontaminated rainwater including roof water and uncontaminated drainage from those areas of the site where vehicles are not stored, repaired, refuelled or washed will be kept separate from contaminated water and channelled directly to the harbour.

The following guidance documents regarding fuel filling station activities must be adhered to during the operational phase of the proposed Service Area:-

- Specific guidance for the prevention of pollution at sites involving particular activities has been issued in the UK by the Environment and Heritage Service, the Scottish Environmental Protection Agency and the Environment Agency in a suite of Pollution Prevention Guidance (PPG) documents. Those specific to the activities on the proposed development include PPG2 (above ground storage tanks), PPG3 (Use and design of oil separators in surface water drainage systems), PPG7 (Refuelling Activities), PPG26 (drums and bulk containers), PPG27 (underground storage tanks).
- The Institute of Petroleum Guidelines for Soil, Groundwater and Surface Water Protection and Vapour Emission Control at Petrol Fillings Stations, June 2002;
- Draft Code of Practice for assessing the Risks from Petrol at Relevant Petrol Stations under The Dangerous Substances (Petrol Stations) Regulations 1999, and
- DEFRA (UK) Groundwater Protection Code: Petrol Stations and other fuel dispensing facilities involving underground storage tanks, November 2002.

Impact of Karst Features: Mitigation measures against the presence of karst features are outlined under construction phase mitigation measures in **Section 11.5.1** above.

Impact to Private Wells: Mitigation measures for the impact to private wells are outlined under construction phase mitigation measures in **Section 11.5.1** (under Dewatering) above.

Accidental Spillages: The proposed surface water drainage system incorporates containment and attenuation measures as described in **Section 3.6** in **Chapter 3: Description of the Proposed Road Development** and **Chapter 9: Hydrology and Drainage.** This will provide protection of groundwater during the operational stage from both routine run-off and accidental spillages associated with traffic using the route**.**

The guidelines listed above under Impact to Vulnerability will be implemented at the proposed Service Area to mitigate against and prevent accidental spillages. The following specific measures as detailed in these guidelines must be adopted:

- All oils and fuels will be stored in tanks of suitable integrity and strength and be placed within a secondary containment system which must be able to contain at least 110% of the tank contents;
- Infiltration by storm water run-off will be minimised by the installation of roofs and covers where appropriate e.g. by providing covers over boreholes;
- Surface water run-off from any area where fuel is stored or dispensed will be separate from the surface water drainage system and any open ground or porous surfaces, by using grids and gullies and surfaces impermeable to the products used;
- Fuel storage and dispensing areas will be paved and potentially contaminated water and spills will be directed through a hydrocarbon separator which has been designed to serve the surface area catchment of the site;
- Underground fuel storage tanks and associated pipework will be double skinned and fitted with an automatic leak detection system;
- Pipework will be protected from corrosion and placed within granular material to protect from stresses caused by obstructions in the ground or uneven settlement;
- Monitoring boreholes will be installed around a facility to enable environmental monitoring;
- Integrity testing will be carried out on tanks and pipe-work before operation of the facility commences, following this it will be used in conjunction with a leak detection system;
- All fuel deliveries will be supervised by personnel trained in the delivery and emergency procedures;
- A full maintenance program, to include, tanks, pipe-work, monitoring equipment, drainage channels and separators will be implemented; and
- All staff will be trained to deal with an environmental incident and formal emergency procedures will be put in place to detail actions to be taken in the event of leaks, spillages, collisions, fires and odours being detected off-site.

Surface Water Run-off: In order to prevent the contamination of groundwater through infiltration of contaminated surface water run-off, a suitable drainage system has been designed which includes containment and attenuation measures as described in **Section 3.6** in **Chapter 3**: **Description of the Proposed Road Development** and **Chapter 9: Hydrology and Drainage.** Mitigation measures include the provision of closed drainage systems for areas of Extreme/High aquifer vulnerability in areas of cut however as these areas are within Locally Important Aquifers; an imperceptible impact on the

groundwater quality is predicted. As aquifer vulnerability is either Extreme or High, the discharge of surface water run-off will be controlled in order to prevent the pollution of groundwater. In the section of road adjacent to Loughbeg at Barnahely there will be a hydrocarbon separator to protect groundwater in the area from contamination and an attenuation pond which will improve the quality of the water being drained to Loughbeg Spring to meet specific water quality standards such as the European Communities Environmental Objectives (Surface Water) Regulations, 2009 (S.I. No. 272 of 2009). The use of SuDS pre-treatment will remove pollutants, suspended solids and silt in order to prevent contamination of the surface water and groundwater as a result of run-off. The details on the proposed drainage measures are outlined in **Chapter 3: Description of the Proposed Road Development** and **Chapter 9: Hydrology and Drainage** and include use of filter drains, infiltration trenches, soak pits and filter strips up gradient of infiltration areas and attenuation ponds. Measures to attenuate and treat carriageway run-off have been incorporated into the drainage design of the proposed road project – see **Section 3.6 of Chapter 3: Description of Proposed Road Development** and **Chapter 9: Hydrology & Drainage**.

During routine operation of the Service Area**,** the surface water drainage system has been designed to limit the potential for contaminated surface water run-off to reach groundwater. The surface water drainage system for the proposed Service Area is described in **Chapter 9: Hydrology and Drainage.** Foul drainage from all on site toilet and washing facilities will be contained and disposed of in an appropriate manner to prevent pollution of groundwater in accordance with the relevant statutory regulations. This will be provided through connection to the main foul sewer network.

Climate Change: The greater Dublin Strategic Drainage Study and the UK Highways Agency publication '*Road Drainage and the Water Environment' (HA216/06)* recommend that the sensitivity of the drainage design to a factored increase on present day rainfall depths for all durations and return periods is established and, where necessary, make provision for this in drainage design. The NRA guidelines state that 'sufficiently robust environmental engineering drainage solutions must be developed to deal with predicted future river flows'.

The proposed surface water drainage network is designed to allow for an increase of 20% in flow rates, in line with OPW and TII requirements. There is therefore no impact predicted in terms of climate change as a result of the proposed M28 Road Project.

Table 11.14: Summary of Sensitive Receptors during Operation along the Proposed M28 Road Project with Mitigation

Receptor Name/Activity	Receptor Type	Receptor Location	Summary of Proposed Mitigation	Potential Impact with Mitigation
Embankment settlement	Topsoils and Subsoils	Throughout the proposed M28 Road Project	Stabilisation techniques.	Imperceptible negative of temporary duration
Accidental Spillages	Groundwater, Topsoils &Subsoils	Throughout the proposed M28 Road Project	Emergency procedures, containment measures, bunding, safe materials handling Adherence to specific guidance for refuelling activities and fuel storage.	Imperceptible negative of temporary duration
Impact to Aquifer Vulnerability	Groundwater	Vulnerability Rating likely to change: Ch. 4,880 to Ch. 5,000 and Ch. 5,550 to Ch. 5,800 (refer to **Table 11.9**) Closed drainage at Ch.7,340 to Ch.7,825 and Ch.5,240-Ch.5,920	Appropriate drainage; hydrocarbon separators, attenuation, SuDS pre-treatment, Closed drainage systems as described in **Chapter 9.**	Imperceptible negative of permanent duration
Impact of karst Features	Groundwater	Locations of known karst feature along route: Ch. 6,500, Ch. 7,000 & Ch. 9,150	Appropriate geotechnical design and control of surface water run-off (where possible, drainage at least 15m away from known karst features). Detailed SI to accurately assess extent of karst.	Imperceptible negative of permanent duration
Impact to Private Wells	Groundwater	One private well (P01) in the immediate vicinity of the cutting at Carr's Hill (Ch. 2,500)	Monitoring programme	Imperceptible negative of temporary duration
Surface Water Run-off	Groundwater	Throughout the proposed M28 Road Project	Appropriate drainage design with containment and attenuation measures as described in **Chapter 3** and **Chapter 9**.	Imperceptible negative of permanent duration
Climate Change	Groundwater	Throughout the proposed M28 Road Project	Drainage design to allow for a 20% increase in flow rates.	None

11.6 DO-NOTHING SCENARIO

Proposed M28 Road Project

If the proposed M28 Road Project does not proceed, ongoing activities would continue within the study area to include continued increase in traffic, localised quarrying at Raffeen and the potential progression of residential, commercial and industrial developments. These activities will result in localised and small scale cumulative negative impacts to the soils, subsoils and groundwater environment within the study area. If the proposed Service Area did not proceed at Ringaskiddy, ongoing activities will continue within the proposed area and its surrounding environs. The harbour area at Ringaskiddy supports shipping and transport navigation and large scale industrial activity. The environmental pressures associated with these industries are likely to continue without the proposed Service Area in place. In the absence of a motor Service Area trucks will continue to park in unauthorised, non-designated parking areas lying on the made ground of the harbour area. Such ongoing activity will continue to pose an increased pressure on the groundwater environment e.g., uncontrolled surface water run-off, increased risk of hydrocarbons run-off, fuel run-off, etc.

11.7 RESIDUAL IMPACTS

This section forms the assessment of the predicted impacts of the proposed works once the mitigation measures outlined above have been taken into consideration. No significant residual impacts are expected on soils and geology or hydrogeological regimes.

11.7.1 Proposed M28 Road Project

The significance of impacts remaining from the proposed M28 Road Project, with the mitigation measures are summarised in **Table 11.15** and **Table 11.16**.

Table 11.15: Residual Impacts during Construction Phase on Soils, Geology and Hydrogeological Receptors

Receptor Name/Activity	Impact	Significance
Earthworks Operations	Imperceptible negative of permanent duration	Permanent excavation of material for the road alignment. Compaction of ground. At the proposed Service Area; permanent excavation of material for hardstanding, foundations, piles etc. Compaction of ground.
Impact to Aquifer Vulnerability	Imperceptible negative of permanent duration	Localised, but minor, changes in groundwater levels and alteration of natural groundwater flow patterns. Risk of groundwater pollution from contaminated run-off. Removal of soil increasing vulnerability at the site of the proposed Service Area. Hardstanding reducing infiltration rates creating localised, but minor, changes in groundwater levels and alteration of natural groundwater flow patterns.

Table 11.16: Residual Impacts during Operational Phase on Soils, Geology and Hydrogeological Receptors

Receptor Name/Activity	Impact	Significance
Embankment Settlement	Imperceptible negative of temporary duration	Settlement of ground.
Impact to Aquifer Vulnerability	Imperceptible negative of permanent duration	Localised, but minor changes in groundwater levels and aquifer vulnerability. Risk of groundwater pollution from contaminated run-off. At the proposed Service Area; hardstanding reducing infiltration rates creating localised, but minor, changes in groundwater levels and alteration of natural groundwater flow patterns. Potential for pollution from contaminated run-off due to refuelling activities.

11.8 MONITORING

In order to establish baseline conditions in advance of works and to monitor the effectiveness of the design including mitigation, monitoring of groundwater quality and levels will take place at the following locations prior to, during and post construction:

11.8.1 Proposed M28 Road Project

- Any private wells located within 300m of proposed areas of cut where the water table is to be intersected. Existing groundwater boreholes at Raffeen Quarry to demonstrate that the proposed road does not impact on the quarry.

- Monitoring boreholes which will be installed prior to the construction phase of the proposed Service Area to establish baseline conditions at the Service Area. Three groundwater monitoring boreholes will be installed; one up gradient of groundwater flow at the boundary of the L2545 Road and two downgradient of groundwater flow at the periphery of the site adjacent to Cork Harbour.

Monitoring for the proposed M28 Road Project will begin 3 months prior to the commencement of works to obtain background levels and will continue for the duration of the works. Groundwater quality monitoring will take place post construction to demonstrate the successful implementation of the mitigation measures and the design solution. A programme of daily groundwater level monitoring will be established in order to demonstrate that the ground water flow regime has not been altered. **Table 11.17** outlines the frequency, locations (refer to **Figure 11.6**) and parameters which will be analysed during the groundwater monitoring programme.

Table 11.17: Groundwater Monitoring Programme

Location	Frequency	Parameters	Rationale
Proposed M28 - Private Wells in **Figure 11.6** and Boreholes under the existing planning for the Quarry	GW Quality: Pre Construction: Monthly for 3 months GW Quality: During Construction: Bi monthly GW Quality: Post Construction: Quarterly for 1 year & Annually for 2 years Water Level: Daily	Colour, turbidity, odour, pH, conductivity, nitrate, nitrite, ammonium, aluminium, iron, manganese, phosphorous, hardness, total hydrocarbons, and microbiological quality.	To monitor and maintain baseline groundwater quality and levels during the construction phase and to demonstrate effective implementation of mitigation measures during the construction phase. Post construction monitoring to demonstrate that the as built proposed M28 Road Project maintains or improves groundwater quality.
Proposed Service Area- Installation of 3 monitoring boreholes	GW Quality: Pre Construction: Monthly for 3 months Water Level: Daily GW Quality: During Construction: Bi monthly GW Quality: Post Construction: Quarterly for 1 year & Annually for 2 years	Colour, turbidity, odour, pH, Conductivity, nitrate, nitrite, ammonium, aluminium, iron, manganese, phosphorous, hardness, total hydrocarbons, and microbiological quality.	To monitor and maintain baseline groundwater quality and levels during the construction phase and to demonstrate effective implementation of mitigation measures during the construction phase. Post construction monitoring to demonstrate that the as built proposed M28 Road Project maintains or improves groundwater quality.

12 TERRESTRIAL ECOLOGY

12.1 INTRODUCTION

12.1.1 Scope and Objectives

This chapter of the EIS examines the terrestrial ecological environment of the proposed M28 Road Project.

The principal objectives of this assessment are as follows:-

- Complete a desk study and all necessary field surveys to obtain relevant terrestrial and ecological data for the Zone of Influence (ZoI)[1] of the proposed works;
- Identify and describe sites of known or potential ecological interest; and
- Assess the significance of the likely significant impacts of the proposed M28 Road Project on each of these environmental aspects.

This chapter initially sets out the methodology to be used for the assessment (**Section 12.2),** then describes the existing environment (**Section 12.4** and **Section 12.5**), sets out the predicted impacts of the proposed road project (**Section 12.6),** describes the avoidance and mitigation measures to be incorporated in the proposed road project (**Section 12.7**) and details any residual impacts (**Section 12.8**).

12.1.2 Description of the Proposed M28 Road Project

A full description of the proposed road project is provided in **EIS Chapter 1: Introduction and Need for the Proposed Road Development** and **Chapter 3: Description of Proposed Road Development** and presented on **Figure 1.3.**

12.1.3 Study Area and Zone of Influence

The proposed M28 Road Project will comprise a motorway from the Bloomfield Interchange to Barnahely with a single-carriageway from Barnahely to the eastern side of Ringaskiddy.

Determination of this project's Zone of Influence (ZoI) was achieved by assessing the project's requirements and deliverables against the ecological receptors within the project footprint, in addition to all ecological receptors that could be connected to and subsequently impacted by the project through abiotic and biotic vectors. To this end, the zone of influence extends outside of the proposed road project footprint to include ecological receptors connected to the project through overlap / intersection, proximity and connectivity through features such as watercourses. The ecological receptors within the ZoI of the Proposed M28 Road Project are presented in **Figure 12.5**.

[1] Zone of Influence (ZoI) – area over which ecological features may be subject to significant effects as a result of the proposed project and associated activities. (CIEEM, 2016)

12.2 METHODOLOGY

12.2.1 General

The assessment methodology is based primarily upon the National Road Authority (NRA)'s[2] *Guidelines for Assessment of Ecological Impacts of National Road Schemes* Rev 2 (NRA, 2009) (referred to hereafter as the NRA Ecological Impact Assessment Guidelines), and the survey methodology is based on the NRA Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna on National Road Schemes (NRA, 2008).

The assessment is prepared having regard to the following guidelines:-

- DoEHLG (2009, rev. 2010) Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities. Department of the Environment, Heritage and Local Government;
- European Communities (2000) Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg. European Commission;
- EC (2002) Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg. European Commission;
- EC (2007) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the commission. European Commission;
- EC (2013) Interpretation Manual of European Union Habitats. Version EUR 28. European Commission;
- EPA (2002) Guidelines on the information to be contained in Environmental Impact Statements. Environmental Protection Agency;
- EPA (2003), Advice Notes on current practice in the preparation of Environmental Impact Statements. Environmental Protection Agency;
- Fossitt, J., 2000. *A Guide to Habitats in Ireland*. The Heritage Council, Kilkenny;
- HA (2001) DMRB Volume 10 Section 4 Part 4 - Ha 81/99 - Nature Conservation Advice In Relation To Otters. The Highways Agency;
- CIEEM (2016) Guidelines For Ecological Impact Assessment in the UK and Ireland Terrestrial, Freshwater and Coastal, 2nd Edition;
- National Parks and Wildlife Service (NPWS) (2013) - The Status of EU Protected Habitats and Species in Ireland. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland;
- NRA (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide Rev. 1. National Roads Authority;
- NRA (2009) Guidelines for the Assessment of Ecological Impacts of National Road Schemes Rev. 2. National Roads Authority;
- NRA (2008) NRA Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna on National Road Schemes). National Roads Authority;

[2] Now known as Transport Infrastructure Ireland (TII).

- NRA Environmental Assessment and Construction Guidelines (both adopted and draft versions);
- O'Neill, F.H., Martin, J.R., Devaney, F.M. & Perrin, P.M. (2013) The Irish semi-natural grasslands survey 2007-2012. Irish Wildlife Manuals, No. 78. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Ireland;
- Smith, G. F., O'Donoghue, P., O'Hora, K., Delaney, E., 2011. Best Practice Guidance for Habitat Survey and Mapping. The Heritage Council, Kilkenny; and
- Consultation with the Public, Statutory and other bodies/ individuals.

Studies were also carried out having regard to following legislation:-

- European Communities (Birds and Natural Habitats) Regulations 2011, as amended;
- European Communities (Environmental Impact Assessment) Regulations, 1989 to 2006;
- European Communities (Environmental Liability) Regulations, 2008;
- European Communities (Quality of Salmonid Waters) Regulations, 1988;
- Flora Protection Order, 2015;
- Planning and Development Act 2000 , as amended;
- Planning and Development Regulations 2001, as amended:
- Roads Acts 1993 to 2007(as amended);
- Water Framework Directive (2000/60/EC); and
- Wildlife Act 1976, as amended.

The methodology comprises the following elements: desk study, consultation and field assessments. These elements are used to identify, describe and map areas of known or potential ecological value.

The ecological features and receptors within the project ZoI were assessed by means of a desk study of literature pertinent to the site and surrounding area, consultation with statutory bodies and field surveys of the site.

A review of Ordnance Survey maps and of detailed high resolution ortho-rectified aerial photography was also carried out to assist in delineating the extents and boundaries of different habitat types. Multidisciplinary site surveys were carried for terrestrial and aquatic flora and fauna, during the optimum seasons for the habitats and species. Multidisciplinary and taxon specific site surveys were undertaken by RPS ecologists and appointed sub-consultants between 2013 and 2017. These surveys were informed by and built upon a catalogue of ecological and environmental surveys completed for earlier iterations of the M28 Road Project, undertaken since 2002.

Specific surveys for targeted plant community groups, birds and mammals including bats were conducted during the optimum seasons. The surveys were carried out in accordance with best practice and the NRA's *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes* (2008).

12.2.2 Desk Study

The sources of published material that were consulted as part of the desk study for the purposes of the EIS are as follows:-

- A review of the National Parks & Wildlife Service (NPWS) natural heritage database for designated areas of ecological interest and sites of nature conservation importance within and adjacent to the study area;
- Review of NPWS Rare Plants Database for all rare and protected species to identify any legally protected or rare plant species known to be present within the study area;
- Balmer, D., Gillings, S., Caffrey, B., Swann, B., Downie, I. & Fuller, R. 2013. Bird Atlas of 2007-2011: The Breeding and Wintering Birds of Britain and Ireland (British Trust for Ornithology);
- Preston, C.D., Pearman, D.A., & Dines, T.D. 2002 New Atlas of the British & Irish Flora Oxford University Press;
- Gibbons, D.W., Reid, J.W. & Chapman, A. 1993. The New Atlas of Breeding Birds in Britain and Ireland: 1988-1991. T. & A.D. Poyser, London, UK;
- Andrews, H. (2013). *Bat Tree Habitat Key*. Available from: www.arcol.co.uk;
- Bat Conservation Ireland, (2010). Guidance notes for Planners, Engineers, Architects, and Developers;
- Collins, J. (ed.) (2016). *Bat Surveys for Professional ecologists: Good Practice Guidelines* (3rd ed.). The Bat Conservation Trust, London;
- Kelleher, C. & Marnell, F. (2006). *Bat Mitigation Guidelines for Ireland*;
- Literature review to identify and collate relevant published information on both ecological aspects of the study area and relevant ecological studies conducted in other areas;
- Review of Ordnance Survey maps and ortho-photography;
- National Biodiversity Data Centre database for records of rare and protected species within the study area;
- Port of Cork Bird Surveys. RPS 2012;
- Review of the Cork County Development Plan 2009-2015;
- Aerial Photography;
- 1:50,000 Ordnance Survey (OS) Map; Discovery Series;
- Review of the Butterfly Ireland website (www.butterflyireland.com) and Irish Butterflies website (www.irishbutterflies.com) to identify the presence of any rare species within the study area including; Marsh Fritillary, Small Blue, Green Hairstreak, Purple Hairstreak, Dingy Skipper, Large Heath and Brimstone;
- Inland Fisheries Ireland (http://www.fisheriesireland.ie);
- Irish Wetland Bird Survey data (IWeBS);
- Cork Bird Report (Cronin *et al*., 2006);
- DePuy (2011) Wind Energy Project Environmental Impact Statement. DePuy (Ireland);
- Janssen (2011) Wind Energy Project Environmental Impact Statement. Janssen Biologics (Ireland);
- Novartis (2011) Wind Energy Project Environmental Impact Statement. Novartis Ringaskiddy Limited;
- Simms, I.C., Plonczkier, P., & Johnson L. (2011a) Cork Lower Harbour Wind Turbine Development Bird Radar Monitoring: Interim Briefing Report. Bird Management Unit Food and Environment Research Agency Sand Hutton York. (cited by GSK, 2011);

- Simms, I.C., Plonczkier, P & Johnson, L. (2011b) Cork Lower Harbour Wind Turbine Development Bird Radar Monitoring: Final Report. Bird Management Unit Food and Environment Research Agency Sand Hutton York, and
- SKB (2011) Wind Energy Project Environmental Impact Statement. SmithKline Beecham (Cork) Limited (GlaxoSmithKline).

In addition, Cork County Council has carried out studies relating to the improvement of the N28 since 2002. The findings of these studies, in particular the various ecological commentaries were considered as part of this chapter's desktop assessment.

12.2.3 Walkover Surveys and Site Visits

Following a full desktop study of available biological information pertaining to the study area, RPS ecologists, specialists and sub-consultants carried out ecological assessments on appointment from December 2013 through to March 2017.

These studies include the following:-

- Targeted mammal surveys for badger and otter conducted in March 2014 and March 2015 (RPS);
- Winter Bird surveys completed for the proposed route and its ZoI including those proximal areas of Cork Harbour SPA, Glas Ecology, winter 2014/2015;
- Breeding Barn Owl survey, Glas Ecology 2014;
- Peregrine Falcon survey of Raffeen Quarry, Glas Ecology 2014;
- Winter Bird surveys completed for the proposed route and its ZoI including those proximal areas of Cork Harbour SPA, Tom Gittings, winter 2015/2016;
- Phase 1 habitat survey of the proposed route and its ZoI, July 2014 (RPS);
- Botanical survey of Raffeen Quarry, completed May 2015 (RPS);
- Breeding Bird Surveys (Barn Owl), Glas Ecology, May – June 2014;
- Bat Surveys, Aardwolf Wildlife Surveys (Conor Kelleher), all existing structures along the route, including bridges, dwellings (occupied and derelict) and farm buildings were surveyed for bats or signs of their presence, conducted 2014[3];
- Bat habitat suitability survey of the Donnybrook Stream and environs, March 2015 (RPS);
- Bat survey of proposed Carr's Hill Interchange, June – September 2015 (RPS);
- Otter survey of the Donnybrook Stream and its environs, March 2015 (RPS);
- Fisheries Assessment, Dixon Brosnan, 2015;
- Survey of Raffeen quarry wetland (Cilian Roden), 2017;
- Badger survey of the proposed road project and ZoI, February & March, 2017; and
- Potential Bat Roost Survey and Assessment, winter, (Greenleaf Ecology), 2017.

The data collected during these surveys provide detailed information on the study areas existing environment. The habitat mapping information is used for assessing the impacts of the proposed M28 Road Project on the terrestrial environment.

[3] Bat surveys completed for this development are provided in **Appendix 12F Volume 4**

12.2.4 Field Assessment Criteria

All ecological sites were assessed according to the criteria for site evaluation outlined in the NRA *Ecological Impact Assessment Guidelines* (NRA, 2009). The geographic frame of reference which is used to determine ecological value is provided in **Table 12.1.** The evaluation of ecological receptors along the scheme was undertaken by competent experts having regard to the guidance provided in the *Ecological Impact Assessment Guidelines* (NRA, 2009).

Table 12.1: Ecological Site Assessment Scheme

Ratings for Ecological Sites
International Importance:
'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation.
Proposed Special Protection Area (pSPA).
Site that fulfils the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended).
Features essential to maintaining the coherence of the Natura 2000 Network.
Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive.
Resident or regularly occurring populations (assessed to be important at the national level) of the following:
Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; and/or
Species of animal and plants listed in Annex II and/or IV of the Habitats Directive.
Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971).
World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972).
Biosphere Reserve (UNESCO Man & the Biosphere Programme).
Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979).
Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979).
Biogenetic Reserve under the Council of Europe.
European Diploma Site under the Council of Europe.
Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).
National Importance:
Site designated or proposed as a Natural Heritage Area (NHA).
Statutory Nature Reserve.
Refuge for Fauna and Flora protected under the Wildlife Acts.
National Park.
Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park.
Resident or regularly occurring populations (assessed to be important at the national level) of the following:
Species protected under the Wildlife Acts; and/or
Species listed on the relevant Red Data list.
Site containing 'viable areas' of the habitat types listed in Annex I of the Habitats Directive.
County Importance:
Area of Special Amenity.
Area subject to a Tree Preservation Order.

Ratings for Ecological Sites
Area of High Amenity, or equivalent, designated under the County Development Plan. Resident or regularly occurring populations (assessed to be important at the County level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance. County important populations of species or viable areas of semi-natural habitats or natural heritage features identified in the National or Local BAP, if this has been prepared. Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county. Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.
Local Importance (higher value): Locally important populations of Priority species or habitats or natural heritage features identified in the Local Biodiversity Action Plan (BAP), if this has been prepared; Resident or regularly occurring populations (assessed to be important at the Local level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality; Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.
Local Importance (lower value): Sites containing small areas of semi-natural habitat that are of some local importance for wildlife; Sites or features containing non-native species that are of some importance in maintaining habitat links.

12.2.5 Habitat Classification

The habitats found in the study area (shown on **Figure 12.3a-e** in **Volume 5**)), are classified in accordance with the guidelines set out in '*A Guide to Habitats in Ireland*' (Fossitt, 2000), which classifies habitats based on the vegetation present and management history. The classification is a standard scheme for identifying, describing and classifying wildlife habitats in Ireland. The classification is hierarchical and operates at three levels, outlining the correlation between its habitat categories and the phytosociological units (plant communities) of botanical classifications.

Where required, classification schemes borne out of surveys such as the *National Survey of Native Woodlands 2003-2008* (Perrin *et al*., 2008) and *the Irish Semi-natural Grassland Survey 2007-2012* (O'Neill *et al*., 2013) were used as a reference to aid refinement of some of the Fossitt (2000) classifications as required. The classification of semi-natural woodlands and scrub are also considered under the Native Woodland Scheme under the *National Development Plan 2007-2013*.

Habitats are also described in terms of their correspondence to Annex I habitats as per the Interpretation Manual of European Union Habitats - EUR28. The Interpretation Manual is a scientific reference document published by the European Commission for the interpretation of Priority and Non-Priority Annex I habitat types of the Habitats Directive. This manual incorporates descriptive sheets for Annex I Priority and Non-Priority Habitats, which establishes clear, operational scientific definitions of habitats, using pragmatic descriptive elements (e.g., characteristic plants) and taking into consideration regional variations.

The Status of EU Protected Habitats and Species in Ireland (NPWS, 2013) was also consulted which provides details on the status of listed habitats and species and also provides lists of typical species for these habitats in Irish context.

The habitats found within the study area of the proposed M28 Road Project are evaluated based on their naturalness, value and vulnerability as well as their inclusion within the Natura 2000 network. Habitats that are assessed to be good examples of Annex I and Annex I Priority habitats are considered to be of International or National importance. Semi-natural habitats with high biodiversity in a county context and that are vulnerable, are considered to be of County Importance. Habitats that are considered semi-natural habitat or locally important for wildlife are considered to be of Local Importance (higher value) and sites containing small areas of semi-natural habitat or are of some importance in maintaining connectivity between habitats are considered to be of Local Importance (lower value). Seasonal factors that affect distribution patterns and habitats or species were taken into account when conducting the surveys and the potential of the site to support certain populations.

The townland locations of the habitats which are found within the ZoI of the proposed M28 Road Project are provided for each habitat type.

12.2.6 Flora

A full desktop review was conducted of the higher plant species recorded within the Ordnance Survey (OS) National Grid 10km Squares within which the proposed M28 Road Project is located. The NPWS *Rare Plants Database* was consulted in order to identify any legally protected or rare plant species known to be present within the study area.

The principal source of information regarding the distribution of flora in Ireland is the *New Atlas of the British & Irish Flora* (Preston *et al*., 2002). The data included in this atlas is from the 1987-1999 atlas survey. This atlas shows data for vascular plants in individual hectads (10 km by 10 km squares). The records for hectad W76 were consulted and a search was carried out to investigate if any rare or protected plant species had been recorded in the square, during the 1987-1999 atlas survey (and previous surveys) carried out by the Botanical Society of the British Isles (BSBI). The search included the vascular plants that are listed in Annex II and IV of the EU Habitats Directive, the *Flora Protection Order* (FPO) 2015 and *The Irish Red Data Book (IRDB) for Vascular Plants* (Wyse Jackson *et al*., 2016). The results were also compared with species mentioned in the site synopses for sites designated for nature conservation in the area and records for these hectads from the NPWS *Rare and Protected Species Database*.

Common, dominant and noteworthy plant species were recorded as part of the habitat survey, the findings of which determined the impact of the proposed M28 Road Project on flora species of conservation value.

12.2.7 Mammals

There is a requirement that any proposed development assesses the likelihood of impacting mammal species. Non-volant faunal surveys were conducted in March 2014, March 2015 and again in February / March 2017. Surveys were undertaken to identify those species listed under Schedule 5 of the Wildlife Act 1976 (as amended) and which could, bearing in mind the habitats found, occur on the site. All surveys met with standard recommended methodologies.

The National Biodiversity Data Centre (NBDC) database was consulted for rare and protected species records held for the study area and its environs. A non-volant mammal survey of the route, its immediate environs and associated ZoI was completed in March 2014, March 2015 and February / March 2017. The mammal surveys inspected all habitats within the footprint and the ZoI of the proposed M28 Road Project. It focused on semi-natural habitats and habitat assemblages that would provide optimum refuge, cover and transit / corridor options for mammal species. In the case of the M28 Road Project, this typically involved semi-natural habitat assemblages such as scrub, woodland (semi-natural and planted), linear woodland (hedgerows and treelines), watercourses, waterbodies and semi-natural grassland. A badger survey of the route, its immediate environs and its ZoI was completed in February and March 2017. These surveys validated badger records identified in 2014 and 2015, in addition to determining ongoing badger activity and interaction with the footprint and the environs of the proposed M28 Road Project.

During the course of the habitat surveys, birds and mammals encountered were recorded, and any bird or mammal species of conservation concern that were encountered were investigated and noted and informed the scope of taxon specific surveys. Mammal signs were actively searched for in any areas that are of potential importance to protected mammal species such as woodlands (badgers, bats, red squirrel and others), watercourses (otter) etc. Any buildings or other structures that have potential to hold roosting bats, including those that may be removed for the construction of any of the route options, were noted and mapped. A potential bat roost survey and assessment was completed in February 2017. This included an inspection of the exterior of any buildings that may potentially be impacted by the proposed M28 Road Project.

A full desktop review of bird and mammal species and populations of conservation concern within OS 10km National Grid Squares within which the proposed M28 Road Project is located, was conducted. Potential impacts of the proposed M28 Road Project on birds of high conservation concern and legally protected mammals were assessed.

For the bat surveys, the study included a desktop study of all information available in relation to bats in the study area, and field surveys which involved an assessment of the bat roost potential of various habitats within the study area, and a nocturnal bat detector surveys using a heterodyne (Pettersson D200) and heterodyne/Frequency Division bat detector (BATBOX Duet). Prior to fieldwork for the present surveys, areas likely to be of interest to bats along the route and in the wider landscape were identified and selected from mapping and aerial photography and assessed on the ground. The nature and type of habitats present are indicative of the species likely to be present and these were assessed in general accordance with techniques adopted for *The Badger & Habitat Survey of Ireland* (Smal 1995).

In 2013, an autumnal bat activity assessment of the proposed route was undertaken by Aardwolf Wildlife Surveys and reported at the time (Kelleher, 2013). A summer season bat survey was completed in August 2014 by Aardwolf Wildlife Surveys representing a continuation of previous

autumn-season assessments of the bat fauna occurring along the proposed road realignment route. The seasonal study is devised to investigate the different behaviour shown by these animals at different times of the year. A bat survey was conducted in the summer and autumn seasons of 2015 by RPS in order to determine bat activity in the vicinity of the proposed Carr's Hill interchange. A bat habitat suitability survey was also completed along the Donnybrook Stream and its adjoining woodland habitats in March 2015. A survey identifying potential bat roost structures focusing on an assessment of trees and structures along the proposed route was carried out in winter of 2017. Bat survey reports completed between 2013 and 2017 are contained within **Appendix 12F** in **Volume 4**.

12.2.8 Birds

'The Bird Atlas 2007-11: The Breeding and Wintering Birds of Britain and Ireland (Balmer *et al*. 2013)' was consulted for information regarding the distribution of birds recorded in the study area. This Atlas provides data for breeding and wintering birds in individual hectads.

Where relevant, those species recorded in '*The Birds Atlas 2007-2011*' and protected under the EU Birds Directive or mentioned on the *Birds of Conservation Concern in Ireland* (BoCCI) (Colhoun and Cummins, 2013) red list were also identified. Birds listed under Annex I and regularly occurring migratory birds not listed on Annex I are offered special protection by the EU Birds Directive were also identified.

Those listed on the BoCCI red list meet one or more of the following criteria:-

- Their breeding population or range has declined by more than 50% in the last 25 years;
- Their breeding population has undergone significant decline since 1900; or
- They are of global conservation concern.

12.2.8.1 Breeding Bird Surveys

A number of avifaunal surveys were completed for the proposed M28 Road Project. A Barn Owl habitat and structure suitability survey was completed by Glas Ecology in 2014 to identify potential or previously known nest sites during the winter (i.e. outside of the breeding season). Follow up visits were made in the period April to June 2014 to check for active nests. Where building access was not possible, dusk visits were undertaken to look for Barn Owl activity. The Irish Raptor Study Group (IRSG), local NPWS staff and BirdWatch Ireland staff were also consulted to advise of any available information on Barn Owl activity in the area.

A Peregrine Falcon survey of Raffeen quarry was undertaken following the guidelines in Hardy *et al*., 2013. It involved carrying out two site visits, the first to check for site occupancy in the period of March to mid-April 2014, with a second visit to check for breeding activity in the period between early May and mid-June. Again, the IRSG and NPWS were consulted to advise of any information on previous breeding activity at the site. Site visits to Raffeen Quarry to undertake habitat mapping and botanical surveys also took cognisance of Peregrine Falcon activity at the quarry site. Incidental avifaunal records collated during site walkover surveys for other ecological disciplines were also noted.

12.2.8.2 Over-Wintering Surveys

Two over-wintering surveys were completed for the proposed M28 Road Project; i.e. 2014/2015 and 2015/2016. These surveys were completed by Glas Ecology (2014/2015) and Dr. Tom Gittings (2015/2016). These surveys are reproduced in full in **Appendix 12A** in **Volume 4**. Surveys completed included line transect surveys of the proposed route footprint and its environs in addition to surveys on expansive arable and pastoral lands north of Lough Beg to confirm their viability as a significant feeding area for Special Conservation Interests (SCI) of Cork Harbour SPA.

12.2.8.3 Line Transect Surveys

For the purposes of the over-wintering avifaunal population within the ZoI of the proposed M28 Road Project transect surveys were completed along the proposed route. The transect counts used the standard Countryside Bird Survey (CBS) methodology (BirdWatch Ireland, 2012) and involves recording birds separately in three distance bands (0-25 m, 25-100 m and > 100 m), as well as overflying birds. Seven transect sections covering the extent of the proposed route were surveyed during the winters of 2014/2015 and 2015/2016. Any additional notable bird species detected on return walks along the transect route were also recorded separately.

12.2.8.4 Field Feeding Surveys

Given the relative proximity of the proposed M28 Road Project to Lough Beg and its potential overlap with field feeding areas north of this area, surveys of those expansive pastoral and arable areas located to the north of Lough Beg were completed during the winters of 2014/2015 and 2015/2016. Key field feeding areas north of Lough Beg were identified by undertaking monthly counts during the winters of 2014/2015 and 2015/2016. Counts were undertaken within four hours of high tide (i.e. two hours before and two hours after high tide), a period that corresponds to the methodologies undertaken for Irish Wetland Bird Survey (IWeBS) count period and covers the key wintering period. In winter 2015/2016, dusk counts were carried out at Lough Beg. Additional searches of the remainder of the proposed M28 route corridor were carried out on three of the count days, and during each of the transect counts.

Incidental avifaunal records collated during site walkover surveys for other ecological disciplines were also noted.

12.2.9 Reptiles and Amphibians

Three species of amphibians are found in Ireland including the smooth newt (*Lissotriton vulgaris*), the common frog (*Rana temporaria*) and the natterjack toad (*Bufo* (*Epidalea*) *calamita*), and two species of reptiles, lizard (*Zootica vivipara*) and slow-worm (*Anguis fragilis*). Suitable habitats for the natterjack toad are not found within the study area and slow worm are confined to the Burren in Co. Clare, therefore the surveys did not include for these species. The surveys for amphibians and reptiles were undertaken as part of the multi-disciplinary site surveys during their breeding season (January to May). Potential breeding sites, i.e. ponds, drains, edges of watercourses were the targeted habitats for the species surveys.

12.2.10 Terrestrial Invertebrates

The NPWS do not hold records for rare or protected invertebrate species for hectad W76. In addition, the proposed M28 Road Project does not support suitable habitat for terrestrial invertebrates protected under Annex II of the EU Habitats Directive; i.e. Kerry slug (*Geomalacus maculosus*), *Vertigo* sp. and Marsh Fritillary (*Euphydryas aurinia*).

The Butterfly Ireland website (www.butterflyireland.com) was consulted to identify the presence of rare butterfly species within the study area including Marsh Fritillary, Small Blue, Green Hairstreak, Purple Hairstreak, Dingy Skipper, Large Heath and Brimstone. These records are based on the distribution maps from a survey conducted by the Dublin Naturalist's Field Club between 2000 and 2009. The surveys for butterflies were undertaken as part of the multi-disciplinary site surveys. In addition, correspondence received from a local naturalist group includes a species list of invertebrate fauna using wetland habitats at Raffeen Quarry are also incorporated into this assessment.

12.2.11 Aquatic Invertebrates

Aquatic macro-invertebrate communities associated with the receiving watercourses within the ZoI were assessed and are considered as part of the aquatic ecology surveys (see **Chapter 10: Aquatic Ecology**).

Correspondence received from a local naturalist group in 2014 and again in 2016 included a list of Dragonfly species recorded within and in the environs of the wetland habitats at Raffeen Quarry. These records were submitted to Mr. Tony Nagle (Irish Raptor Study Group) who was undertaking a Peregrine Falcon survey at the Raffeen quarry site at the time (on behalf of Glas Ecology), and are reproduced in **Table 12.2** below.

Table 12.2: Dragonfly Species Recorded within and in the Environs of the Wetland Habitats Raffeen Quarry

Common Name	Species Name	Assessment[4]
Emerald Damselfly / Common Spreadwing	*Lestes sponsa*	Least Concern (LC)
Azure Damselfly / Azure Bluet	*Coenagrion puella*	Least Concern (LC)
Variable Damselfly / Variable Bluet	*Coenagrion pulchellum*	Least Concern (LC)
Common Blue Damselfly / Common Bluet	*Enallagma cyathigerum*	Least Concern (LC)
Scarce Blue-tailed Damselfly / Small Bluetail	*Ischnura pumilio*	Vulnerable (VU)
Blue-tailed Damselfly	*Ischnura elegans*	Least Concern (LC)
Common Hawker / Moorland Hawker	*Aeshna juncea*	Least Concern (LC)
Migrant Hawker	*Aeshna mixta*	Least Concern (LC)
Emperor Dragonfly / Blue Emperor	*Anax imperator*	Least Concern (LC)
Four-spotted Chaser	*Libellula quadrimaculata*	Least Concern (LC)
Common Darter	*Sympetrum striolatum*	Least Concern (LC)
Ruddy Darter	*Sympetrum sanguineum*	Least Concern (LC)

[4] Conservation status following Red List Assessment: Nelson, B., Ronayne, C. & Thompson, R. (2011) Ireland Red List No.6: Damselflies & Dragonflies (Odonata). National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

With the exception of scarce Blue-Tailed Damselfly, which is considered to be of Vulnerable (VU) conservation concern, all other species identified by the local naturalists group are considered to be of Least Concern.

12.3 CONSULTATION

As part of the informal EIS Scoping Assessment, non-statutory consultation was undertaken with the Development Applications Unit (DAU) of the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs (DAHRRGA), IFI and Non-Governmental Organisations (NGOs) were consulted with regard to the proposed M28 Road Project. Consultation responses are summarised below in **Table 12.3**.

Table 12.3: Summary of Consultations and EIA Scoping Responses for the Proposed M28 Road Project

Proposed M28 Road Project EIA Scoping Response Summary Table			
Organisation	**Date**	**Form of Consultation**	**Responses and Key Issues Raised by Consultees**
Bat Conservation Ireland	04/03/2015	Email	▪ Highlight the seriousness of bat decline across Europe and resulting associated legislation and conservation programmes to stabilise population numbers. ▪ Note that consideration should be given to the following: protection of bats and bat roosts under the Wildlife Act 1976 as amended, the Habitats Directive 1992 (EEC 92/43), the SEA Directive 2001/42/EC and the National Biodiversity Plan. ▪ Identify a number of pressures on Irish bat species i.e. removal of hedges and scrub, bridge repairs, water pollution, renovation of buildings, alterations to aquatic systems and bank vegetation, roads etc. ▪ Request to follow NRA Guidelines in relation to a four season bat survey. ▪ Recommendation to apply for bat records from national database.
DAHRRGA (then DAHG)	17/02/2015	Email	Acknowledgement only.
	18/02/2015	Email	Acknowledgement only.
	19/02/2015	Email	Acknowledgement and request to correspond by email only.
DAHRRGA (then DAHG)	09/04/2015	Letter (Response to Consultation letter and EIS Scoping Report).	The following are among the key potential conservation issues which will need to be addressed in the NIS and EIS of the effects of the proposed road project on the above site: 1. NIS: Effects on feeding curlew and other waders (to which the conservation objectives of Cork Harbour SPA apply), including potential fragmentation of feeding habitats; 2. NIS: Effects of noise and disturbance on roosting birds in Lough Beg (to which the conservation objectives of Cork Harbour SPA apply), with an

Proposed M28 Road Project EIA Scoping Response Summary Table			
Organisation	**Date**	**Form of Consultation**	**Responses and Key Issues Raised by Consultees**
			assessment of any necessary mitigation options, and including effects in combination with the industrial zoning in the Carrigaline Electoral Area Local Area Plan (CEALAP) (2011) ; 3. EIS: Direct effects on breeding sites and resting places of otters; 4. EIS: Effects of road fragmentation on otter territories, prey sources, traffic mortality and breeding success of otters; 5. EIS: Effects of construction disturbance and operational disturbance (including any cyclist and pedestrian use) on otter use of rivers; 6. EIS: Effects of felling of old trees on roosts (breeding sites and resting sites) of Leisler's bats; 7. EIS: Effects of fragmentation of bat foraging habitat; 8. EIS: Direct effects on badger breeding sites and resting places; 9. EIS: Effects of fragmentation on badgers, and an assessment of badger mortality including mitigation with underpasses, etc. 10. EIS: Effects on peregrine falcon breeding sites; 11. EIS: Effects on limestone flora and invertebrate fauna of conservation importance in limestone rock areas (a botanical survey during the flowering season is recommended); 12. EIS: Effects on barn owl traffic mortality; 13. EIS: Effects on habitat of red-listed bird species, in particular Yellowhammer. 14. EIS: Likelihood of introduction of invasive plant species (especially Japanese knotweed and Himalayan balsam), and mitigation measures to avoid their establishment.
EPA	23/02/2015	Email	Acknowledgement only
IFI	19/02/2015	Email	Acknowledgement only. In relation to road proposals at Carr's Hill recommend conducting an electrofishing survey and asked to revert with the results. Advised that if fish are present in the stream the design as proposed in relation to the culverting is unsatisfactory and requested an alternative approach as per an attached sketch (diverting Donnybrook stream to west of proposed roadway and provision of one culvert to the south of the interchange) and having a meeting to discuss alternative design details. ▪ Advised that based on available information at the time, the preferred route option has potential to interfere with both the Donnybrook and Glounatouig streams and tributaries. ▪ Recommend electrofishing survey in both streams
	24/02/2015	Email	
	02/03/2015	Email	
	03/05/2017	Meeting	

Proposed M28 Road Project EIA Scoping Response Summary Table			
Organisation	**Date**	**Form of Consultation**	**Responses and Key Issues Raised by Consultees**
			and to revert to IFI with survey results. ▪ In relation to the Donnybrook Stream advise that Carr's Hill Interchange proposals are far from satisfactory and if fish are deemed to be present suggests an alternative proposal (as per previous email) and requested a meeting to discuss detailed design and timing of works. ▪ In the case of the Glounatouig Stream and its tributaries, advise that the information as submitted is not detailed enough to assess impacts and therefore request to revert when greater footprint information is available. Recommended in all cases that any instream works or works liable to increase suspended solids level of a waterbody above ambient level should be limited to the period of May to September.
NPWS	11/06/2014	Meeting	This meeting focussed on the potential for impacts to Cork Harbour SPA. The NPWS requested additional bird monitoring to address potential impacts to feedings areas for curlew. Other items discussed include peregrine falcon at Raffeen Quarry, badger mitigation and baseline results to date.
NPWS	21/01/2015	Meeting	Suggested looking into in-combination assessment in AA in detail by looking at Carrigaline Electoral Area Local Area Plan (CEALAP) (2011) zonings and objectives and how these will be opened up as a result of the new roadway. Suggested undertaking a detailed review of CEALAP AA as part of AA in-combination assessment. Recommended covering bird survey results of Barnahely area in detail as part of AA. Suggested contacting CCC Conservation Officer for results of bird surveys in the area and bird survey results from Ringaskiddy Industrial turbines. Consider impacts to bird feeding patterns as a result of road fragmentation. Consider impacts to otter, badger (impacts of habitat fragmentation). Consider deer and red squirrel usage along the project route and environs. Consider impacts to Barn Owl. Identify trees with potential to support bat roosts in the EIS. Include invasive species management plan as a mitigation measure to deal with invasive species along the project route. Road drainage should not drain unattenuated into SAC. Sufficient lands need to be CPO to include drainage systems.
NPWS	18/02/2015	Email	Based on the Carr's Hill Interchange proposals advised that it is likely that the DAHRRGA will recommend otter and bat surveys of the entire Donnybrook Stream.

Proposed M28 Road Project EIA Scoping Response Summary Table			
Organisation	**Date**	**Form of Consultation**	**Responses and Key Issues Raised by Consultees**
NPWS	16/01/2017	Meeting	A meeting was held with the EIS Project Manager, CCC Representative and the Ecologist and members of the NPWS to discuss the M28 road project, results of surveys undertaken and the key findings. The following key items were raised by the NPWS:- ▪ EIS to ensure badger mitigation does not result in risk to badger population from TB; ▪ EIS to ensure underpasses are provided at appropriate time (i.e., pre-main construction activity); ▪ EIS to address impacts to Barn Owls and Yellowhammer; ▪ EIS to address impacts to bats in all seasons; and ▪ EIS to provide mitigation for Peregrine Falcon at the Quarry. The meeting also discussed the previous route option and the ecological impacts of the new route v the previous route. NPWS noted that moving the route should not solely be based on ecological grounds. EIS Project Manager advised that the route was moved for a number of reasons as outlined in **Chapter 4**: **Outline of Alternatives.** The meeting also addressed issues at Raffeen Quarry under its current planning condition including the presence of pennyroyal.
OPW	17/02/2015	Email	Acknowledgement only.
South Western River Basin District	20/02/2015	Email	Advised the EPA should be consulted in respect of the matter. An acknowledgement was received from the EPA.
Raffeen Quarry Local Interest Group	04/10/2016	Written correspondence	Written correspondence received from group of individuals with an interest in Raffeen Quarry. The correspondence outline the ecological value of Raffeen Quarry which includes habitats and species of conservation concern including pennyroyal *Mentha pulegium* a species protected on the Flora Protection Order (2015). This group regard the quarry as a valuable educational and recreational asset. Would welcome a chance to meet with the project design team to contribute to the project and to the preparation of the EIS.
Raffeen Quarry Local Interest Group	15/03/ 2017	Meeting	Informal meeting with members of this local interest group outlining the route trajectory and its interaction with Raffeen Quarry. Discussion of the ecological features associated with this area, the ecological importance of this area and the potential impacts and mitigation measures proposed for Raffeen Quarry.

12.4 RECEIVING ENVIRONMENT -DESKTOP ASSESSMENT

12.4.1 Designated Areas

The site synopses for sites designated for nature conservation provide a description of the scientific interest and conservation importance of each designated site. Natura 2000 Standard Data Forms are also available for European sites. These forms are drawn up at the time when Member States submit their list of potential sites to the European Commission. This form is used as a legal reference when assessing the management of the species and habitats through the concept of favourable conservation status.

The proposed M28 Road Project is not located within the footprint of any site designated for nature conservation. However, the project supports connectivity with two European sites, Cork Harbour SPA and Great Island Channel SAC, through watercourses draining the project footprint. The project does not support connectivity to any other European sites, through biotic or abiotic vectors. As a result, impacts to the following European sites were considered as part of Natura Impact Statement prepared for this project:-

- Cork Harbour SPA (Site Code: 004030); and
- Great Island Channel pNHA/SAC (Site Code: 001058).

The northern and southernmost reaches of the proposed M28 Road Project are proximal to Cork Harbour SPA. Potential impacts to these sites of International Importance will be considered in greater detail as part of the accompanying NIS.

There are no NHAs located within the zone of influence affected by the proposed M28 Road Project. However, the proposed road project is located within 15km of 23 additional pNHAs; i.e. pNHAs that are not also designated as European sites. NHAs are legally protected from damage from the date they are formally proposed for designation under the Wildlife (Amendment) Act 2000 and pNHAs have not been statutorily proposed or designated, but do have some protection under County Development Plans, Agri-Environmental Schemes and Licensing Authorities. pNHAs within a 15km radius of the proposed road project are as follows:-

1. Monkstown Creek pNHA (Site Code: 001979),
2. Lough Beg pNHA (Site Code: 001066),
3. Douglas River Estuary pNHA (Site Code: 001046),
4. Owenboy River pNHA (Site Code: 001990),
5. Fountainstown Swamp pNHA (Site Code: 000371),
6. Templebreedy National School, Crosshaven pNHA (Site Code: 000107),
7. Whitegate Bay pNHA (Site Code: 001084),
8. Rostellan Lough, Aghada Shore and Poulnabibe Inlet pNHA (Site Code: 001076),
9. Cuskinny Marsh pNHA (Site Code: 001987),
10. Carrigacrump Caves pNHA (Site Code: 001408),
11. Carrigshane Hill pNHA (Site Code: 001042),
12. Leamlara Wood pNHA (Site Code: 001064),
13. Rockfarm Quarry, Little Island pNHA (Site Code: 001074),

14. Dunkettle Shore pNHA (Site Code: 001082),
15. Glanmire Wood pNHA (Site Code: 001054),
16. Lee Valley pNHA (Site Code: 000094),
17. Cork Lough pNHA (Site Code: 001081),
18. Ballincollig Caves pNHA (Site Code: 001249),
19. Shournagh Valley pNHA (Site Code: 000103),
20. Blarney Lake pNHA (Site Code: 001798),
21. Blarney Bog pNHA (Site Code: 001857),
22. Ardamadane Wood pNHA (Site Code: 001799), and
23. Minane Bridge Marsh pNHA (Site Code: 001966).

Sites 4 to 23, and all other NHAs and pNHAs exceeding a 15km radius of the project are outside of the hydrological and hydrogeological catchments, biotic and abiotic vectors associated within this project's ZoI. As a result, these sites do not support connectivity to the proposed M28 Road Project and its associated development. Due to this lack of connectivity, there will be no deterioration of habitats or significant disturbance to species, so it is considered extremely unlikely that the proposed M28 Road Project will impact these sites. As a result, impacts to pNHA sites 4 to 23 (and all other pNHAs outside of the 15km radius) will not be considered any further as part of this proposed assessment.

Sites 1 to 3 support connectivity to the proposed M28 Road Project's ZoI. The road project supports indirect connectivity to the Douglas River Estuary pNHA via the Woodbrook and Donnybrook Streams which drain the northern section of the project and discharge to the Douglas River Estuary pNHA. The Glounatouig Stream drains the southern and eastern stretches of the project and supports connectivity to Monkstown Creek pNHA. Between Barnahely and Ringaskiddy, the proposed M28 Road Project is located in proximity to Lough Beg pNHA. There is no indirect interconnectivity between the proposed M28 Road Project and Lough Beg pNHA in the form of significant watercourses and waterbodies. Nonetheless, proximity of these sites means that potential for impacts cannot be discounted. Sites 1-3 are also designated as part of Cork Harbour SPA (Site code: 004030). Descriptive synopses for these sites are presented in **Section 12.4.1.3** to **Section 12.4.1.5**. Site walkover surveys of the study area and its environs considered that each of these pNHAs support intertidal mudflats with marginal shingle and saltmarsh areas that are also of International Importance to avifauna, in particular over-wintering waders and wildfowl.

The location of the proposed M28 Road Project in relation to these designated sites is shown in **Figure 12.1** and **Figure 12.2**. Descriptions of designated sites within the ZoI and their qualifying features are provided in **Table 12.4**. Impacts to European sites are considered in greater detail in the accompanying NIS provided in **Volume 3.**

Figure 12.1: European Sites within 15km of the Proposed M28 Road Project

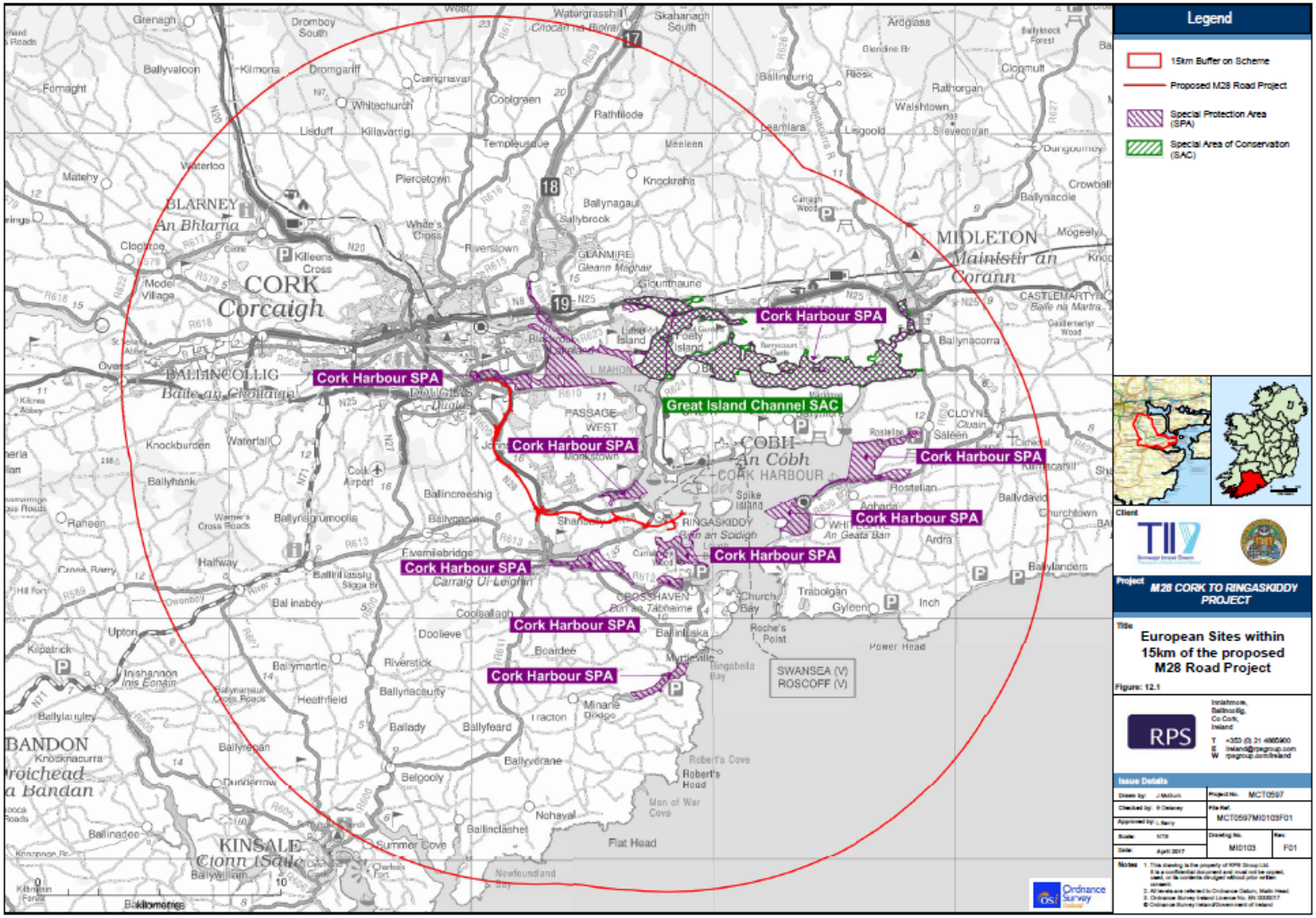
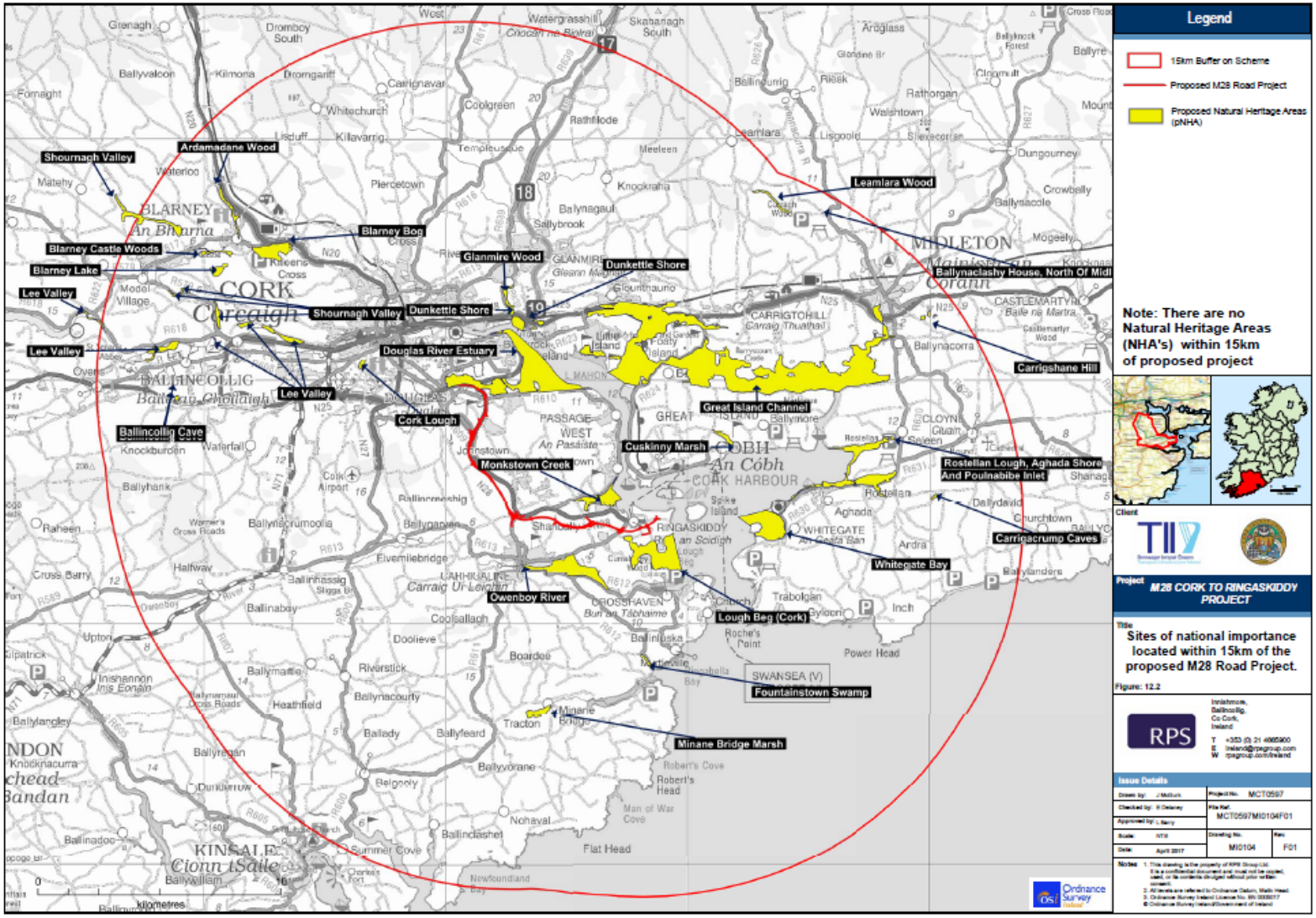


Figure 12.2: Sites of National Importance Located within 15km of the Proposed M28 Road Project



The below tables provide details on the qualifying habitats and species of those European sites located the project zone of influence. This information is obtained from the Conservation Objectives Form and Natura 2000 Data Form prepared for each site. The Natura 2000 Data Form presents details of the Percentage Cover and Representativity of the qualifying habitats. The percentage cover for each habitat within the European site is described and the degree of Representativity gives a measure of 'how typical' a habitat type is. Representativity is ranked on a scale from A to D as follows:-

- A - Excellent,
- B - Good,
- C - Significant, and
- D - Non-significant.

For species, the population significance is based on the relative size or density of the population in the site with that of the national population. Population Significance (p) is ranked on a scale from A to D as follows:-

- A - 100>=p>15%,
- B - 15>=p>2%,
- C - 2>=p>0%, and
- D - Non-significant population.

Table 12.4: Qualifying Features for Designated Sites within Zone of Influence

Site Name	Code	Status	Qualifying Features
Cork Harbour SPA	004030	SPA	Bird Species: Little grebe (*Tachybaptus ruficollis*) [wintering] Great crested Grebe (*Podiceps cristatus*) [wintering] Cormorant (*Phalacrocorax carbo*) [wintering] Grey heron (*Ardea cinerea*) [wintering] Shelduck (*Tadorna tadorna*) [wintering] Wigeon (*Anas penelope*) [wintering] Teal (*Anas crecca*) [wintering] Pintail (*Anas acuta*) [wintering] Shoveler (*Anas clypeata*) [wintering] Red-breasted Merganser (*Mergus serrator*) [wintering] Oystercatcher (*Haematopus ostralegus*) [wintering] Golden Plover (*Pluvialis apricaria*) [wintering] Grey Plover (*Pluvialis squatarola*) [wintering] Lapwing (*Vanellus vanellus*) [wintering] Dunlin (*Calidris alpina*) [wintering] Black-tailed Godwit (*Limosa limosa*) [wintering] Bar-tailed Godwit (*Limosa lapponica*) [wintering] Curlew (*Numenius arquata*) [wintering] Redshank (*Tringa totanus*) [wintering]

Site Name	Code	Status	Qualifying Features
			Black-headed Gull (*Chroicocephalus ridibundus*) [wintering] Common Gull (*Larus canus*) [wintering] Lesser Black-backed Gull (*Larus fuscus*) [wintering] Common Tern (*Sterna hirundo*) [breeding] Wetlands
Great Island Channel SAC	001058	SAC/ pNHA	Mudflats and sandflats not covered by seawater at low tide (1140) Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (1330)
Monkstown Creek	001979	pNHA	Mudflats, shingle and saltmarsh areas supporting viable roosting and feeding habitat for avifauna.
Douglas River Estuary	001046	pNHA	Mudflats, shingle and saltmarsh areas supporting viable roosting and feeding habitat for avifauna
Lough Beg	001066	pNHA	Mudflats, shingle and saltmarsh areas supporting viable roosting and feeding habitat for avifauna

12.4.1.1 Great Island Channel SAC/pNHA (Site Code: 001058)

The Great Island Channel SAC stretches from Little Island to Midleton, with its southern boundary being formed by Great Island. It is an integral part of Cork Harbour which contains several other sites of conservation interest.

The site is of major importance for the two habitats listed on Annex I of the EU Habitats Directive, as well as for its important numbers of wintering waders and wildfowl. It also supports a good invertebrate fauna.

The qualifying habitats found within Great Island Channel SAC/pNHA are provided in **Table 12.5**. The Great Island Channel does not support any qualifying species.

Table 12.5: Great Island Channel SAC Qualifying Habitats

Habitat Code	Habitat Name (SAC Qualifying Feature)	% Cover (approx.)	Representativity
1140	Mudflats and sandflats not covered by seawater at low tide	62	B
1330	Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	2	B

12.4.1.2 Cork Harbour SPA (Site Code: 004030)

Cork Harbour is a large, sheltered bay system, with several river estuaries - principally those of the Rivers Lee, Douglas, Owenboy and Owennacurra. The SPA site comprises most of the main intertidal areas of Cork Harbour, including all of the North Channel, the Douglas River Estuary, inner Lough Mahon, Monkstown Creek, Lough Beg, the Owenboy River Estuary, Whitegate Bay and the Rostellan and Poulnabibe inlets.

The EU Birds Directive (2009/147/EC) requires designation of SPAs for:-

- Annex I Listed rare and vulnerable species;
- Regularly occurring migratory species, such as ducks, geese and waders, and
- Wetlands, especially those of international importance, which attract large numbers of migratory birds each year (Internationally important means that 1% of the population of a species uses the site, or more than 20,000 birds regularly use the site).

Cork Harbour SPA is designated for twenty-two species over-wintering bird species and one breeding species. The species for which Cork Harbour SPA is designated and their population significance are listed below in **Table 12.6**.

Table 12.6: Cork Harbour SPA Species

Species Code	Species Type	Population Significance[5]
A004	Little Grebe (*Tachybaptus ruficollis*)	68i
A005	Great Crested Grebe (*Podiceps cristatus*)	B
A017	Cormorant (*Phalacrocorax carbo*)	B
A028	Grey Heron (*Ardea cinerea*)	47i
A048	Shelduck (*Tadorna tadorna*)	B
A050	Wigeon (*Anas penelope*)	C
A052	Teal (*Anas crecca*)	C
A054	Pintail (*Anas acuta*)	B
A056	Shoveler (*Anas clypeata*)	B
A069	Red-breasted Merganser (*Mergus serrator*)	B
A130	Oystercatcher (*Haematopus ostralegus*)	C
A140	Golden Plover (*Pluvialis apricaria*)	C
A141	Grey Plover (*Pluvialis squatarola*)	C
A142	Lapwing (*Vanellus vanellus*)	C
A149	Dunlin (*Calidris alpina*)	B
A156	Black-tailed Godwit (*Limosa limosa*)	B
A157	Bar-tailed Godwit (*Limosa lapponica*)	C
A160	Curlew (*Numenius arquata*)	B
A162	Redshank (*Tringa totanus*)	B
A179	Black-headed Gull (*Chroicocephalus ridibundus*)	C
A182	Common Gull (*Larus canus*)	B
A183	Lesser Black-backed Gull (*Larus fuscus*)	B
A193	Common Tern (*Sterna hirundo*)	B
A999	Wetlands and Waterbirds	N/A

[5] "i" Signifies individuals

12.4.1.3 Lough Beg pNHA

Lough Beg is a constituent part of Cork Harbour, occurring south of Ringaskiddy in the lower harbour. It occupies low ground between two small ridges, one behind Ringaskiddy and the other running through Coolmore and Currabinny. Limestone outcrops on part of the shore show that it is in the syncline or valley between the two main sandstone ridges on which Cork Airport and Ballymartle are sited. It is a significant area for wintering shorebirds and an attractive local amenity for this part of Cork.

12.4.1.4 Monkstown Creek pNHA

Monkstown Creek is situated between Monkstown and the major seaport of Ringaskiddy on the western shores of Cork Harbour. Geologically, Cork Harbour consists of two large areas of open water in a limestone basin, separated from each other and the sea by ridges of old red sandstone. Within this system, Monkstown Creek is a tidal inlet composed of mudflats, with limestone along the southern shore. A brackish lake also occurs, separated from the sea by a sluice gate.

The mudflats and tidal creeks are fringed by a small amount of saltmarsh vegetation while, above the limestone on the southern shore, two areas of semi-natural woodland occur. The marsh interest of the site is ornithological, with the mudflats acting as winter refuge to waterfowl, including Shelduck, Teal, Redshank and Dunlin. The predominant land use is as a safe mooring for small craft; however major industry and a golf course adjoin the site. The main potential threat is water pollution.

The area is of value because its mudflats provide an important feeding area for waterfowl and it is a natural part of Cork Harbour which, as a complete unit, is of international importance for waterfowl (NPWS, 1997a)[6].

12.4.1.5 Douglas Estuary pNHA

This is a large site situated in the north-west corner of Cork Harbour, stretching from Blackrock to Passage West. This site occurs within the upper harbour and consists of extensive mudflats, formed from fine silts, bisected by the Douglas River. Damp grassland occurs on part of the southern side, extending to some low islands which are inundated in extreme tides.

The main land use within the site is conservation, with the Douglas Estuary designated a wildfowl sanctuary. Some damage has occurred to the site through water pollution, including sewage, tidal littering and the spread of *Spartina* sp. This site is of interest because it is an essential part of the Cork Harbour complex and contains much higher densities of waders than would be expected from its relative size. It is ranked as the second most important area within the harbour (NPWS, 1997b[7]).

[6] NPWS (1997a) Site synopsis of Monkstown Creek pNHA. National Parks and Wildlife Service, Dublin.
[7] NPWS (1997b) Site synopsis of Douglas Estuary Pnha. National Parks and Wildlife Service, Dublin

12.4.2 NPWS and NBDC Rare and Protected Species Databases

The NPWS was consulted for records of rare and protected species within the study area. The NPWS maintains a database collating all rare and protected species records for individual hectads (10 km by 10 km squares). The proposed M28 Road Project falls within hectad W76. The records for this Grid Square were consulted to investigate the likelihood of the presence of rare and protected species within the study area. In addition, the NBDC online dataset of species was interrogated for the occurrence of rare and/or protected species within hectad W76[8]. Records for rare and protected species recorded in W76 are listed in **Table 12.7** below.

Table 12.7: NPWS and NBDC Rare and Protected Species Records for the 10km Grid Square W76

Dataset	Common Name	Scientific Name	Protection	Sample Locations
NPWS	Twaite Shade	*Alosa fallax*	Annex II, V Habitats Directive, Red List (Vulnerable)	N/A
NPWS	Common Dolphin	*Delphinus delphis*	-	Fennell's Bay, Crosshaven
NPWS	Leatherback Turtle	*Dermochelys coriacea*	Annex IV Habitats Directive, Wildlife Act (1976 & 2000), OSPAR), Red List (least concern)	Near Rocky Bay, off Cork Harbour
NPWS	Irish Hare	*Lepus timidus subsp. hibernicus*	Annex V Habitats Directive, Wildlife Act (1976 & 2000), Red List (least concern)	Coosallagh Townland, south-west of Carrigaline
NPWS	Otter	*Lutra lutra*	Annex II, IV Habitats Directive Wildlife Act (1976 & 2000)	Estuary south-west of Monkstown, Stream at Ballynacrusha crossroads, Owenboy River south of Curraghbinny Point, Lough Mahon, northwest of Rochestown, Owenboy/Ballea Bridge Lower Co. Cork.
NPWS	Badger	*Meles meles*	Wildlife Act (1976 & 2000), Red List (least concern)	Carrigaline
NPWS	Red Squirrel	*Sciurus vulgaris*	Wildlife Act (1976 & 2000), Red list (Near threatened)	N/A
NPWS	Irish Stoat	*Mustela erminea subsp. hibernica*	Wildlife Act (1976 & 2000), Red List (least concern)	Crosshaven and Carrigaline
NPWS	Eurasian Pygmy Shrew	*Sorex minutus*	Wildlife Act (1976 & 2000), Red List (least concern)	Carrigaline and Douglas
NPWS	Round-leaved Crane's-Bill	*Geranium rotundifolium*	Red Data Book (Vulnerable)	Waterpark Castle, Carrigaline, Shanbally Limestone Outcrop and Cobh

[8] Red and amber listed species listed on the BoCCI are considered in **Table 12.9.**

Dataset	Common Name	Scientific Name	Protection	Sample Locations
NPWS	Crane's-Bill	*Geranium purpureum subsp. purpureum*	Red Data Book (Near Threatened)	Currabinny Strand
NPWS	Little Robin	*Geranium purpureum*	Red Data Book (Vulnerable)	Currabinny Strand
NPWS	Meadow Barley	*Hordeum secalinum*	Flora Protection Order, Red Data Book (Vulnerable)	Douglas Marshes
NPWS	Sharp-leaved fluellen	*Kickxia elatine*	Red Data Book (Vulnerable)	Cobh, Carrigaline, Mouth of Lough Beg, East of Ringaskiddy terminal
NPWS	Pennyroyal	*Mentha Pulegium*	Flora Protection Order, Red Data Book (Vulnerable)	Great Island at Belvelly[9]
NPWS	Lesser Snapdragon / Weasel's snout	*Misopates orontium*	Flora Protection Order, Red Data Book (Vulnerable)	Monkstown, Carrigaline Castle
NPWS	Greater broomrape	*Orobanche rapum-genistae*	Red Data Book (Rare)	Curraghbinny Forest Park
NPWS and NBDC	Common Frog	*Rana temporaria*	Annex V Habitats Directive, Wildlife Act (1976 & 2000), Red list (least concern)	Carrigaline, Curraghbinny, Private Gardens Sallins, Carrigaline
NPWS	Shepherd's Needle	*Scandix pecten-veneris*	Red Data Book (Extinct)	Crosshaven
NPWS	Annual knawel	*Scleranthus annuus*	Flora Protection Order	Cobh
NPWS	*Weissia brachycarpa* var. *obliqua*	*Weissia brachycarpa var. obliqua*	-	Raffeen Quarry, Ballyhemiken
NPWS	*Schistidium elegantulum* subsp. *elegantulum*	*Schistidium elegantulum subsp. elegantulum*	Red Data Book(data deficient)	Carrigaline Castle Quarry, Carrigaline & Ringaskiddy
NBDC	White whale	*Delphinapterus leucas*	-	Hectad W76
NBDC	Common dolphin	*Delphinus delphinus*	-	Hectad W76
NBDC	Risso's dolphin	*Grampus griseus*	-	Hectad W76
NBDC	Grey seal	*Halichoerus grypus*	Annex II V Habitats Directive, Wildlife Act (1976 & 2000)	Hectad W76
NBDC	Northern bottlenose whale	*Hyperoodon ampullatu*	-	Hectad W76
NBDC	Killer Whale	*Orcinus orca*	-	Hectad W76
NBDC	Common seal	*Phoca vitulina*	Annex II V Habitats Directive, Wildlife Act (1976 & 2000)	Hectad W76

[9] Also confirmed growing within Raffeen Quarry and Shanbally during the current survey.

Dataset	Common Name	Scientific Name	Protection	Sample Locations
NBDC	Common porpoise	*Phocoena phocoena*	Annex II V Habitats Directive, Wildlife Act (1976 & 2000), OSPAR	Hectad W76
NBDC	Glass-wort Feather moss	*Scleropodium tourettii*	Red List (Endangered)	Hectad W76
NBDC	Leathery Turtle	*Dermochelys coriacea*	Annex IV Habitats Directive, Wildlife Act (1976 & 2000), OSPAR, Red list (least concern)	Hectad W76
NBDC	Red Deer	*Cervus elaphus*	Wildlife Act (1976 & 2000), Red list (least concern)	Hectad W76
NBDC	Sika Deer	*Cervus nippon*	Wildlife Act (1976 & 2000), Red list (not assessed)	Hectad W76
NBDC	Fallow Deer	*Dama dama*	Wildlife Act (1976 & 2000), Red list (least concern)	Hectad W76
NBDC	Hedgehog	*Erinaceus europaeus*	Wildlife Act (1976 & 2000), Red list (least concern)	Hectad W76
NBDC	Irish Hare	*Lepus timidus hibernicus*	Annex V Habitats Directive, Wildlife Act (1976 & 2000), Red list (least concern)	Hectad W76
NBDC	Otter	*Lutra lutra*	Annex II, IV Habitats Directive, Wildlife Act (1976 & 2000)	Hectad W76
NBDC	Irish Stoat	*Mustela erminea subsp. hiberncia*	Wildlife Act (1976 & 2000), Red List (least concern)	Hectad W76
NBDC	Badger	*Meles meles*	Wildlife Act (1976 & 2000), Red List (least concern)	Hectad W76
NBDC	Daubenton's bat	*Myotis daubentonii*	Annex IV Habitats Directive, Wildlife Act (1976 & 2000), Red list (least concern)	Hectad W76
NBDC	Natterer's bat	*Myotis nattereri*	Annex IV Habitats Directive, Wildlife Act (1976 & 2000), Red list (least concern)	Hectad W76
NBDC	Lesser Noctule	*Nyctalus leisleri*	Annex IV Habitats Directive, Wildlife Act (1976 & 2000), Red list (near threatened)	Hectad W76
NBDC	Pipistrelle	*Pipistrellus pipistrellus sensu lato*	Annex IV Habitats Directive, Wildlife Act (1976 & 2000), Red list (least concern)	Hectad W76
NBDC	Soprano Pipistrelle	*Pipistrellus pygmaeus*	Annex IV Habitats Directive, Wildlife Act (1976 & 2000), Red list (least concern)	Hectad W76
NBDC	Brown Long-eared Bat	*Plecotus auritus*	Annex IV Habitats Directive, Wildlife Act (1976 & 2000), Red list (least concern)	Hectad W76
NBDC	Red Squirrel	*Sciurus vulgaris*	Wildlife Act (1976 & 2000), Red list (Near threatened)	Hectad W76
NBDC	Pygmy Shrew	*Sorex minutus*	Wildlife Act (1976 & 2000), Red List (least concern)	Hectad W76

12.4.3 Flora Atlas

The New Atlas of British and Irish Flora (Preston *et al*., 2002) and NPWS records were reviewed for information on the presence of rare flowering vascular plants and ferns that are listed on *the Flora (Protection) Order*, 2015 (S0I No. 356 of 2015) or included in the *Red Data Book* for vascular plant species (Wyse Jackson et al., 2016) (**Table 12.8**). The study area is located in the 10km grid square W76.

With the exception of pennyroyal (*Mentha pulegium*), none of those species listed in **Table 12.8** were identified during the site walkover survey. Pennyroyal occurs within Raffeen Quarry in localised abundance within the open gravel access tracks and recolonising bare ground habitats. The distribution of pennyroyal at Raffeen Quarry intersects with the northern embankment of the proposed M28 Road Project.

Pennyroyal also occurs within an area of recolonising bare ground, east of Shanbally. This area supports similar edaphic conditions to Raffeen Quarry; i.e. exposed areas of gravel / aggregate that support localised, ephemeral ponding in addition to bryophyte lawns that provide humid and moist microclimates. An area of the recolonising bare ground ($25m^2$) at Shanbally supporting pennyroyal intersects with the footprint of the proposed M28 Road Project.

Suitable habitat occurs within the proposed study area for the majority of the other rare and protected species listed, especially those species associated with disturbed ground or arable crops. However, many of these species are associated with now disused farming practices and co-occurred with tillage crops as part seed mixes and associated arable ‘weeds’ before seed cleaning was practiced. The advent of clean seed mixes in addition to selective herbicide application along the periphery of arable crops makes their occurrence very unlikely. In addition, the majority of those arable species listed in **Table 12.8** have not been recorded within W76 since before 1970.

Table 12.8: Rare and Protected Plants Recorded in 10km square W76

Common Name	Species Name	Status[10]	Last Recorded	Habitat[11]
Annual Knawel	*Scleranthus annuus*	Vulnerable (VU) / FPO	Pre-1970	An annual or biennial herb found in soil pockets on summer-droughted rocks, and on disturbed sandy soil on heaths, commons, waste places, arable fields and, rarely, river or maritime shingle.
Autumn Lady's Tresses	*Spiranthes spiralis*	Near Threatened (NT)	1970-1986	A rhizomatous herb of unimproved, well-grazed grassland on dry calcareous soils, especially on chalk and limestone, and on cliff-tops and sand dunes; also on lawns and, rarely, on less acidic heathland.
Black Horehound	*Ballota nigra*	Near Threatened (NT)	1970-1986	A foetid perennial herb of hedgerows, field-borders, walls, waysides and waste ground, often on disturbed nutrient-rich soils near habitations
Brackish Water Crowfoot	*Ranunculus baudotii*	Near Threatened (NT)	Pre-1970	This annual or perennial herb grows in coastal water bodies, including lagoons, machair lochs, ditches, pools, dune-slacks and borrow-pits. It is most frequent in water 0.5-1 m deep, but can grow in shallower water or as a dwarf terrestrial form on wet mud. Its inland sites include flooded mineral workings and canals, some receiving saline drainage water but others lacking any saline influence.
Common Toadflax	*Linaria vulgaris*	Near Threatened (NT)	1987-1999	This perennial herb is found in open grassy places, on stony and waste ground, hedge banks, road verges, railway embankments and cultivated land, especially on calcareous soils. It reproduces by seed and also spreads by creeping rhizomes
Corn Chamomile	*Anthemis arvensis*	Waiting List (WL)	Pre-1970	An aromatic annual of light calcareous or sandy soils, growing in arable fields, especially cereals; also in leys, field-borders and waste places, and on roadsides and disturbed ground near the sea. It is occasionally introduced as a contaminant of grass-seed or in wild-flower seed mixtures.
Dittander	*Lepidium latifolium*	Vulnerable (VU)	1987-1999	A rhizomatous perennial herb native on creek-sides, ditches, sea-walls, open brackish grassland and the upper fringes of estuarine saltmarshes. It is also naturalised in disturbed areas such as waste ground, dockland, railways and roadsides.
Dwarf Mallow	*Malva neglecta*	Near Threatened (NT)	Pre-1970	An annual which sometimes overwinters, occurring in waste places, gateways, paths, rough ground and on roadsides (often near habitation), occasionally on coastal drift-lines. It favours shallow, dry soils, and is tolerant of grazing and mowing, but not of competition with more vigorous species.

[10] Conservation status and red list category according to the Ireland Red List No. 10: Vascular Plants (Wyse Jackson et. al., 2016). FPO denotes a species protected under the Flora Protection Order (2015).
[11] All habitat descriptions taken from Preston *et al*. (2002).

Common Name	Species Name	Status[10]	Last Recorded	Habitat[11]
Greater Broomrape	*Orobanche rapum-genistae*	Near Threatened (NT)	1987-1999	A perennial root parasite of leguminous shrubs, especially *Ulex europaeus* and *Cytisus scoparius*, but also known to occur occasionally on *Genista tinctoria*. Its habitat, governed by that of its hosts, is mainly scrub, but hedge banks and track-sides are also favoured
Green Field Speedwell	*Veronica agrestis*	Near Threatened (NT)	1970-1986	This spring-germinating annual is a colonist of cultivated land, waysides, gardens and allotments. It prefers soils which are well-drained and acidic, occurring on calcareous substrates only when there is surface leaching
Hound's Tongue	*Cynoglossum officinale*	Near Threatened (NT)	Pre-1970	A biennial herb of disturbed ground, growing mostly on dry, often base-rich soils. Habitats include coastal dunes, shingle, open grassland, woodland margins and clearings, field edges, cleared land and gravelly waste. It is unpalatable to grazing animals and is often frequent on disturbed ground by rabbit warrens.
Knotted Hedge Parsley	*Torilis nodosa*	Near Threatened (NT)	Pre-1970	An annual found in a wide range of dry, sparsely vegetated habitats, including open grassland, sunny banks, sea walls, cliff-tops, arable fields, tracks and waste ground; occasionally in disused sand- and gravel-pits, and on rubbish tips.
Meadow Barley	*Hordeum secalinum*	Vulnerable (VU) / FPO	Pre-1970	A perennial herb of meadows, pastures and roadsides, often in river valley floodplains and showing a strong preference for sticky clay soils. In coastal areas it is frequently abundant in grazing marsh grasslands and on earthen sea walls.
Meadow Brome	*Bromus commutatus*	Near Threatened (NT)	Pre-1970	An annual of unimproved damp meadows, also found on waysides, road verges and the borders of fields and tracks. Many recent records are of casual occurrences arising from grass-seed impurities.
Milk Thistle	*Silybum marianum*	Near Threatened (NT)	1970-1986	An annual or biennial, found in rough pasture, on grassy banks, in hedgerows and on waste ground.
Moonwort	*Botrychium lunaria*	Near Threatened (NT)	Pre-1970	A small fern, often occurring singly or in small populations. It prefers well-drained sites, usually with a high base-content, although it can occur on more acidic substrates. Habitats include meadows, pastures, open woodland, sand dunes and grassy rock ledges.
Pale Flax	*Linum bienne*	Near Threatened (NT)	1987-1999	An annual, biennial or short-lived perennial herb of dry grassy places and grassland-scrub mosaics, chiefly near the sea; its habitats include cliff-slopes and coombes, path and field margins, roadsides, railway banks and old quarries.
Pennyroyal	*Mentha pulegium*	Endangered (EN) / FPO	Pre-1970	A short-lived perennial herb of seasonally inundated grassland overlying silt and clay. The majority of native populations are now confined to pools, runnels, ruts and poached areas on heavily grazed village greens, but habitats also include damp heathy pastures, lake shores and coastal grassland.

Common Name	Species Name	Status[10]	Last Recorded	Habitat[11]
Prickly Poppy	*Papaver argemone*	Vulnerable (VU)	Pre-1970	An annual of arable crops, usually found on field edges and in unsprayed corners, often in small numbers. It is most frequent on light sandy, gravelly and chalky soils.
Scots Pine	*Pinus sylvestris*	Waiting List (WL)	1987-1999	*P. sylvestris* occurs as a native in pure stands or with other trees in mixed woodland. It prefers sandy and stony, acidic soils, though will also grow on waterlogged peats. It is widely planted in woods and shelter-belts, often becoming naturalised on heaths and bogs.
Sea Kale	*Crambe maritima*	Near Threatened (NT)	Pre-1970	A long-lived perennial herb of shingle and boulder beaches, very occasionally found on dunes (but only where these overlay shingle) and on cliffs. It reproduces by seed and from detached pieces of root.
Shepherd's Needle	*Scandix pecten-veneris*	Regionally Extinct (RE)	Pre-1970	An annual of arable fields, particularly on calcareous clay soils; occasionally on paths and banks beside current or former arable sites, and rarely on waste ground, coastal cliffs, and in gardens.
Slender Thistle	*Carduus tenuiflorus*	Near Threatened (NT)	1987-1999	This biennial, or sometimes perennial, herb is mainly found on chalk, limestone or lime-enriched soils, but also occurs on sandy or shingly ground. It is found in rough, often overgrazed or recently established pastures, on roadsides and in disturbed places.
Stag's Horn Clubmoss	*Lycopodium clavatum*	Near Threatened (NT)	Pre-1970	A prostrate, evergreen perennial herb of heaths, moors and mountains. It is often frequent on base-rich micaceous soils, but also occurs on more acidic *Calluna* heath and Nardus grassland. Propagation is mostly vegetative, but spores can colonise new sites, particularly the disturbed soil of roadside embankments and quarries.
Stinking Chamomile	*Anthemis cotula*	Waiting List (WL)	Pre-1970	A foetid annual of cereals and other arable crops. In some areas it favours heavy soils, including clay, clay-loam and marl, being replaced by *A. arvensis* on lighter soils, but it can grow on light soils, including those over chalk.
Vervain	*Verbena officinalis*	Near Threatened (NT)	1987-1999	A perennial herb, usually of open habitats or bare ground on freely-draining, often calcareous soils. It is most frequent in rough grassland and scrub, on roadsides, and on sheltered coastal cliffs and rock outcrops; less often in quarries and gravel-pits, and on streamsides, wood-borders and walls.
Weasel's Snout	*Misopates orontium*	Endangered (EN)/ FPO	Pre-1970	A spring-germinating annual of light soils, found in arable and other cultivated ground including among horticultural crops, and in gardens and waste places. It reproduces by seed, but cold, wet summers inhibit its germination and growth.
White Horehound	*Marrubium vulgare*	Waiting List (WL)	Pre-1970	A perennial herb, probably native only near the sea on open, exposed cliff-top grasslands and slopes overlying limestone and chalk, and on sandy banks and verges in Breckland. It is cultivated for tea and its medicinal properties, and is naturalised in rough and waste places; it also occurs as a wool-shoddy alien.

Common Name	Species Name	Status[10]	Last Recorded	Habitat[11]
Wild Privet	*Ligustrum vulgare*	Waiting List (WL)	1987-1999	A deciduous to semi-evergreen shrub found as a native in hedgerows, woodland and scrub, preferring well-drained, calcareous or base-rich soils. It is also often planted, particularly in hedges and woodland, and occurs as a garden escape and a relic of cultivation
Yellow Horned Poppy	*Glaucium flavum*	Near Threatened (NT)	1987-1999	A short-lived perennial herb of shingle banks and stony beaches; also, more rarely, amongst loose rock and on eroding cliffs of sand and clay, and on the bare tops of chalk cliffs. The few inland records are of casual occurrences.

12.4.4 Bird Atlases

NBDC online mapviewer supports records for breeding and over-wintering birds for hectad W76. The majority of these records originate from *The Bird Atlas 2007-2011: The Breeding and Wintering Birds of Britain and Ireland* (British Trust for Ornithology) (Balmer *et al*., 2013). **Table 12.9** presents records for species protected under Annex I of the EU Birds Directive, in addition to red and amber listed species on the BoCCI that occur within hectad W76.

The following sources of information were consulted in order to determine the conservation status of bird species:-

- NBDC online mapviewer http://maps.biodiversityireland.ie/#/Home;
- Annex I of the EU 'Birds Directive'; and
- The 'Red List' of BoCCI (Cummins and Colhoun, 2013).

Table 12.9: Breeding and Wintering Records for Annex I Bird Species and Birds of High Conservation Concern Recorded by Balmer *et al*., 2013 from Hectad W76

Common Name	Species Name	Data Source[12]	Designation and Protection[13]
Kingfisher	*Alcedo atthis*	Balmer *et al*. (2013)	Wildlife Acts, Annex I EU Birds Directive, Amber Listed
Whooper Swan	*Cynus cygnus*	Balmer *et a*l. (2013)	Wildlife Acts, Annex I EU Birds Directive, Amber Listed
Little Egret	*Egretta garzetta*	Balmer *et al*. (2013), site walkover surveys	Wildlife Acts, Annex I EU Birds Directive
Golden Plover	*Pluvialis apricaria*	Balmer *et al*. (2013)	Wildlife Acts, Annex I EU Birds Directive, Red Listed
Peregrine	*Falco peregrinus*	Balmer *et al*. (2013), site walkover surveys	Wildlife Acts, Annex I EU Birds Directive
Merlin	*Falco columbarius*	Balmer *et al*. (2013)	Wildlife Acts, Annex I EU Birds Directive, Merlin
Chough	*Pyrrhocorax pyrrhocorax*	Balmer *et al*. (2013)	Wildlife Acts, Annex I EU Birds Directive, Amber Listed
Great Northern Diver	*Gavia immer*	Balmer *et al*. (2013)	Wildlife Acts, Annex I EU Birds Directive, Amber Listed
Red-throated Diver	*Gavia stellata*	The First Atlas of Wintering Birds in Britain and Ireland: 1981/82-1983/84.	Wildlife Acts, Annex I EU Birds Directive, Amber Listed
Mediterranean Gull	*Larus melanocephalus*	Balmer et al. (2013), site walkover surveys	Wildlife Acts, Annex I EU Birds Directive, Amber Listed
Little Gull	*Larus minutus*	The First Atlas of Wintering Birds in Britain and Ireland: 1981/82-1983/84.	Wildlife Acts, Annex I EU Birds Directive, Amber Listed

[12] Data sourced from records held on the National Biodiversity Centre online database in addition to findings of avifaunal surveys completed for this development.
[13] Designation and protection under the Irish Wildlife Acts, the EU Birds Directive and the Birds of Conservation Concern in Ireland (Colhoun and Cummins, 2013).

Common Name	Species Name	Data Source[12]	Designation and Protection[13]
Dunlin	*Calidris alpina*	Balmer et al. (2013), site walkover surveys	Wildlife Acts, Annex I EU Birds Directive, Red Listed
Bar-tailed Godwit	*Limosa lapponica*	Balmer et al. (2013), site walkover surveys	Wildlife Acts, Annex I EU Birds Directive, Amber Listed
Ruff	*Philomachus pugnax*	The First Atlas of Wintering Birds in Britain and Ireland: 1981/82-1983/84.	Wildlife Acts, Annex I EU Birds Directive, Amber Listed
Common Tern	*Sterna hirundo*	Birds of Ireland, Port of Cork EIS	Wildlife Acts, Annex I EU Birds Directive, Amber Listed
Wigeon	*Anas penelope*	Birds of Ireland	Wildlife Acts, Red Listed
Pintail	*Anas acuta*	Balmer *et al*. (2013)	Wildlife Acts, Red Listed
Northern Shoveler	*Anas clypeata*	Balmer *et al*. (2013)	Wildlife Acts, Red Listed
Tufted Duck	*Aythya fuligula*	Balmer *et al*. (2013)	Wildlife Acts, Red Listed
Long-tailed Duck	*Clangula hyemalis*	Balmer *et al*. (2013)	Wildlife Acts, Red Listed
Goldeneye	*Bucephala clangula*	Balmer *et al*. (2013)	Wildlife Acts, Red Listed
Lapwing	*Vanellus vanellus*	Birds of Ireland	Wildlife Acts, Red Listed
Eurasian Woodcock	*Scolopax rusticola*	Balmer *et al*. (2013), site walkover surveys	Wildlife Acts, Red Listed
Redshank	*Tringa totanus*	Birds of Ireland, site walkover surveys	Wildlife Acts, Red Listed
Black-headed Gull	*Chroicocephalus ridibundus*	Birds of Ireland, site walkover surveys	Wildlife Acts, Red Listed
Herring Gull	*Larus argentatus*	Birds of Ireland, site walkover surveys	Wildlife Acts, Red Listed
Barn Owl	*Tyto alba*	Balmer et al. (2013)	Wildlife Acts, Red Listed
Meadow Pipit	*Anthus pratensis*	Balmer et al. (2013), site walkover surveys	Wildlife Acts, Red Listed
Grey Wagtail	*Motacilla cinerea*	Birds of Ireland, site walkover surveys	Wildlife Acts, Red Listed
Yellowhammer	*Emberiza citrinella*	Site walkover surveys, consultation with NPWS	Wildlife Acts, Red Listed
Common Sandpiper	*Actitis hypoleucos*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Sparrowhawk	*Accipter nisus*	Balmer *et al*. (2013), site walkover survey	Wildlife Acts, Amber Listed
Skylark	*Alauda arvensis*	Balmer *et al*. (2013), site walkover survey	Wildlife Acts, Amber Listed
Razorbill	*Alca torda*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Gadwall	*Anas strepera*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Greylag Goose	*Anser anser*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Common Swift	*Apus apus*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Short-eared Owl	*Asio flammeus*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Brent Goose	*Branta bernicla*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Barnacle Goose	*Branta leucopsis*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Knot	*Calidris canutus*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed

Common Name	Species Name	Data Source[12]	Designation and Protection[13]
Linnet	*Carduelis cannabinna*	Balmer *et al*. (2013), site walkover surveys	Wildlife Acts, Amber Listed
Greenfinch	*Carduelis chloris*	Balmer *et al*. (2013), site walkover surveys	Wildlife Acts, Amber Listed
Guillemot	*Uria aalge*	Seabird 2000	Wildlife Acts, Amber Listed
Hen Harrier	*Circus cyaneus*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Stock Pigeon	*Columba oenas*	Balmer *et al*. (2013), site walkover surveys	Wildlife Acts, Amber Listed
Mute Swan	*Cynus olor*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
House Martin	*Delichon urbicum*	Balmer *et al*. (2013), site walkover survey	Wildlife Acts, Amber Listed
Robin	*Erithacus rubecula*	Balmer *et al*. (2013), site walkover survey	Wildlife Acts, Amber Listed
Kestrel	*Falco tinnunculus*	Birds of Ireland	Wildlife Acts, Amber Listed
Coot	*Fulica atra*	Balmer *et al*. (2013), site walkover survey	Wildlife Acts, Amber Listed
Snipe	*Gallinago gallinago*	Balmer *et al*. (2013), site walkover surveys	Wildlife Acts, Amber Listed
Jack Snipe	*Lymnocryptes minimus*	Birds of Ireland and Site walkover surveys	Wildlife Acts, Amber Listed
Oystercatcher	*Haematopus ostralegus*	Birds of Ireland, site walkover surveys	Wildlife Acts, Amber Listed
Barn Swallow	*Hirundo rustica*	Birds of Ireland, site walkover surveys	Wildlife Acts, Amber Listed
Common Gull	*Larus canus*	Balmer *et al*. (2013), site walkover surveys	Wildlife Acts, Amber Listed
Lesser black-backed Gull	*Larus fuscus*	Balmer *et al*. (2013), site walkover surveys	Wildlife Acts, Amber Listed
Great black-backed Gull	*Larus marinus*	Birds of Ireland	Wildlife Acts, Amber Listed
Black-tailed Godwit	*Limosa limosa*	Birds of Ireland	Wildlife Acts, Amber Listed
Red Kite	*Milvus milvus*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Gannet	*Morus bassanus*	Birds of Ireland	Wildlife Acts, Amber Listed
Spotted Flycatcher	*Muscicapa striata*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Curlew	*Numenius arquata*	Birds of Ireland, site walkover surveys	Wildlife Acts, Amber Listed
Wheatear	*Oenanthe oenanthe*	The Second Atlas of Breeding Birds in Britain and Ireland: 1988-1991	Wildlife Acts, Amber Listed
House Sparrow	*Passer domesticus*	Balmer *et al*. (2013), site walkover surveys	Wildlife Acts, Amber Listed
Cormorant	*Phalacrocorax carbo*	Birds of Ireland,	Wildlife Acts, Amber Listed
Black Redstart	*Phoenicurus phoenicurus*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Grey Plover	*Pluvialis squatarola*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Slavonian Grebe	*Podiceps auritus*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed

Common Name	Species Name	Data Source[12]	Designation and Protection[13]
Great-crested Grebe	*Podiceps cristatus*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Goldcrest	*Regulus regulus*	Balmer *et al*. (2013), site walkover surveys	Wildlife Acts, Amber Listed
Sand Martin	*Riparia riparia*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Kittiwake	*Rissa tridactyla*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Stonechat	*Saxicola torquata*	Balmer *et al*. (2013), site walkover surveys	Wildlife Acts, Amber Listed
Starling	*Sturnus vulgaris*	Birds of Ireland, site walkover surveys	Wildlife Acts, Amber Listed
Little Grebe	*Tachybaptus ruficollis*	Balmer *et al*. (2013), site walkover surveys	Wildlife Acts, Amber Listed
Shelduck	*Tadorna tadorna*	Birds of Ireland, site walkover surveys	Wildlife Acts, Amber Listed
Spotted Redshank	*Tringa erythropus*	Balmer *et al*. (2013)	Wildlife Acts, Amber Listed
Mistle Thrush	*Turdus viscivorus*	Balmer *et al*. (2013), site walkover surveys	Wildlife Acts, Amber Listed

12.4.5 Bats

The key locations of importance for bats for commuting and foraging within the study area are woodlands, watercourses, treelines and hedgerows. Additional favourable habitats include scrub and scattered trees. Some mature trees in the area also offer roosting opportunities for bats due to the presence of cracks from storm damage or by having hollows and crevices through decay. Some of these and indeed younger trees also have ivy (*Hedera helix*) cover that may be used for roosting by bats on occasion.

Many of the area's structures offer potential for roosting bats as farm buildings and disused/derelict buildings have open access for these animals through dilapidated doors and windows, holed roofing, gaps at eaves etc. and modern dwellings allow bats access beneath tiles, lead flashing and gaps between walls and soffits.

12.4.5.1 Desk Study Findings

The review of existing records (sourced from Bat Conservation Ireland's National Bat Records Database) of bat species in the area of the proposed M28 route reveals that seven of the ten known Irish species have been observed within a 10km radius of the study area. These include common *Pipistrellus pipistrellus* and soprano *P. pygmaeus* pipistrelle, Leisler's *Nyctalus leisleri*, brown long-eared *Plecotus auritus*, Daubenton's *Myotis daubentonii,* Natterer's *M. nattereri* and whiskered *M. mystacinus* bats as shown in **Table 12.10** below.

Table 12.10: Adjudged Status of Bat Species within the Study Area

Common Name	Scientific Name	Occurrence	Source
Common Pipistrelle	*Pipistrellus pipistrellus*	Present	Bat Conservation Ireland
Soprano Pipistrelle	*Pipistrellus pygmaeus*	Present	
Nathusius' Pipistrelle	*Pipistrellus nathusii*	Potential – rare	
Leisler's Bat	*Nyctalus leisleri*	Present	
Brown Long-Eared Bat	*Plecotus auritus*	Present	
Lesser Horseshoe Bat	*Rhinolophus hipposideros*	Potential	
Daubenton's Bat	*Myotis daubentonii*	Present	
Natterer's Bat	*Myotis nattereri*	Present	
Whiskered Bat	*Myotis mystacinus*	Present	
Brandt's Bat	*Myotis brandtii*	Potential – rare	

Two soprano pipistrelle roosts, two Leisler's bat roosts and one brown long-eared bat roost have also been identified in the area but all are several kilometres distant to the proposed M28 Road Project.

Brandt's bat *M. brandtii* (only discovered in 2003 (Mullen, 2007)), may potentially occur in the area but records of the species are few to date and, since it cannot be distinguished from the whiskered bat by detector, it is often misidentified or overlooked.

The lesser horseshoe bat *Rhinolophus hipposideros* is restricted to the west of Ireland and it is only known from Counties Mayo, Galway, Clare, Limerick, Kerry and Cork (Kelleher, 2004 & Bat Conservation Ireland). However, single specimens have recently been discovered in Lough Key, near Boyle, Co. Roscommon in 2004 (B. Keeley, pers. comm.) and in Tubbercurry, Co. Sligo in 2008 (C. Kelleher, pers. comm.), two counties where their low numbers may have caused their presence to be overlooked until now. The population of this species in Co. Cork is small and most roosts are in west Cork however small numbers are known to be present in the Ovens, Ballincollig and Blarney areas within 20km of the proposed M28 Road Project so potential exists for the species to be present within the area but there are no records to date.

The remaining Irish bat species; Nathusius' pipistrelle *P. nathusii*, may occur in the area occasionally, however, to date, its known maternity roosts are restricted to north-east Ireland but it is being recorded more often, probably as a result of climate change, with more animals of this highly migratory species arriving from the continent, and with increased use of bat detectors in Ireland. The species has yet to be recorded in the immediate area of the proposed M28 Road Project but potential exists for its occurrence as it has been recorded near the village of Dripsey (C. Kelleher, pers. comm.), approximately 20km to the west.

12.5 EXISTING ENVIRONMENT - FIELD ASSESSMENT FINDINGS

Extensive field surveys were carried out in order to identify the habitats and species present within the study area of the proposed road project. The below text details the aquatic and terrestrial habitats located within the footprint and the ZoI of the proposed road project. Spatial locations for each habitat type as it occurs within the study area are also provided. In addition, the ecological value (**Table 12.1**) for each habitat and their correspondence to habitats listed on Annex I of the EU Habitats Directive are also provided. Aquatic species recorded within the ZoI are discussed in **Chapter 10: Aquatic Ecology**. A Habitat and Species Management Plan has been prepared for the proposed M28 Road Project and is presented in **Appendix 12B** in **Volume 4**.

FIELD ASSESSMENT FINDINGS

12.5.1 Aquatic Habitats – Survey Findings

12.5.1.1 Eroding (Upland) Rivers (FW1)

Watercourses that are actively eroding, unstable and that do not deposit fine sediments are classified as eroding upland rivers (FW1). These watercourses are typically associated with upland river systems where gradients are very steep and waterflow is consequently fast and turbulent. Although, not located within upland areas, each of the three small streams draining the proposed M28 route corridor corresponds to the eroding rivers classification. Each stream supports sections that are actively eroding, in some areas along steep sloping terrain, supporting very little deposition of fine sediments or particulate matter and restricted emergent macrophyte growth. Such streams include the Woodbrook Stream which flows through Bloomfield Wood, the Donnybrook Stream which drains the northern side of Carr's Hill before following the R611 towards Donnybrook, and the Glounatouig Stream which drains the southern areas of Carr's Hill fringing the existing N28 continuing towards Monkstown Creek.

The Woodbrook Stream is the northernmost watercourse within the study area flowing immediately west of the existing N28 at Douglas. This watercourse supports a narrow channel < 2.0 metres that is heavily fringed and overtopped by scrub and woodland cover. The stream substrate comprises poorly assorted assemblages of gravels and cobbles. Aquatic macrophytes fringing the Woodbrook Stream include fool's watercress (*Apium nodiflorum*), brooklime (*Veronica beccabunga*) and local abundances of opposite-leaved golden saxifrage (*Chrysosplenium oppositifolium*). Woodland herbs and ferns are also common along the stream margins and include broad buckler fern (*Dryopteris dilatata*), male fern (*Dryopteris filix-mas*), enchanter's nightshade (*Circaea lutetiana*) and remote sedge (*Carex remota*).

The Donnybrook Stream rises in the Ballinimlagh townland, draining the steep sloping terrain of the Moneygourney and Donnybrook townlands. Nearer its origins, the stream channel is narrow and shallow, poorly defined and is fringed by open pastureland, arable land, scrub and linear woodland cover. Continuing further north, the stream valley steepens considerably and in turn is fringed by semi-natural woodland and scrub along its well defined stream valley.

The Glounatouig Stream drains the southern section of the proposed M28 Road Project. The Glounatouig Stream comprises a number of smaller streams and tributaries rising within elevated terrain north of Hilltown. The confluence of these watercourses at Hilltown creates the Glounatouig Stream which fringes the eastern section of the existing N28 to the Shannonpark roundabout. East of Shannonpark roundabout, the Glounatouig adjoins both the northern and southern fringes of the N28 before continuing along the southern fringes of the R610. Like the Woodbrook and Donnybrook streams, the Glounatouig Stream comprises a narrow fast flowing channel (ca. 2.0 metres on average) with substrate comprises poorly sorted gravels and cobbles. From its origins, the Glounatouig Stream is almost continually fringed by woodland, scrub and linear woodland habitats. As a result, instream macrophytes are largely absent with occasional occurrences of fool's water cress (*Apium nodiflorum*), water cress (*Nasturtium officinale*), opposite-leaved golden saxifrage (*Chrysosplenium oppositifolium*) and yellow iris (*Iris pseudacorus*) on the channel margins.

Ecological Interest	Links to Annex I Habitats	Locations within the ZoI
Local Importance Higher Value – National Importance	The Glounatouig and Woodbrook stream do not correspond to habitats listed on Annex I of the EU Habitats Directive and are considered to be of Local Importance - Higher Value The Donnybrook stream within the footprint of the proposed M28 road project does not correspond to habitats listed on Annex I of the EU Habitats Directive and is considered to be of Local Importance – Higher Value.	There are 3 streams located within the ZoI. These are located between the townlands of Shannonpark and Raffeen between Ballinimlagh and Donnybrook and along the northernmost sections of the route near Douglas. This habitat comprises part of ER 7 to ER 10.

Plate 12.1: Woodbrook Stream Fringed by Mixed Broadleaved Woodland (WD1)

12.5.1.2 Reservoirs (FL7)

A sealed, water reservoir is located east north-east of the existing N28 at the townland of Moneygourney.

Ecological Interest	Links to Annex I Habitats	Locations within the ZoI
Negligible	This habitat type does not correspond to any EU Annex I habitats	Located to the north of the existing N28 within the townland of Moneygourney.

Plate 12.2: Water Reservoir at Moneygourney

12.5.1.3 Artificial Lakes and Ponds (FL8)

Areas of ponding water corresponding to this habitat category are located along the eastern and southern bounds of Raffeen Quarry. Water levels within this habitat fluctuate seasonally, partially drying out or receding during summer months. Nonetheless, water within this habitat persists throughout the year, predominantly within the south-eastern section of the quarry, and it is likely that water levels are maintained to some extent through groundwater influences. Water depth within this habitat does not exceed 1.5m, with water depth within the majority of this wetland habitat not exceeding depths of 1.0m.

The shallower areas of this wetland habitat along its northern and western margins support emergent (semi-submerged) semi-aquatic vegetation that includes sharp-flowered rush (*Juncus acutiflorus*), hard rush (*Juncus inflexus*), water mint (*Mentha aquatica*), lesser spearwort (*Ranunculus flammula*), common spike rush (*Eleocharis palustris*), water horsetail (*Equisetum fluviatile*), rosebay willowherb (*Chamerion angustifolium*), purple loosestrife (*Lythrum salicaria*), compact rush (*Juncus conglomeratus*), marsh bedstraw (*Galium palustre*) and brookweed (*Samolus valerandi*). The southern and eastern margins of this waterbody are somewhat deeper and adjoin the quarried limestone cliffs. Areas of deeper water comprise more abundant broadleaved pondweed (*Potamogeton natans*), stonewort (*Chara vulgaris*), common water crowfoot (*Ranunculus aquatilis*) with emergent bulrush (*Typha latifolia*) and young grey willow (*Salix cinerea*) establishing along its margins. Other marginal or transitional species along the shallower margins include water mint (*Mentha aquatica*), yellow-wort (*Blackstonia perfoliata*), shoreweed (*Littorella uniflora*), eyebright

(*Euphrasia officinalis* agg.), sea clubrush (*Bolboschoenus maritimus*) which is indicative of brackish conditions, and lesser spearwort (*Ranunculus flammula*).

Another localised artificial pond is located south-west of an abandoned railway cutting east of Shannonpark and north of Fernhill Golf course. This small pond habitat comprises bulrush (*Typha latifola*) and willowherbs (*Epilobium* spp.) with occasional celery leaved buttercup (*Ranunculus scleratus*) and common water starwort (*Callitriche stagnalis*). A survey of the wetland area in Raffeen Quarry was completed by Cillian Roden in April 2017. The findings of this survey are presented in **Appendix 12D** in **Volume 4**.

Ecological Interest	Links to Annex I Habitats	Locations
Local Importance (Lower value)	This habitat type does not correspond to EU Annex I Habitats	Raffeen Quarry and abandoned railway at Shannonpark. This habitat comprises part of ER 12

12.5.2 Terrestrial Habitats - Survey Findings

The coverage of each terrestrial habitat recorded within the study area are provided in **Table 12.11** and **Table 12.12** and shown in **Figure 12.3** and **Figures 12.3a-e** (in **Volume 5**). The habitats are classified in accordance to Fossitt (2000) while the *National Survey of Native Woodlands 2003-2008* (Perrin *et al*., 2008) and the *Irish Semi-natural Grassland Survey 2007-2012* (O'Neill *et al*., 2013) were used as a reference to aid refinement of the Fossitt (2000) Classifications as required. The total area of habitat within the proposed M28 Road Project ZoI is provided and the area of the habitat found within the proposed land acquisition boundary is also provided. The corresponding Annex I habitat code was also noted where relevant as per the Interpretation Manual of European Union Habitats - EUR28.

Table 12.11: Terrestrial and Coastal Habitat Types Recorded within the Proposed M28 Road Project Zone of Influence

Habitats	Corresponding Annex I Habitat Code[14]	Total Area (ha) (within ZoI)	Total Area (ha) within CPO
Improved agricultural grassland (GA1)	N/A	486.77	47.46
Arable crops, Horticultural Land / Tilled land / Flower Beds and Borders (BC1 / BC2 / BC3 / BC4)	N/A	373.19	29.57
Dry calcareous and neutral grassland (GS1)	N/A	1.31	1.08
Dry meadows and grassy verge grassland (GS2)	N/A	5.68	0.84
Wet grassland (GS4)	N/A	1.44	0.005
Marsh (GM1)	N/A	1.50	0.04

[14] Potentially corresponding Annex I habitat(s) as outlined under Fossitt (2000). Linkages of habitats as they occur within the project's zone of influence are examined in greater detail under each habitat description below

Habitats	Corresponding Annex I Habitat Code[14]	Total Area (ha) (within ZoI)	Total Area (ha) within CPO
Oak-ash-hazel woodland (WN2)	N/A	8.80	0.03
Wet willow-alder-ash woodland (WN6)	N/A	8.99	2.35
Mixed broadleaved woodland (WD1)	N/A	23.07	3.74
Mixed broadleaved / conifer woodland (WD2)	N/A	0.33	-
(Mixed) Conifer Woodland (WD3)	N/A	1.02	-
Scattered Trees & Parkland (WD5)	N/A	11.97	0.04
Scrub (WS1)	N/A	94.30	11.1
Spoil and bare ground (ED2)	N/A	5.75	-
Recolonising bare ground (ED3)	N/A	12.89	1.73
Other artificial lakes and ponds (FL8)	N/A	1.79	1.62
Stone walls and other stonework (BL1)	N/A	0.34	-
Buildings and artificial surfaces (BL3)	N/A	227.70	4.15
Lower salt marsh (CM1)	1330	1.54	-
Shingle and gravel shores (LS1)	1210	1.32	-
Buildings and artificial surfaces/ Amenity grassland (BL3/GA2)	N/A	2.64	0.04
Tidal Rivers (CW2)	1130	0.19	-
Spoil and bare ground/Recolonising bare ground (ED2/ED3)	N/A	3.08	1.78
Recolonising bare ground / dry calcareous and neutral grassland (ED3 / GS1)	N/A	0.74	-
Recolonising bare ground (ED3) / Scrub (WS1)	N/A	3.77	0.66
Improved Agricultural Grassland/Scrub (GA1/WS1)	N/A	1.08	-
Amenity grassland (GA2)	N/A	89.11	1.63
Amenity grassland/Buildings and artificial surfaces (GA2/BL3)	N/A	1.64	-
Dry Meadows and Grassy Verges / Scrub (GS2/WS1)	N/A	0.22	-
Wet Grassland/Reed and Large Sedge Swamps / Marsh / Scrub (GS4/FS1/GM1/WS1)	N/A	1.67	0.72
Wet Grassland/Dry Meadows and Grassy Verges/Scrub (GS4/GS2/WS1)	N/A	0.59	0.53
Dense Bracken / Dry Meadows and Grassy Verges (HD1/GS2)	N/A	0.42	-
Muddy sand shores (LS3)	1140	91.78	-
(Mixed) Broadleaved Woodland/ Recolonising Bare Ground (WD1/ED3)	N/A	1.14	-

Habitats	Corresponding Annex I Habitat Code[14]	Total Area (ha) (within ZoI)	Total Area (ha) within CPO
(Mixed) Broadleaved Woodland/Scrub (WD1/WS1)	N/A	1.66	1.53
(Mixed) Broadlwaved Woodland / Oak-ash-hazel Woodland (WD1 / WN2)	N/A	1.46	-
(Mixed) Broadlwaved Woodland / Wet willow-alder-ash Woodland (WD1 / WN6)	N/A	0.79	0.21
Conifer plantation/Scrub (WD4/WS1)	N/A	3.50	-
Oak-ash-hazel woodland/Scrub (WN2/WS1)	N/A	0.63	-
Wet willow-alder-ash woodland (WN6)	N/A	8.99	2.35
Wet willow-alder-ash Woodland / Mixed Broadleaved Woodland (WN6 / WD1)	N/A	1.06	-
Scrub/Recolonising Bare Ground (WS1/ED3)	N/A	2.38	-
Scrub/Amenity Grassland (WS1/GA2)	N/A	0.71	-
Scrub/Dry Calcareous and Neutral Grassland (WS1/GS1)	N/A	7.16	1.48
Scrub/Dry Meadows and Grassy Verges (WS1/GS2)	N/A	0.79	-
Scrub / (Mixed) Broadleaved Woodland (WS1/WD1)	N/A	15.57	0.93
Scrub/Ornamental/Non-Native Scrub (WS1/WS3)	N/A	0.44	-

Table 12.12: Linear Habitats Recorded within the Proposed M28 Road Project Zone of Influence

Habitats	Corresponding Annex I Habitat Code	Total Length (km) (within ZoI)	Total Length (km) (within CPO)
Stone Walls & Other Stonework (BL1)	N/A	1.88	0.14
Hedgerows (WL1)	N/A	10.32	1.24
Treelines (WL2)	N/A	25.99	2.06
Exposed calcareous rock (ER2)	N/A	0.2	0.2
Eroding / upland rivers (FW1)	N/A	49.79	1.18

Figure 12.3a-e: Terrestrial Habitats within Project Alignment and Associated Zone of Influence

Refer to Volume 5.

12.5.2.1 Improved Agricultural Grassland (GA1)

Improved Agricultural Grassland GA1 is widespread throughout the study area, concentrated mainly along the extremities of the main population centres. Within the footprint of the proposed M28 route and its associated ZoI, improved agricultural grassland comprises a species poor grassy sward of typical agricultural grassland cultivars, including a dominance of perennial rye-grass (*Lolium perenne*) with occasional to frequent occurrences of 'agricultural' herbs such as white clover (*Trifolium repens*), creeping buttercup (*Ranunculus repens*), common mouse-ear (*Cerastium fontanum*) and broad-leaved dock (*Rumex obtusifolius*). The margins or headlands of this habitat type commonly support an accompaniment of tussocky grass species such as cock's-foot (*Dactylis glomerata*), rough meadow grass (*Poa trivialis*) and false-oat grass (*Arrhenatherum elatius*).

This habitat does not correspond to any Annex I Habitat Type as per the Interpretation Manual of European Union Habitats - EUR28. For the majority of the route this habitat is of negligible botanical and ecological importance. Those areas of improved agricultural grassland located in proximity to Lough Beg, provide opportunistic feeding habitat for over-wintering species, mostly small numbers and intermittent occurrences of Curlew, Gull species and Oystercatcher. The importance of these areas as viable feeding habitat for Cork Harbour SPA were assessed in the over-wintering surveys completed in 2014/2015 and 2015/2016 and are considered in greater detail in the accompanying NIS. It was concluded that the areas of improved grassland within the footprint and environs of the project, north of Lough Beg are used intermittently and in small numbers by opportunistic feeding activities and in small numbers, by SCI species of Cork Harbour SPA.

In addition, areas of improved agricultural grassland located to the north of Lough Beg and located throughout the study area are of local importance to foraging mammal species such as badger, fox and rabbit.

Ecological Interest	Links to Annex I Habitats	Locations
Local Importance (Lower value)	This habitat type does not correspond to EU Annex I Habitats.	Covering expansive tracts of land throughout the study area. Much of the proposed route will traverse this habitat. This habitat comprises part of ER 13.

Plate 12.3: Improved Agricultural Grassland (GA1) at Barnahely

12.5.2.2 Amenity Grassland (GA2)

This type of grassland is highly improved and species-poor, and is managed for purposes other than grass production. There are many lawns and other recreational grasslands within the environs of the proposed road which fit in to this category. These areas are mainly associated with housing developments and those green spaces associated with the settlements of Douglas, Carrigaline, Shanbally, Shannonpark and Ringaskiddy. Plant species composition is poorly developed comprising abundances of red fescue (*Festuca rubra*), perennial rye grass (*Lolium perenne*) and clovers (*Trifolium* spp).

Ecological Interest	Links to Annex I Habitats	Locations
Negligible	This habitat type does not correspond to EU Annex I Habitats	Covering expansive tracts of land throughout the study area. Much of the proposed route will traverse this habitat.

Plate 12.4: Amenity Grassland Located to the South of Ringaskiddy Terminal

12.5.2.3 Arable Crops (BC1) and Tilled Land (BC3)

The footprint and the environs of the proposed M28 Road Project will pass through extensive areas of arable land north-west and east of the Shannonpark roundabout at the Ballinrea and Shannonpark townlands respectively. These habitats are located within expansive field systems comprising wheat and barley and to a lesser extent, maize. Although these habitats are not plant species rich they do provide feeding habitats for seed eating birds such as finches, in particular Yellowhammer, a red listed species on the BoCCI (Colhoun and Cummins, 2013).

Ecological Interest	Links to Annex I Habitats	Locations
Local Importance (Lower value)	This habitat type does not correspond to EU Annex I Habitats	Ballinrea, Shannonpark, Ballyhemiken, Ardnacloghy and Moneygurney.

12.5.2.4 Dry Calcareous and Neutral Grassland (GS1)

Dry Calcareous and Neutral Grassland is a locally restricted habitat type for this part of County Cork. Agricultural intensification has resulted in the effective removal of these habitats from the locality to be replaced by expansive arable and improved grassland fields. As a result remnant pockets of this habitat type are considered to be of County Importance.

The largest area of GS1 within the study area lies within Raffeen Quarry, a disused limestone quarry within the townlands of Raffeen and Ballyhemiken. Areas of GS1 at Raffeen Quarry often occur in mosaic with scattered scrub habitats on the higher margins surrounding the relatively deep quarry void. These areas are closely grazed by rabbits, an occurrence that is likely to deter the continuing spread of scrub. A botanical survey of Raffeen Quarry calcareous grassland was completed in July 2015 and is presented in full in **Appendix 12E** in **Volume 4**. Plant species assemblage is diverse and mixed throughout with some very forb rich areas. Other areas support localised abundances of pyramidal orchid (*Anacamptis pyramidalis*), with one section supporting 40+ orchid pikes. In general, plant species assemblage comprises crested dog's tail (*Cynosurus cristatus*), sweet vernal grass (*Anthoxanthum odoratum*), common bent (*Agrostis capillaris*) and red fescue (*Festuca rubra*) with locally abundant glaucous sedge (*Carex flacca*) and locally frequent field-wood rush (*Luzula campestris*). Forb rich areas support localised abundances of red bartsia (*Odontites vernus*), bird's-foot trefoil (*Lotus corniculatus*), black medick (*Medicago lupulina*), clovers (*Trifolium* spp.) and meadow vetchling (*Lathyrus pratensis*). Other occasional to locally frequent species associated with this habitat include eyebright (*Euphrasia officinalis* agg.), wild strawberry (*Fragaria vesca*), yarrow (*Achillea millefolium*), lady's bedstraw (*Galium verum*), common centaury (*Centaurium erythraea*), common knapweed (*Centaurea nigra*), wild carrot (*Daucus carota*), bugle (*Ajuga reptans*), self-heal (*Prunella vulgaris*), carnation sedge (*Carex panicea*), ox-eye daisy (*Leucanthemum vulgare*), fairy flax (*Linum catharticum*), ribwort plantain (*Plantago lanceolata*), hawkweeds (*Hieracium* spp.), autumn hawkbit (*Scorzoneroides autumnalis*), thyme-leaved speedwell (*Veronica serpyllifolia*), cowslip (*Primula veris*) and mouse-ear hawkweed (*Pillosella officinarum*).

This habitat corresponds to the semi-natural grassland category 3a *Briza media – Thymus polytrichus* (O'Neill *et al*., 2013). Botanical surveys completed in this grassland habitat in 2015 and 2016 identified bee orchid (*Ophrys apifera*) and marsh orchid (*Dactylorhiza* sp.) within this diverse calcareous grassland habitat. In spite of this habitat's diversity and orchid abundance, it does not correspond with the Annex I habitat 'Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (*important orchid sites) (6210)' as it does not meet the requisite

assessment criteria determining this Annex I habitat[15]. Nonetheless, this is a very diverse and orchid rich habitat, a habitat that is greatly restricted within the proposed M28 alignment, its accompanying ZoI and the greater locality.

Another area of GS1 was identified within Mount Oval, near the northern section of the route. This is situated within the footprint of a disused quarry that is now located between recently developed residential areas and the existing N28. This area is being encroached by dense gorse scrub but still retains some elements of GS1 grassland. Interspersed amongst gorse patches of dry calcareous and neutral grassland (GS1) occur. This habitat includes grasses such as false oat-grass (*Arrhenatherum elatius*), red fescue (*Festuca rubra*), perennial rye grass (*Lolium perenne*), crested dog's-tail (*Cynosurus cristatus*), cock's-foot (*Dactylis glomerata*), meadow grasses (*Poa* spp.), bent grasses (*Agrostis* spp.) and Yorkshire-fog (*Holcus lanatus*) in addition to glaucous sedge (*Carex flacca*) and field woodrush (*Luzula campestris*). Common broadleaved herbs include clovers (*Trifolium* spp.), wild carrot (*Daucus carota*), yarrow (*Achillea millefolium*), common knapweed (*Centaurea nigra*), selfheal (*Prunella vulgaris*), common bird's-foot trefoil (*Lotus corniculatus*), common centuary (*Centaurium erythraea*), cat's-ear (*Hypochoeris radicata*), oxeye daisy (*Leucanthemum vulgare*) and field scabious (*Knautia arvensis*). This habitat does not correspond to the Annex I habitat 6210.

The lands north of Lough Beg also support another isolated area of GS1 surrounded by enclosing gorse, bracken, bramble, common nettle. Species present include false-oat grass (*Arrhenatherum elatius*), red fescue (*Festuca rubra*), ragwort (*Senecio jacobea*), common knapweed (*Centaurea nigra*), bush vetch (*Vicia sepium*), bugle (*Ajuga reptans*), pignut (*Conopodium majus*), creeping thistle (*Cirsium arvense*), red clover (*Trifolium pratense*), alexanders (*Smyrnium olusatrum*), meadow vetchling (*Lathyrus pratensis*), yarrow (*Achillea millefolium*) and ribwort plantain (*Plantago lanceolata*). This habitat does not correspond to the Annex I habitat 6210.

The remaining sections of the study area do not support large sections of GS1 habitat. Small strips of neutral grassland including species such as crested dog's tail, ribwort plantain, hawkweeds and bird's foot trefoil are localised along roadside margins or along the headlands of GA1 fields such as those expansive improved grassland fields at Barnahely. Although this habitat where it occurs within the study area's ZoI is species rich and of considerable local and regional ecological importance, it does not correspond with habitats listed on Annex I of the EU Habitats Directive as per the Interpretation Manual of European Union Habitats - EUR28.

Ecological Interest	Links to Annex I Habitats	Locations
County Importance – Local Importance (Higher value)	None of the dry calcareous and neutral grasslands recorded within the study area corresponds to Annex I habitats.	Overall this habitat is not widely distributed within the study area and its surrounding environs. Raffeen Quarry supports the most diverse GS1 habitat within the study area. Given its diversity and scare local and regional distribution, this area is considered to be of County Importance. Smaller pockets of remnant GS1 are located near Mount Oval and north of Lough Beg. These habitats are less diverse when compared with those at Raffeen Quarry. Therefore, these habitats are considered to be of Local Importance (Higher value). This habitat comprises ER 14 and part of ER 6 and ER 12.

[15] Appendix 1: Assessment criteria for the five Annex I grassland habitats surveyed during the Irish Semi-natural Grassland Survey (ISGS) (O'Neill *et al*., 2013)

Plate 12.5: Calcareous Grassland (with Pyramidal Orchids) at Raffeen Quarry

12.5.2.5 Dry Meadows and Grassy Verges (GS2)

This grassland habitat was found in small pockets throughout the study area, mainly on roadside verges, field margins and smaller fields that have remained unmanaged (lack of grazing/mowing in recent years) or have been fragmented through recent and nearby developments. As these areas are rarely fertilised and only occasionally mown they can develop a good diversity of grassland species including: false oat-grass (*Arrhenatherum elatius*), cock's-foot (*Dactylis glomerata*), rough meadow grass (*Poa trivialis*), creeping bent (*Agrostis stolonifera*), meadow foxtail (*Alopecurus pratensis*), tall fescue (*Schedonorus aurundinaceus*) and Yorkshire fog (*Holcus lanatus*). In general there is not a good diversity or abundance of herbaceous species, however species such as spear thistle (*Cirsium vulgare*), creeping thistle (*Cirsium arvense*), ragwort (*Senecio jacobaea*), meadow vetchling (*Lathyrus pratensis*), red and white clover (*Trifolium pratense* and *T. repens*), hogweed (*Heracleum sphondylium*), upright hedge parsley (*Torilis japonica*) and hedge bindweed (*Calystegia sepium*) often establish well in these conditions. Due to the lack of ongoing management, many of these grassland habitats are being encroached by bramble (*Rubus fruticosus* agg.) and gorse (*Ulex europaeus*) scrub. This habitat is primarily found as isolated or linear parcels comprising the grassy verges of the N28 and the surrounding local road network. Bramble scrub regularly encroaches where there has been no ongoing management over the short to medium term.

At Barnahely, immediately east of Janssen Biologics, an area of unmanaged grassland has developed into a species poor dry meadows and grassy verge habitat on steep sloping ground. This habitat supports abundant cock's-foot (*Dactylis glomerata*) and Yorkshire fog (*Holcus lanatus*), with frequent timothy (*Phleum pratense*), pignut (*Conopodium majus*) and creeping thistle (*Cirsium arvense*). The more low-lying sections support frequent common bent (*Agrostis capillaris*), creeping bent (*Agrostis stolonifera*); locally frequent meadow vetchling (*Lathyrus pratensis*) and common sorrel (*Rumex acetosa*). This area is also adjoined by two isolated banks of scrub that are spreading from unmanaged hedgerows.

Those areas of GS2 found within the study area do not support the botanical species or vegetation communities which correspond to the Annex I Habitat, as per the Interpretation Manual of European Union Habitats - EUR28.

Ecological Interest	Links to Annex I Habitats	Locations
Local Importance (Lower value)	None of the GS2 habitats within the study area correspond to the EU Habitats Directive Annex I Habitat: 'Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*)'.	This habitat was identified throughout the study area, mostly on roadside verges, abandoned or unmanaged agricultural fields and field margins.

Plate 12.6: Dry Meadows and Grassy Verge Grassland (GS2) at Barnahely, Ringaskiddy

12.5.2.6 Wet Grassland (GS4)

Like other semi-natural grassland habitats, this habitat type is not widely distributed throughout the study area. It occurs on lower slopes where drainage is impeded, mostly along the margins of the streams and watercourses that drain the study area. Wet grassland typically occurs as small patches of species poor oligotrophic wet grassland habitats dominated by common rush (*Juncus effusus*) with locally abundant yellow iris (*Iris pseudacorus*) and occasional to frequent marsh thistle (*Cirsium palustre*), creeping bent (*Agrostis stolonifera*), silverweed (*Potentilla anserina*) and creeping buttercup (*Ranunculus repens*).

Another area of rush dominated wet grassland is located on the margins of Lough Beg pNHA on abandoned farmland that is thoroughly encroached by common rush (*Juncus effusus*) and compact rush (*Juncus conglomeratus*) with openings of sweet vernal grass (*Anthoxanthum odoratum*), creeping bent (*Agrostis stolonifera*) and common fleabane (*Pulicaris dysenterica*).

The wet grassland communities found within the study area do not correspond to the Annex I Habitat, as per the Interpretation Manual of European Union Habitats - EUR28 however they are of local ecological interest.

Ecological Interest	Links to Annex I Habitats	Locations
Local Importance (Higher value)	None of the GS4 habitats within the study site correspond to the EU Habitats Directive Annex I Habitat: '*Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (Molinion caeruleae)' (6410).	Locally restricted to low-lying, poorly drained areas, mostly within the margins of river valley slopes and margins. This habitat comprises part of ER 2.

Plate 12.7: Rush Dominated Wet Grassland on the Margins of Lough Beg pNHA

12.5.2.7 Marsh (GM1)

A large area of Marsh GM1 exists to the north of Lough Beg and is designated as part of Lough Beg pNHA. This relatively diverse, lush and 'grassy' marsh habitat occurs on the eastern and north-eastern margins of those tidal channels linking the area to Lough Beg. Plant species composition includes abundant common spike rush (*Eleocharis palustris*) in addition to marsh willowherb (*Epilobium palustre*), great willowherb (*Epilobium hirsutum*) common fleabane (*Pulicaria dysenterica*), lesser marshwort (*Apium inundatum*), water forget-me-not (*Myosotis scorpioides*), water horsetail (*Equisetum fluviatile*), star sedge (*Carex echinata*), common sedge (*Carex nigra*), distant sedge (*Carex distans*), false fox-sedge (*Carex otrubae*) lesser spearwort (*Ranunculus flammula*), creeping buttercup (*Ranunculus repens*), water mint (*Mentha aquatica*), curled dock (*Rumex crispus*), marsh ragwort (*Senecio aquaticus*) and common marsh bedstraw (*Galium palustre*) with occasional marsh orchid (*Dactylorhiza incarnata*) and bulrush (*Typha latifolia*). This habitat is relatively firm underfoot with no areas of ponding water. However it receives infrequent tidal inundations (possibly during spring tides) evidenced by occasional occurrences of halophytic species. This marsh area is used as a high tide roost for avifauna associated with Lough Beg. The marsh habitat found within the study area does not correspond to habitats listed on Annex I of the EU Habitats Directive as per the Interpretation Manual of European Union Habitats - EUR28.

Ecological Interest	Links to Annex I Habitats	Locations
National Importance	Marsh may sometimes contain pockets of the Annex I habitat, 'hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)'. The Marsh habitat found within the study area does not correspond to this Annex I Habitat, as per the Interpretation Manual of European Union Habitats - EUR28.	One area within Lough Beg pNHA. This habitat comprises part of ER 2.

Plate 12.8: Marsh Habitat on the Eastern Margins of Lough Beg

12.5.2.8 Oak-Ash-Hazel Woodland (WN2)

The free draining, steep and gently sloping valley margins of the Glounatouig Tributary at Ballinrea and the Donnybrook Stream at Donnybrook support linear areas of oak-ash-hazel woodland (WN2). Both habitats are situated along the sloping stream and stream valley margins and are characterised by ash (*Fraxinus excelsior*) in the canopy layer in addition to occasional sessile oak (*Quercus robur*) and frequent hazel (*Corylus avellana*) in the shrub layer. The oak-ash-hazel woodland at Ballinrea supports abundant bluebell (*Hyacinthoides non-scripta*) in the understorey with accompanying early dog violet (*Viola reichenbachiana*), lords and ladies (*Arum maculatum*), hart's tongue fern (*Asplenium scolopendrium*) and soft shield fern (*Polystichum setiferum*). The oak-ash-hazel woodland at Donnybrook comprises a similar structure with ash and hazel the principal tree and shrub components.

This woodland habitat type is restricted within the proposed M28 route's ZoI and within the study area's locality and as such is considered to be of County Importance. The WN2 woodlands within the study area correspond to the National Survey of Native Woodland Scheme woodland category 2 *Fraxinus excelsior – Hedera helix* group a. *Geum urbanum - Veronica montana* vegetation type. This woodland habitat does not correspond to habitats listed on Annex I of the EU Habitats Directive.

Ecological Interest	Links to Annex I Habitats	Locations
County Importance	This habitat does not correspond to an Annex I habitat.	Adjoining the Glounatouig Stream Tributary and Donnybrook Stream. This habitat comprises part of ER 7.

12.5.2.9 Wet Willow Alder Ash Woodland (WN6)

Within the study area, this habitat type generally occurs as fringing vegetation along stream valleys. Each of the three streams within the study areas support some elements of this habitat especially the areas that immediately fringe each watercourse. In most instances these semi-natural woodland habitats are associated with steep river valley margins that are a common geographical feature of the study area. The WN6 habitats occurring within the study area and the associated ZoI correspond to the National Survey of Native Woodland Scheme woodland category 3a *Alnus glutinosa* – Filipendula ulmaria group *Fraxinus excelsior* – *Carex remota* vegetation type.

The upper reaches of the Donnybrook Stream, an erosional stream, are fringed by WN6 woodland that is set into a steep stream valley margin/ravine that comprises thin straight boled alder (*Alnus glutinosa*) to 8-10m with frequent grey willow (*Salix* cinerea) occasional ash and occasional to rare sycamore. The woodland understorey along the higher, steep sloping reaches of the river valley supports a shrub layer of hawthorn (*Crataegus monogyna*), elder (*Sambucus nigra*). The understory on the drier, more elevated areas of the woodland support dense growth of bramble (*Rubus fruticosus* agg.) and ivy (*Hedera helix*) with bluebell (*Hyacinthoides non-scripta*), lords and ladies (*Arum maculatum*), false brome (*Brachypodium sylvaticum*) and wood speedwell (*Veronica montana*). These areas support frequent fern cover including male fern (*Dryopteris filix-mas*), broad buckler fern (*Dryopteris dilatata*), soft shield fern (*Polystichum setiferum*) and Hart's tongue fern (*Asplenium scolopendrium*). Closer to the river channel, the woodland understorey is more low-lying and is consequently wetter and more open when compared with the higher, drier reaches of the river valley. These areas support frequent opposite-leaved golden saxifrage (*Chrysosplenium oppositifolium*) and yellow iris (*Iris pseudacorus*), in addition to enchanter's nightshade (*Circaea lutetiana*), lesser celandine (*Ranunculus ficaria*), wood sorrel (*Oxalis acetosella*), herb Robert (*Geranium robertianum*), wood avens (*Geum urbanum*), common dog violet (*Viola riviniana*), wood speedwell and yellow pimpernel (*Lysimachia nemorum*) on the higher river embankments, with small (<10m^2) wet and enriched localised patches and runnels adjoining the river supporting co-abundant common nettle (*Urtica dioica*), yellow iris with rare occurrences of angelica (*Angelica sylvestris*) and water mint (*Mentha aquatica*). Both bramble and the fern assemblages persist throughout the lower sections of the woodland floor, particularly on localised higher sections adjoining the stream banks, however not to the same abundance as those areas in the higher reaches of the stream valley margins.

The interface of Raffeen Quarry and the existing N28 supports a linear strip of wet willow alder ash woodland (WN6) fringing the Glounatouig Stream. This linear woodland habitat comprises abundant alder and ash (*Fraxinus excelsior*) with occasional sycamore (*Acer pseudoplatanus*) with abundant fern and bramble growth in the woodland understorey. Other linear strips of this habitat occur along the upper reaches of the Glounatouig Stream, such as that east of the existing N28 at the Ballinrea townland. This is linear, willow-dominated woodland with abundant hawthorn and a field layer of bracken (*Pteridium aquilinum*), meadowsweet (*Filipendula ulmaria*), fools-water-cress (*Apium nodiflorum*), bramble and gorse (*Ulex europaeus*).

This woodland habitat within the study area does not correspond to the Annex I Priority Habitat 91E0 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae) as it does not meet the requisite assessment criteria determining this Annex I habitat[16]. Nonetheless, these areas are considered to be of Local Importance (Higher value) as they support semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness.

Ecological Interest	Links to Annex I Habitats	Locations
Local Importance (Higher value) – National Importance	With the exception of the woodland habitat at Donnybrook Wood, the WN6 habitats within the study area are fragmented, discontinuous and poorly developed. None of the WN6 habitats within the footprint or ZoI of the proposed M28 Road Project correspond to the Annex I habitat Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-padion, Alnion incanae, Salicion albae)' (91E0).	Small woodland parcels and linear areas located along the valley margins of the Glounatouig, Donnybrook and Woodbrook streams. This habitat comprises part of ER 7.

Plate 12.9: Wet Willow Alder Ash Woodland WN6 Fringing the Donnybrook Stream

[16] As described by Perrin et al., (2008) National Survey of Native Woodlands 2003-2008: Volume II Woodland Classification

12.5.2.10 Mixed Broadleaved Woodland (WD1)

Several small patches of this woodland type were found scattered throughout the study area. This woodland type comprises all other woodlands with 75-100% broadleaved trees that do not correspond to any of the 'semi-natural' woodland categories. These woodlands may include both native and non-native tree species. This habitat type does not correspond to any Annex I habitats.

The main abundances of this habitat occurred as screen planting fringing the existing N28 such as those near Douglas, young woodlands associated with Fernhill Golf and Country Club, young woodlands fringing the Janssen Biological and Carbon Group buildings in the Barnahely area in addition to more established woodland habitats fringing the Woodbrook Stream at Douglas.

The young woodland habitats fringing the existing stretches of the N28 comprise mixed assemblages of ash (*Fraxinus excelsior*), sycamore (Acer pseudoplatanus), maple (*Acer* sp.), oak (*Quercus* sp.) and lime (*Tilia* sp.) in addition to accompanying shrubs such as cherry (*Prunus* sp.), hazel (*Corylus avellana*), hawthorn (*Crataegus monogyna*), blackthorn (*Prunus spinosa*) and holly (*Ilex aquifolium*). Typically, this habitat's ground layer was heavily shaded and underdeveloped supporting localised ivy (*Hedera helix*), bramble (*Rubus fruticosus* agg.) or nettle (*Urtica dioica*) growth. Similarly, young woodland habitats associated with Fernhill Golf and Country Club comprise linear stretches of mixed broadleaved woodland with ash, sycamore, lime and maple.

The eastern fringes of Raffeen Quarry support young woodland with co-abundant semi-mature sycamore, ash and common birch (*Betula pubescens*) with frequent blackthorn and willow within the understory. The ground layer is poorly developed with abundant bramble and invasive traveller's joy (*Clematis vitalba*) spreading from the woodland margins.

Nearer the northern margins of the proposed M28 route, longer established mixed broadleaved woodland occurs on either side of the existing N28. To the east at Mount Oval, the woodland is dominated by beech (*Fagus sylvatica*) with occasional ash, oak and locally frequent sycamore occurs to the east of the existing N28 at Mount Oval. The component beech trees are structurally uniform, ca. 15m height and 2.0m bole girth while the woodland's ground layer is species poor comprising ivy and dead leaf litter. Holly occurs occasionally in the woodland's shrub layer.

Another larger pocket of mature mixed broadleaved woodland (known as Bloomfield Wood) is located immediately west of the N28 at Maryborough. This woodland is located on the steep and extensive western slopes of the Woodbrook Stream comprising mature specimens of beech, pedunculate oak (*Quercus robur*) in addition to ash and sycamore and occasional conifers such as Douglas fir (*Pseudotsuga menziesii*) and Scots pine (*Pinus sylvestris*). Nearer the margins of the Woodbrook Stream, alder and grey willow are more common and are in turn underlain by localised abundances of opposite-leaved golden saxifrage (*Chrysosplenium oppositifolium*). This woodland exhibits well used tracks and trampling associated with the adjoining residential development with evidence of fly tipping of domestic and household waste. Toward the northern end of the woodland, the understorey vegetation is sparse especially on the woodland's steep slopes with occasional bracken (*Pteridium aquilinum*), hard fern (*Blechnum spicant*), male fern (*Dryopteris filix-mas*) and bramble (*Rubus fruticosus* agg). Nearer the southern end of Bloomfield Wood, the ground layer corresponds to oak-ash-hazel woodland (WN2) to include bluebell (*Hyacinthoides non-scriptus*), wood avens (*Geum urbanum*), sanicle (*Sanicula europaea*), lords and ladies (*Arum maculatum*), wood sedge (*Carex sylvatica*), wood speedwell (*Veronica montana*), false brome (*Brachypodium*

sylvaticum), wood dock (*Rumex sanguineus*), woundwort (*Stachys sylvatica*) and herb Robert (*Geranium robertianum*).

Japanese knotweed (*Fallopia japonica*) was identified on the western margins of this woodland habitat (See **Figure 12.4)**.

This habitat does not correspond to habitats listed on Annex I of the EU Habitats Directive.

Ecological Interest	Links to Annex I Habitats	Locations
Local Importance (Higher value)	This habitat does not correspond to Annex I habitats listed on the EU Habitats Directive. However the habitat provides valuable cover and corridor functionality in a study area characterised by intensive farming practices and peri-urban development. Therefore this habitat is of high conservation value in a local context.	Several small areas scattered throughout the study area. This habitat comprises part of ER 5, ER 8, ER 11, ER 12 and ER 15.

Plate 12.10: Mixed Broadleaved Woodland and scrub fringing the Existing N28

12.5.2.11 Mixed Broadleaved/Conifer Plantation (WD2)

This category comprises woodlands with a mixture of broadleaved and coniferous trees, where both types have between 25% and 75% cover. Tree species in these woodlands may be native or non-native species. Small isolated stands of this woodland type primarily established as screen planting, were found within the study area. This habitat type does not correspond to any Annex I habitat. This habitat is scarce within the proposed M28's ZoI, with localised pockets surrounding industrial facilities at Barnahely and the roadside margins of the existing N28. These habitats are typified by co-occurrences of lodgepole pine (*Pinus contorta*), Scots pine (*Pinus sylvestris*) and larch (*Larix* spp.) amongst mixed assemblages of broadleaved trees such as ash, sycamore, birch and oak. Where these woodland areas occur within the proposed M28's ZoI, they are not large enough to support associated species such as Pine Marten or Red Squirrel.

Ecological Interest	Links to Annex I Habitats	Locations
Local Importance (Lower value)	This habitat does not correspond to Annex I habitats.	Localised within screen planting established along the N28 and the industrial complexes near Barnahely and Ringaskiddy.

Plate 12.11: Mixed Broadleaved/Conifer Woodland (WD2)

12.5.2.12 Scattered Trees and Parkland (WD5)

This habitat corresponds to areas supporting isolated or localised stands/groups of trees. These are usually associated with long established demesne dwellings, municipal land holdings and the landscaped surrounds of golf courses. Both Fernhill Golf and Country Club and Douglas Golf Club support this habitat, mostly as semi-mature stands of deciduous trees situated alongside fairway margins. Species composition includes sycamore (*Acer pseudoplatanus*), ash (*Fraxinus excelsior*), maple (*Acer* sp.), oak (*Quercus* sp.), lime (*Tilia* sp.), birch (*Betula* sp.), horse chestnut (*Aesculus hippocastanum*) and sweet chestnut (*Castanea sativa*).

This habitat, particularly component mature trees, is considered to be of Local Importance for foraging and breeding birds and bats in the locality.

Ecological Interest	Links to Annex I Habitats	Locations
Local Importance (Lower value)	This habitat does not correspond to Annex I habitats.	Fernhill Golf and Country Club & Douglas Golf Club.

12.5.2.13 Scrub (WS1)

Small, discontinued and linear patches of scrub occur throughout the study area. They occur most commonly along stream margins, along the roadside margins and within unused, unmanaged or overgrown sections of the private dwellings and built-up areas.

Plant species assemblage varies greatly with species such as gorse forming mono-dominant stands along the existing N28 at Mount Oval. Large blocks of gorse dominated scrub are located along the margins of an abandoned quarry/holding area east of Shanbally, at Lough Beg, east of Ringaskiddy car terminal, and east of the existing N28 at Mount Oval. Similarly, mixed scrub fringes the valley margins of the three streams within the study area. These typically comprise willows, gorse, bramble, hawthorn and blackthorn. At Raffeen Quarry, mixed scrub occurs throughout the quarry margins with willow (*Salix* spp.), butterfly bush (*Buddleja davidii*)[17], traveller's joy (*Clematis vitalba*) bramble and occasional gorse (*Ulex europaeus*) the component species.

An extensive block of mixed scrub occurs along the southern margins of the abandoned quarry/holding area east of Shanbally. This area supports gorse, hawthorn (*Crataegus monogyna*), butterfly bush (*Buddleja davidii*), bramble (*Rubus fruticosus* agg.), with bracken (*Pteridium aquilinum*), localised abundances of common knapweed (*Centaurea nigra*) in addition to pockets of species poor dry meadows and grassy verge grassland. Other areas of extensive scrub occur in mosaic or are actively encroaching grassland areas, such as that area located at Mount Oval with gorse, willow and tall ruderals encroaching semi-natural grassland.

In an area dominated by expansive arable and pastoral habitats, areas of scrub that are contiguous with larger woodland blocks, treelines and hedgerows are of considerable local importance to local avifauna, mammals and invertebrate fauna. They provide viable cover, refuge, nesting and burrowing habitats for a suite of species in the locality.

Ecological Interest	Links to Annex I Habitats	Locations
Local Importance (Higher value).	This habitat does not correspond to Annex I habitats.	Throughout study area. This habitat comprises part of ER 6, 7, 8, 9, 10, 11, 12, 15 & 16.

[17] Both traveller's joy and butterfly bush are classified as "medium impact" non-native invasive plant species by the National Biodiversity Data Centre

Plate 12.12: Dense Scrub Fringing River the Upper Reaches of the Donnybrook Stream Hedgerows (WL1) and Treelines (WL2)

Hedgerows (WL1) and Treelines (WL2) within the study area support a variety of shrub/tree species that provide a viable corridor and transit route for a range of flora and faunal species in a landscape dominated by expansive and intensively managed agricultural habitats. In addition, mature treelines within the study area provide optimal roosting and nesting habitats for birds and bats. In general, treelines fringing and surrounding pastoral and arable lands are often unmanaged and overgrown. Hedgerows typically comprise abundant ash (*Fraxinus excelsior*) with frequent to occasional English elm (*Ulmus procera*), sycamore (*Acer pseudoplantanus*) and beech (*Fagus sylvatica*). Treelines fringing demesne boundaries (such as Castlewarren or Mount Oval) or long established farmhouse buildings typically support mature, good specimen deciduous trees such as oak, beech, ash and sweet chestnut. Treelines fringing watercourses and drainage channels typically support alder (*Alnus glutinosa*), willow (*Salix* sp.) and ash (*Fraxinus excelsior*).

Hedgerows are an abundant feature of the study area as they also act as boundaries for the expansive pastoral and arable field systems throughout. In general, hedgerows are unmanaged and no longer stock-proof, and are often supplemented by earth banks and fencing. Plant species composition is dominated by hawthorn (*Crataegus monogyna*) with varying occurrences of blackthorn (*Prunus spinosa*), young ash (*Fraxinus excelsior*), gorse (*Ulex europaeus*), holly (*Ilex aquifolium*), dog-rose (*Rosa canina*), bramble (*Rubus fruticosus* agg.), elder (*Sambucus nigra*), English elm (*Ulmus procera*) and willows (*Salix* spp.). Climbing plants are a common hedgerow component and include ivy (*Hedera helix*), honeysuckle (*Lonicera periclymenum*), hedge bindweed (*Calystegia sepium*), cleavers (*Galium aparine*) and bush vetch (*Vicia sepium*). Hedgerows fringing roadsides or located alongside field boundaries typically support tall grasses, including false brome (*Brachypodium sylvaticum*), cock's-foot grass (*Dactylis glomerata*), false oat grass (*Arrhenatherum elatius*), and tall fescue (*Schedonorus arundinaceus*) in addition to woodland herbs and forbs such as ground ivy (*Glechoma herderacea*), herb Robert (*Geranium robertianum*), nipplewort (*Lapsana communis*), hogweed (*Heracleum sphondylium*), bush vetch (*Vicia sepium*) and suckering English elm. Hedgerows and treelines located alongside roadsides and private dwellings can also support non-native and invasive plant species such as snowberry (*Symphoricarpos albus*), butterfly bush (*Buddleja davidii*), fuchsia (*Fuchsia magellanica*) and Japanese knotweed. Refer to **Section 12.5.2.21** and **Figure 12.4** for further information on the location of invasive species along the proposed M28 Road Project.

Ecological Interest	Links to Annex I Habitats	Locations
Local Importance (Higher value)	This habitat does not correspond to Annex I habitats, however it provides an ecological corridor and refugia for flora and fauna throughout the survey area.	Located throughout the study area surrounding the majority of the study area's expansive field networks. These habitats comprise parts of ER 11, 12, 13 and 17.

Plate 12.13: Beech Treeline Underlain by Hawthorn and English Elm at Ballinimlagh

12.5.2.14 Spoil and Bare Ground/Recolonising Bare Ground (ED2/ED3)

These habitat classifications are used to describe areas of bare ground or derelict sites that have been previously disturbed and are in various stages of recolonisation by herbaceous plants. This habitat typically supports a diversity of early pioneer plants and ruderal species including common nettle (*Urtica dioica*), dandelion (*Taraxacum* spp.), colt's-foot (*Tussilago farfara*), teasel (*Dipsacus fullonum*), willowherbs (*Epilobium* spp.) and grasses favouring disturbed ground such as annual meadow grass (*Poa annua*) and Yorkshire fog (*Holcus lanatus*).

Areas of bare ground are localised and small, often occurring in mosaic or as part of other habitats, i.e., nearby field entrances, marginal areas of built-up areas, etc. As a result, recolonising bare ground occurs throughout the study area, the largest areas are located at Raffeen Quarry, Ringaskiddy and Lough Beg.

Raffeen Quarry and the quarry located to the east of Shanbally both support extensive areas of recolonising bare ground. At Raffeen Quarry, the northern extents and the quarry footprint support recolonising bare ground. Recolonising bare ground in the central and south-western sections of the site occurs in mosaic with open scrub. This habitat hosts butterfly bush (*Buddleja davidii*), wild teasel (*Dipsacus fullonum*), barren strawberry (*Potentilla sterilis*), yellow-wort (*Blackstonia perfoliata*), wood sage (*Teucrium scorodonia*), lesser trefoil (*Trifolium dubium*), eyebright (*Euphrasia officinalis* agg.), common centaury (*Centaurium erythraea*), rosebay willowherb (*Chamerion angustifolium*) and pennyroyal (*Mentha pulegium*), a species protected under the Flora Protection Order 2015.

Pennyroyal grows in profusion within the recolonising bare ground habitat within the site, aswell as the gravel tracks providing access to the existing quarry void[18].

The quarry/holding area located to the east of Shanbally supports both bare ground and recolonising bare ground habitats. Plant species cover is sparse but includes a relatively diverse ruderal flora including teasel (*Dipsacus fullonum*), scentless mayweed (*Tripleurospermum inodorum*), weld (*Reseda luteola*), great mullein (*Verbascum thapsus*), American willowherb (*Epilobium ciliatum*), ox-eye daisy (*Leucanthemum vulgare*), creeping thistle (*Cirsium arvense*), common centaury, hard rush (*Juncus inflexus*), common fleabane (*Pulicaria dysenterica*), bird's foot trefoil (*Lotus corniculatus*), imperforate St John's wort (*Hypericum maculatum*), daisy (*Bellis perennis*) and yellow bartsia (*Parentucellia viscosa*). This area supports ephemeral, localised ponding, in addition to localised lawns of bryophyte cover predominantly dominated by *Calliergonella cuspidata*. The southern and south-western sections of this holding area comprise ephemeral ponds and bryophyte lawns that support pennyroyal (*Mentha pulegium*), a species protected under *Flora Protection Order* (2015) and considered endangered on the *Irish Red List No. 10 for Vascular Plant Species* (Wyse Jackson *et al*., 2016).

Another small but relatively diverse recolonising bare ground habitat occurs to the north of Lough Beg. This area was disturbed within the past ten years. It has since recolonised with low growing ruderals and is somewhat maintained by grazing rabbit and horses. The calcareous parent material and surrounding bedrock is influencing the species composition of this habitat, with some areas in transition towards dry calcareous and neutral grassland habitat (GS1). Plant species composition includes red clover (*Trifolium pratense*), white clover (*Trifolium repens*), red bartsia (*Odontites vernus*), self-heal (*Prunella vulgaris*), bird's foot trefoil (*Lotus corniculatus*), common fleabane, common knapweed (*Centaurea nigra*), common sorrel (*Rumex acetosa*), meadow vetchling (*Lathyrus pratensis*), hard Rush (*Juncus inflexus*) and broadleaved dock (*Rumex obtusifolius*).

Although these habitats are routinely influenced by man-made activities they can, if allowed to develop sufficiently, support considerable plant species diversity that provides locally important foraging habitat for invertebrates, small mammals and avifauna.

Ecological Interest	Links to Annex I Habitats	Locations
Local Importance (Higher value)	This habitat does not correspond to Annex I habitats.	Throughout with large areas at Raffeen Quarry, east of Shanbally, north of Lough Beg and the Ringaskiddy area. This habitat comprises part of ER 12.

[18] In 2001, Tony O'Mahony, the then BSBI county recorder for Cork, authored a paper on the occurrence of adventive or introduced populations of pennyroyal from four sites in Co. Cork (O'Mahony, 2001) recorded between 1995 and 2000. This paper provided data on the floral biology, reproductive structure and probable life histories of three of these populations, which occur about Cork City.
This paper identified the growth habit, edaphic conditions, habitat occurrences and reproductive characteristics of adventive pennyroyal populations as follows: growth habitat, habitat preferences and reproductive characteristics. O'Mahony, T. (2001b) Putative adventive populations of *Mentha pulegium* L. (Pennyroyal) in Britain and Ireland. *Irish Botanical News* 11: 16–20.

Plate 12.14: Recolonising Bare Ground north of Lough Beg

12.5.2.15 Lower Saltmarsh (CM1) / Upper Saltmarsh (CM2)

Saltmarsh habitats comprise assemblages of halophytic (salt tolerant) vegetation that experience routine or diurnal inundations of marine or brackish water. The composition and plant assemblages of saltmarshes are influenced by a range of factors, including the degree and duration of tidal submersion, the salinity of the inundating water source and underlying substrata. Other factors such as land use, particularly grazing, can also influence saltmarsh composition and diversity. Saltmarsh habitats are located to the south of the proposed route at Lough Beg and north of the proposed M28 route fringing the Douglas River Estuary.

A tidal creek located to the north of Lough Beg (and located within Lough Beg pNHA) supports an assemblage of saltmarsh, marsh and scrub habitats. This intertidal area was originally reclaimed following the construction of a seawall along the creek's southern boundary. However, the tidal inlet/flap associated with the sea wall no longer functions and as a result the creek empties and fills during each tidal cycle. The tidal creek supports bare anoxic mud onto which dense green algal growth has established. The tidal inlet in turn is flanked by a mosaic of lower and upper saltmarsh habitats. Upper saltmarsh habitats support abundant sea clubrush (*Bolboschoenus maritimus*) while areas of lower saltmarsh support abundant common saltmarsh grass (*Puccinellia maritima*), frequent marsh arrowgrass (*Triglochin palustre*) in addition to occasional saltmarsh rush (*Juncus gerardii*), false fox sedge (*Carex otrubae*), sea plantain (*Plantago maritima*), common spike rush (*Eleocharis palustris*) and rare occurrences of sea purslane (*Halimione portulacoides*).

An area of common cord grass (*Spartina anglica*) dominated saltmarsh (CM1) forms the western margins of Lough Beg (which is designated as part of Cork Harbour SPA) and is spreading onto the adjoining muddy sand shores (LS3) habitat that comprises Lough Beg.

Those sections of the Douglas River Estuary to the north of the proposed M28 Road Project are designated as part of Cork Harbour SPA and support isolated parcels of common cord grass dominated lower saltmarsh. Other species include glasswort (*Salicornia agg.*), greater sea-spurrey (*Spergularia media*) and lax-flowered sea lavender (*Limonium humile*).

Those saltmarsh habitats located within Cork Harbour SPA are considered to be of International Importance by virtue of their location within this European site and correspond to the Annex I habitat 1330. In addition, it provides valuable roosting and feeding habitat for over-wintering avifauna associated with Cork Harbour SPA. The saltmarsh habitats located to the north of Lough Beg are considered to be of National Importance as they support viable areas of the habitat types listed on Annex I of the EU Habitats Directive.

Ecological Interest	Links to Annex I Habitats	Locations
National to International Importance	Corresponds to the Annex I habitat Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (1330).	Saltmarsh habitats within and to the north of Lough Beg and within the Douglas River Estuary. These habitats comprise part of ER 1, ER 2, ER 3 and ER 4.

Plate 12.15: Sea Clubrush Dominated Saltmarsh Habitat at Lough Beg

12.5.2.16 Shingle and Gravel Shores (LS1)

The extensive areas of muddy sand shores comprising Lough Beg are fringed by shoreline strips of shingle and gravel shores. This area supports a dispersed and relatively sparse shingle vegetation community that includes sea mayweed (*Tripleurospermum maritimum*), sea campion (*Silene uniflora*), sea radish (*Raphanus raphanistrum* subsp. *maritimus*), sea beet (*Beta vulgaris* subsp. *maritima*), sea sandwort (*Honckenya peploides*), curled dock (*Rumex crispus*), sea purslane (*Halimione portulacoides*) and lax-flowered sea lavender (*Limonium humile*).

This habitat is located within the bounds of Cork Harbour SPA and corresponds to the Annex I habitat 'Perennial vegetation of stony banks (1220)' and is therefore considered to be of International Importance.

Ecological Interest	Links to Annex I Habitats	Locations
International Importance	'Perennial vegetation of stony banks (1220)'.	Fringing the northern margins of Lough Beg. These habitats comprise part of ER 1, ER 2, ER 3 and ER 4.

Plate 12.16: Shingle and Gravel Shores Adjoining the Northern Margins of Lough Beg

12.5.2.17 Muddy Sand Shores (LS3)

The mud and sand dominated shorelines of Lough Beg and the River Douglas Estuary correspond to this habitat. This habitat supports sparse plant cover with occasional common cord grass (*Spartina anglica*) and the sea lettuce (*Ulva lactuca*). Both the Douglas River Estuary and Lough Beg are designated as part of Cork Harbour SPA due to their importance as bird feeding and roosting habitats.

This habitat, where it occurs within the study area's ZoI, is located within the bounds of Cork Harbour SPA. In addition, it corresponds to the Annex I habitat 'Mudflats and sandflats not covered by seawater at low tide (1140)' and provides valuable roosting and feeding habitat for a range of over-wintering avifauna associated with Cork Harbour SPA. As a result this habitat is considered to be of International Importance.

Ecological Interest	Links to Annex I Habitats	Locations
International Importance	Mudflats and sandflats not covered by seawater at low tide (1140).	Lough Beg and Douglas River Estuary. These habitats comprise part of ER 1, ER 2, ER 3 and ER 4.

Plate 12.17: Muddy Sand Shores of Lough Beg

12.5.2.18 Stone Walls and Other Stonework (BL1)

This habitat includes stone walls, bridges and ruined stone buildings within the study area. The ruins of Castlewarren and those boundary walls enclosed adjoining pastureland and arable land correspond to this habitat. The in-situ ruins of Castlewarren are heavily covered with dense ivy (*Hedera helix*) and support numerous gaps and crevices that provide optimal nesting and roosting habitat for birds and bats. Many of the fields surrounding Castlewarren are bound by stone walls that are in various stages of structural disrepair. A roadside stone wall boundary located to the south of Castlewarren, known locally as school road supports relatively diverse plant species cover including polypody fern (*Polypodium vulgare*), navelwort (*Umbilicus rupestris*), ivy (*Hedera helix*), false oat grass (*Arrhenatherum elatius*), cleavers (*Galium aparine*) and squirrel-tail fescue (*Vulpia bromoides*). Ivy clad stone walls, some of which reach more than 2m in height are located west of Castlewarren at Barnahely.

In general the distribution and abundance of this habitat within the study area is restricted to older farm dwellings and their surrounds such as those associated with the grounds of Hilltown House and Hilltown Bridge, north of Shannonpark. This habitat supports a unique botanical assemblage that is not common throughout the study area and is also a viable habitat for mammal species such as Irish Stoat and Pygmy Shrew. As a result this habitat is considered to be of Local Importance (Higher value).

Ecological Interest	Links to Annex I Habitats	Locations
Local Importance (Higher value)	This habitat does not correspond to Annex I habitats.	Ruined buildings and boundary stonewalls associated with Castlewarren and Hilltown House. This habitat comprises part of ER 13.

Plate12.18: Ivy Clad Stone Walls at Barnahely

12.5.2.19 Sea Walls, Piers and Jetties (CC1)

The now defunct seawall along the southern fringes of Lough Beg wetland corresponds to this habitat. This supports little or no plant species cover with the exception of localised lichen cover (*Xanthoria* sp.).

Ecological Interest	Links to Annex I Habitats	Locations
Local Importance (Lower value)	This habitat does not correspond to Annex I habitats.	Sea wall at Lough Beg. This habitat comprises part of ER 2.

12.5.2.20 Buildings and Artificial Surfaces (BL3)

The existing N28, the R611 and the R613, the many private houses, farmyards and farm buildings, Ringaskiddy terminal and the extensive industrial complexes at Barnahely, Raheens and Ringaskiddy correspond to this habitat. Buildings within the footprint and immediate environs of the proposed M28 Road Project were assessed as supporting of Moderate suitability for bats[19].

Ecological Interest	Links to Annex I Habitats	Locations
Local Importance (Lower value) to Local Importance (Higher value)	This habitat does not correspond to Annex I habitats.	Buildings are scattered throughout the study area.

Plate 12.19: Buildings and Artificial Surfaces – Existing N28 Roadway

[19] Moderate suitability is defined as 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. Source: Collins, J (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.

12.5.2.21 Invasive Species

The control of Invasive Alien Species (IAS) in Ireland is regulated through the European Communities (Birds and Natural Habitats) Regulations 2011 as amended, specifically Regulations 49 as follows:

Regulation 49

(2) *Save in accordance with a licence granted under paragraph (7), any person who plants, disperses, allows or causes to disperse, spreads or otherwise causes to grow in any place specified in relation to such plant in the third column of Part 1 of the Third Schedule, any plant which is included in Part 1 of the Third Schedule, shall be guilty of an offence*.

Part 4, Section 27(5) (c) of the European Communities (Birds and Natural Habitats) Regulations 2011 as amended, relates to the role of Local authorities in the control of invasive species:

(5) *Without prejudice to paragraphs (2), (3) and (4), every public authority in the exercise of any of its functions or responsibilities, shall—*

(b) take the appropriate steps to avoid damage to European Sites through activities that may cause deterioration of natural habitats or to the conservation status of the species for which the sites have been designated, including such activities that take place outside the boundaries of the sites.

In addition, the 2015 EU Regulation (No. 1143/2014) on 'the prevention and management of the introduction and spread of invasive alien species' requires EU action to prevent, minimise or mitigate their adverse impacts. Currently 37 species are listed under the 2015 Regulations, 12 of which occur in Ireland, and these require particular attention.

The Wildlife Acts, 1976 and as amended, contain a number of provisions relating to non-native invasive species. Ireland has also ratified a number of international conventions that oblige the government to address the issues of non-native invasive species including the Convention on Biological Diversity, the Bern Convention and the International Plant Protection Convention. In addition, there are obligations under the EU Habitats Directive to address any threats to the conservation status of the various habitats and species listed for protection under the Directive.

Table 12.13 below provides a list of non-native invasive species found within the proposed M28 Road Project and also gives their location. The introduction and spread of non-native invasive species etc. can have significant impacts on the ecological functioning on terrestrial and aquatic habitats and the ecotone between both. Within the study area species such as Japanese knotweed (*Fallopia japonica*) has been commonly found in verge of local roads and in nearby private dwellings and can also be aggressive colonists of riverbanks. River bank soil can become exposed after these invasive species create shading effects and reduce local flora cover in winter when plants die back. The soil is then eroded into rivers, altering substrate characteristics, providing favourable conditions for abundant aquatic plant growth and rendering the river substrates unsuitable for salmon and lamprey spawning (Caffrey, 1994; Lucey, 1994). Japanese knotweed was identified in the study area at the abandoned quarry/holding area east of Shanbally, adjoining the origins of the Donnybrook Stream at Ballinimlagh and along the margins of a private dwelling east of Shanbally.

The invasive shrub species cherry laurel (*Prunus laurocerasus*) is present within some of the longer established woodlands at Mount Oval and Bloomfield Woods. Cherry Laurel is not listed on the Third Schedule European Communities (Birds and Natural Habitats) Regulations 2011 as amended, however it is a high risk[20] species subject to control measures. The species is a dense thicket forming shrub of gardens, parks and woodlands. It was first established in demesne woodlands as cover for game. The ecology of cherry laurel significantly affects the surrounding plant communities, as it forms dense monospecific stands that shades and out-competes species associated with the woodland's ground and shrub layers. Three cornered garlic (*Allium triquetrum*) occurs within mixed broadleaved woodland at Bloomfield Woods and along the roadside verges in Ringaskiddy.

Three cornered garlic, traveller's joy (*Clematis vitalba*) and butterfly bush (*Buddleja davidii*) are species included on the Amber list compiled by Invasive Species Ireland and are rated as medium risk due to the score of the overall assessment however, their impact on conservation goals remains uncertain due to lack of data showing impact (or lack of impact).[21] Therefore, precautionary measures to avoid interaction and spread of this species will be undertaken.

Table 12.13: Invasive Species Recorded Throughout the Study Area

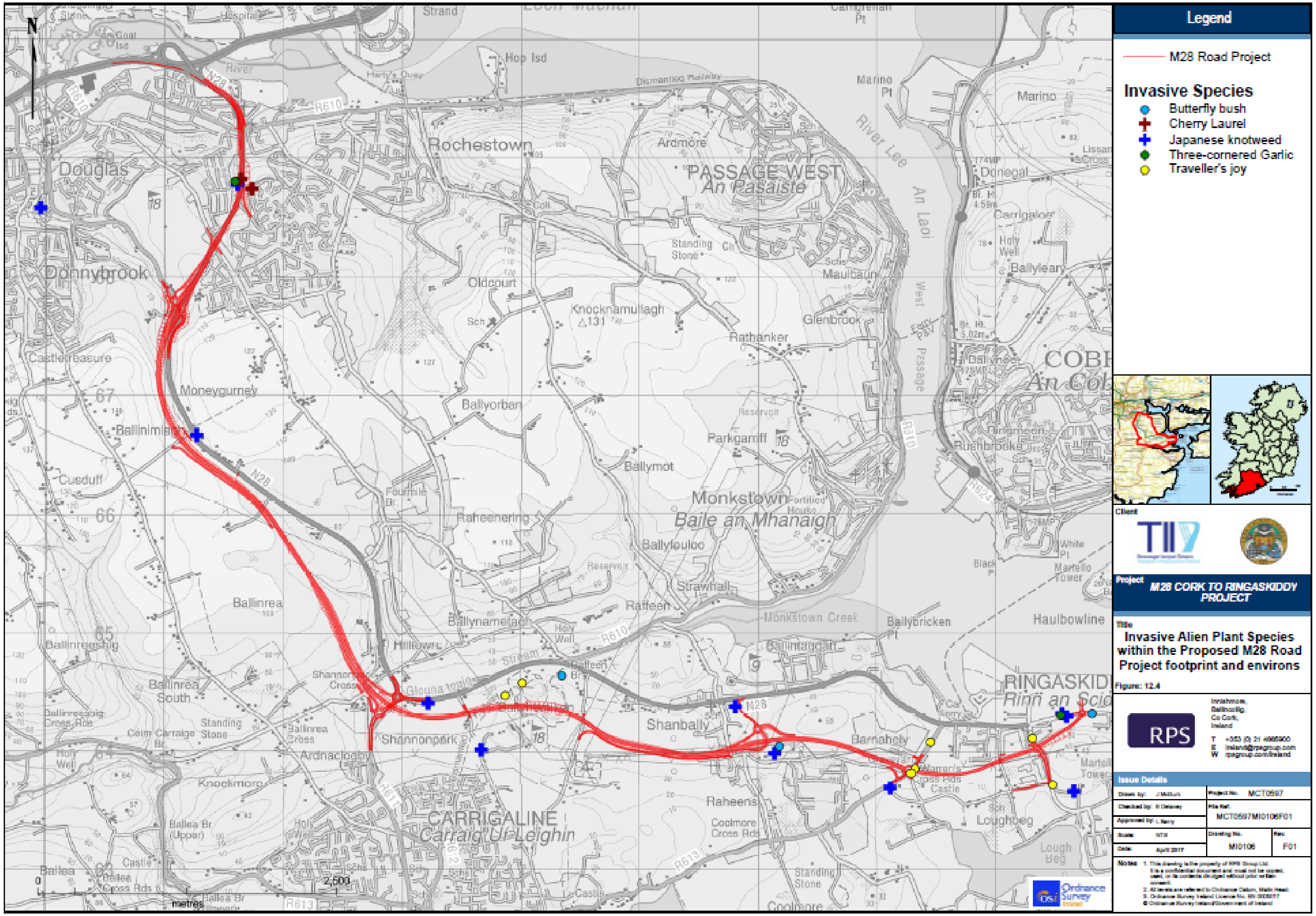
Common Name	Latin Name	Location[22]	Commentary
Japanese knotweed	*Fallopia japonica*	Shanbally (W76083 63977)	Line of young Japanese knotweed plants have established within holding area/compound. Growth of Japanese knotweed concentrated on mounded spoil adjoining trackway leading to the eastern half of the site.
		Shanbally (W75762 64405)	Extensive linear stand of Japanese knotweed located in boundary hedgerow/treeline east of Shanbally (see **Image 12.20**).
		Donnybrook stream, Donnybrook (W69907 68600)	Extensive Japanese knotweed stands established on left bank of Donnybrook Stream, downstream and outside of the proposed M28 Road Project.
		Ballinimlagh (W 71221 66689)	Located within scrub habitat immediately south of junction between local road serving Ballinimlagh and the M28.
		Shannonpark (W 73163 644404)	Located to the south of the existing N28 beside entrance to pastoral lands.
		Ballyhemiken (W 73618 64041)	Within hedgerow across from the entrance of Fernhill Golf and Country Club.
		Bloomfield Woods (W71565 68796)	Located along western boundary of Bloomfield Woods, west of the existing and proposed M28 Road Project.
		Donnybrook Stream at Douglas (W69988 68965)	West of the proposed M28 Road Project, downstream of Carr's Hill Interchange.
		Barnahely / Castlewarren (W 77118 63692)	Stand within roadside vegetation south of Castlewarren Safety Centre

[20] http://www.biodiversityireland.ie/wordpress/wp-content/uploads/Invasives_taggedlist_High Impact_2013RA.pdf
[21] http://invasivespeciesireland.com/toolkit/risk-assessment/amber-list-recorded-species/
[22] Grid Locations provided in Irish National Grid (ING).

Common Name	Latin Name	Location[22]	Commentary
		Ringaskiddy (W78567 64349)	Separate Japanese knotweed stands on both sides of the existing N28.
		Ringaskiddy (south of Martello Tower) (W787660 63665)	An Appropriate Assessment (Stage 2 NIS) (Atkins, 2016) completed for proposed *Materials Extraction and Land Re-Profiling* works south of the Martello Tower in Ringaskiddy identified a localised stand of Japanese knotweed to the south of the proposed project boundary. The stand is located within a hedgerow fringed to the south by disturbed ground and construction waste. The proposed extraction and re-profiling works will not be completed within or in immediate proximity to this area.
Cherry Laurel	*Prunus laurocerasus*	Bloomfield Woods, Mount Oval	Cherry Laurel identified within the woodland habitats on either side of the existing N28 at Bloomfield Woods and Mount Oval.
Traveller's joy	*Clematis vitalba*	Raffeen Quarry Disused railway line at Raffeen N28 at Ringaskiddy Local road serving Lough Beg at Ringaskiddy	Growing within scrub within Raffeen Quarry and growing along abandoned railway line between Raffeen and Monkstown. Growing on roadside margins on N28, R613 at Ringaskiddy and local roads serving Lough Beg.
Butterfly bush	*Buddleja davidii*	Throughout Raffeen Quarry Shanbally Ringaskiddy	Growing throughout Raffeen Quarry and its environs. Located within area of recolonising bare ground at Shanbally Embanked verge on margins of N28 at Ringaskiddy
Three cornered garlic	*Allium triquetrum*	Bloomfield Woods Ringaskiddy	Occurs occasionally within mixed broadleaved woodland understorey at Bloomfield Woods. Roadside verge on existing N28 at Ringaskiddy Roadside verges at Shanbally

Plate 12.20: Japanese knotweed at the Rear of a Private Dwelling, East of Shanbally

Figure 12.4: Invasive Alien Plant Species within the Proposed M28 Road Project Footprint and Environs



The proposed Service Area (SA) at Ringaskiddy is located immediately north of the existing N28 at Ringaskiddy and east of the extensive car parking area associated with Ringaskiddy ferry terminal. The proposed Service Area comprises an existing car park that corresponds to buildings and artificial surfaces (BL3) habitat that in turn overlaps into an adjacent area recolonising ground of (ED3), that previously supported semi-natural grassland and gorse dominated scrub. Habitats within the Service Area vary; the area of recolonising bare ground is of Local Importance (Lower value) while the existing car park area is considered to be of negligible ecological value.

12.5.3 Fauna

This section comprises an assessment on the faunal species found or that are likely to occur in the existing environment.

Fauna Survey Findings

12.5.3.1 Bats

All Irish bat species are protected under the Wildlife Act (1976) as amended. Also, the Habitats Directive 92/43/EEC, as transposed, seeks to protect rare species, including bats, and their habitats and requires that appropriate monitoring of populations be undertaken. Lesser Horseshoe Bats are listed under Annex II of the Habitats Directive and all bat species are listed in Annex IV. Across Europe, they are further protected under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982), which, in relation to bats, exists to conserve all species and their habitats. The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979, enacted 1983) was instigated to protect migrant species across all European boundaries. The Irish government has ratified both these conventions.

Bat emergence and foraging surveys were completed on 5th and 6th of August 2014. These were informed by the bat surveys completed for earlier alignments of the project in 2006 and 2013. Five bat species including common and soprano pipistrelle, Leisler's, Natterer's and Daubenton's were detected during surveys carried out during the nights of 5th and 6th of August 2014. Although not recorded during these surveys, brown long-eared bat was recorded during the 2013 survey as it commuted along a hedgerow near the ruined Castlewarren in Barnahely on the 18th of October. This is a very quiet species which produces very weak echolocation pulses and sometimes hunts without emitting sounds and can therefore be present without being detected.

As in the autumn 2013 survey, the summer 2014 survey identified ubiquitous common and soprano pipistrelle along hedgerows, treelines and woodland edge throughout the study area on each night with the exception of Barnahely wetland where only soprano pipistrelle was recorded. Leisler's bat, which forages over agricultural landscapes, scrub and woodland as well as urban areas, was detected commuting high overhead at Bloomfield Wood, Shannonpark, Shanbally and Ringaskiddy. This is a high flying species and its commuting routes and foraging areas will not be impacted by the proposed M28 Road Project. Natterer's bat, a woodland species, was detected hunting along the edge of Bloomfield Wood on the night of August 6th 2014 while Daubenton's bat which hunts close to the surface of still watercourses and other bodies of water, was detected foraging over the River Lee/Ringaskiddy Port area on the night of August 5th 2014.

Observations of flying bats along with location and activity noted are provided in **Table 12.14** below.

Table 12.14: Observations of Bat Species within the Study Area

Bat Species	Location	Activity	Habitat & Code (Fossitt 2000)
Common pipistrelle *Pipistrellus pipistrellus*	Bloomfield Wood Ch: 750-1100	Foraging	Mixed broadleaved woodland (WD1)
	Donnybrook Stream Ch: 2150-3500	Foraging	Mixed broadleaved woodland (WD1) and stream (FW1)
	Glounatouig Stream Ch: 5200-6100	Foraging	Mixed broadleaved woodland (WD1) and stream (FW1)
	Shannonpark Ch: 6100-6800	Foraging	Mixed broadleaved woodland (WD1)
	Barnahely Ch:10600-11000	Foraging	Ruined castle (BL1) and scattered trees
	Ringaskiddy Ch: 11000-11350	Foraging	Mixed broadleaved woodland (WD1) and scrub (WS1)
Soprano pipistrelle *Pipistrellus pygmaeus*	Bloomfield Wood Ch: 750-1100	Foraging	Mixed broadleaved woodland (WD1)
	Donnybrook Stream Ch: 2150-3500	Foraging	Mixed broadleaved woodland (WD1) and stream (FW1)
	Glounatouig Stream Ch: 5200-6100	Foraging	Mixed broadleaved woodland (WD1) and stream (FW1)
	Shannonpark Ch: 6100-6800	Foraging	Mixed broadleaved woodland (WD1)
	Barnahely Ch:10600-11000	Foraging	Ruined castle (BL3) and scattered trees (WD5)
	Ringaskiddy Ch: 11000-11350	Foraging	Pond (FL8), scrub (WS1), immature coniferous woodland (WD4) and derelict buildings (BL3)
	Bloomfield Wood Ch: 750-1100	Foraging	Mixed broadleaved woodland (WD1) and scrub (WS1)
Leisler's bat *Nyctalus leisleri*	Bloomfield Wood Ch: 750-1100	Commuting	Mixed broadleaved woodland (WD1)
	Donnybrook Stream Ch: 2150-3500	Commuting	Mixed broadleaved woodland (WD1)
	Glounatouig Stream Ch: 5200-6100	Commuting	Built-up area (BL3)
	Shannonpark Ch: 6100-6800	Commuting	Mixed broadleaved woodland (WD1) and scrub (WS1)
Natterer's bat *Myotis nattereri*	Barnahely Ch:10600-11000	Foraging	Mixed broadleaved woodland (WD1)
Daubenton's bat *Myotis daubentonii*	Ringaskiddy Ch: 11000-11350	Foraging	River Lee (Estuary) (MW4)/ Cork harbour

Potential Bat Roost Survey and Assessment – Winter 2017

Preliminary Roost Assessment of Trees

No trees within the study area were confirmed as roost sites. A total of thirty six trees or clusters of trees within the proposed M28 alignment and its immediate environs were categorised as being of moderate suitability for roosting bats as they contained one or more potential roost features, but none were obviously suitable for use by larger numbers of bats on a regular basis.

Preliminary Roost Assessment of Structures

One building at Maryborough is due to be demolished as part of the construction works. The structure is a two storey domestic dwelling. There are potential access points for bats to the building via the soffit boxes and the roof tiles. A single story domestic dwelling at Shanbally may potentially require demolition as part of the works. The building was not accessed at close quarters, but there appears to be potential access points for bats to the building via the roof tiles. Both of these dwellings are classified as being of moderate suitability.

There are a number of derelict buildings adjacent to the proposed route in the Barnahely area. These buildings support no, or very low potential for roosting bats. There are also a number of stone walls in the Barnahely area that provide a linear habitat that may be used by commuting and foraging bats. The stone walls also provide crevices that may be used in the spring, summer and autumn months by individual bats, but are not suitable for use as maternity roosts or hibernation roosts. These walls are categorised as being of low suitability.

Works are proposed at one bridge along the proposed M28 route; namely the Maryborough bridge. This bridge is a concrete overbridge that crosses the existing N28. No Potential Roost Features (PRFs) were observed within this bridge and it is therefore classified as being of negligible potential for bats.

Raffeen Quarry face contains several cracks and crevices that are of potential use by bats, and is classified as being of moderate suitability.

Carr's Hill / Moneygourney Area

Following correspondence with NPWS, a bat habitat suitability survey of the Donnybrook Stream and the Carr's Hill/Moneygourney area was completed in March 2015. The findings of this habitat suitability survey confirmed that the Donnybrook Stream offers foraging and commuting opportunities for bats, with mature and semi-mature trees along its length that offer potential for roosting. It should be noted however, that the most suitable areas are located outside of the proposed project's footprint, within the Donnybrook area.

The Carr's Hill area is not of particularly high value to bats as it supports few suitable roosting features such as mature trees, derelict buildings, stone arch bridges etc. Nonetheless, the hedgerows, treelines and vegetated earth banks in this area provide suitable foraging and commuting habitat for bats in the locality.

A detailed bat survey of the Donnybrook Stream and Carr's Hill was conducted by RPS in the summer and autumn seasons 2015 (July to September) in order to determine bat activity in the vicinity. Surveys were conducted on 17th July, 5th and 6th August and 22nd September 2015. A Passive

Monitoring System of bat detection was deployed for this survey scheme (i.e. a bat detector is left in the field, there is no observer present and bats which pass near enough to the monitoring unit are recorded and their calls are stored for later analysis). To support the Passive Monitoring Programme, dusk surveying was also completed by one surveyor on four occasions using a Batbox Duet detector.

The woodland alongside the Donnybrook Stream supports some mature trees with features that are of potential use by bats, such as cracks and crevices in the trunk or limbs, or heavy ivy cover. Trees fringing the stream with medium to high potential for roosting or resting places for bats are located to the west and outside of the proposed M28 Road Project works area. The area to the south of the woodland that would be subject to habitat loss as part of the road layout provides foraging habitat for bats, however the trees in this area provide limited roosting potential. In the Moneygourney area, there are some semi-mature and mature trees in the hedgerows that are of low to medium potential for bats. A line of ash and beech with medium potential for bats form the boundary of a farm yard to the east of Carr's Hill, but no evidence of use by bats was found during the activity surveys.

The four detector surveys undertaken within the active season in summer and autumn 2015 recorded the presence of three bat species within the study area. Soprano Pipistrelle was the most frequently recorded species, and was observed foraging or commuting along the hedgerows, woodland and scrub throughout the study area. Common Pipistrelle was also recorded foraging throughout the study area, as were a number of Pipistrelle species that were unidentifiable to species level. The findings of the summer and autumn activity surveys are presented in **Table 12.15**.

Table 12.15: Summer and Autumn Activity Survey 2015 - Observations and Recordings of Bat Species within the Carr's Hill / Moneygourney area

Bat Species	Location	Activity	Habitat
Common Pipistrelle	Moneygourney	Foraging	Hedgerow
	Adjacent to Donnybrook Stream	Foraging	Woodland and scrub, grassland
Soprano Pipistrelle	Moneygourney	Foraging	Hedgerow
	R610 junction	Foraging/ commuting	Scrub
	Adjacent to Donnybrook Stream	Foraging	Woodland and scrub, grassland
Pipistrelle Species	Moneygourney	Foraging	Hedgerow
	R610 junction	Foraging/ commuting	Scrub
Leisler's Bat	Moneygourney	Foraging/commuting	Hedgerow/ treeline

Leisler's Bat was recorded foraging or commuting overhead at Moneygourney, but was not recorded during the survey along the Donnybrook Stream.

Brown Long-eared bat was not detected during the surveys, however it is a quiet bat which has weak echolocation and sometimes hunts without sound, and so can be missed by bat detectors. Brown Long-eared bats have been recorded in the area and are widespread throughout Ireland and so would be expected to be present within the study area.

12.5.3.2 Non-Volant Fauna

A non-volant mammal survey of the route was completed in March 2014 with targeted validations completed in March 2015 in addition to further surveys undertaken in 2017. These surveys were informed by earlier mammal surveys completed for the route for the 2009 EIS and again in 2010 and 2011. The March 2014 mammal survey inspected all habitats within the footprint and the proposed M28's ZoI. It focused on semi-natural habitats and habitat assemblages that would provide optimum refuge, cover and transit/corridor options for mammal species. In the case of the proposed M28 and its associated ZoI, this typically involved habitat assemblages such as scrub, woodland (semi-natural and planted), linear woodland (hedgerows and treelines) and semi-natural grassland.

12.5.3.3 Badger (Meles meles)

Badgers are protected under the Wildlife Acts 1976 and as amended. They are also listed in the Ireland Red List No. 3: Terrestrial Mammals '(Marnell et al., 2009) as being of least conservation concern and in Appendix III of the Bern Convention as a species requiring protection. Badgers prefer farmland/woodland mosaics but are sometimes found in upland areas up to 500m in elevation and solitary badgers can occupy territory in open upland, which is dry and not susceptible to flooding.

Badgers are common throughout Ireland and there is potential for foraging corridors and locations of badger setts in the study area. In particular, a concentration of active setts was identified at woodland fringing the Glounatouig Stream at the Ballinrea townland. **Table 12.16** lists those active badger setts identified during the 2014 mammal survey with subsequent validations in early 2015. **Table 12.17** presents badger signs and features identified during the site walkover surveys. In March 2017, the NBDC dataset held four records of badger road mortalities on the existing N28 between Douglas and Ballinimlagh townland in addition to one record of otter road mortality between Bloomfield Wood and Douglas in February 2016.

Table 12.16: Active Badger Setts Identified During Site Walkover Surveys

Sign Type	Sett Type	Activity	Townland / Habitat Feature	Note
Badger Sett	Main sett – three entrances	Active	Woodland and bracken scrub at Ballinrea / Glounatouig Tributary	Active sett located within bracken scrub adjoining area of semi-natural woodland. Consistent activity evidenced by paths, snuffle holes, latrines and guard hairs.
Badger Sett	Main sett – two entrances	Active	Woodland fringing abandoned railway at Raffeen	2 large entrances, latrine 3m away, lots of snuffle holes, large spoil heaps Large burrow. No rabbit activity, droppings in the immediate environs. February 2017 - Roadkill badger identified 160m north on the roadside verge of M28
Badger Sett	One entrance	Active	Scrub and open woodland at Ringaskiddy	One active sett supporting 1 large entrance. Guard hairs and latrine identified in local area.
Badger Sett	Three entrances	Active	Woodland fringing Donnybrook Stream west of Carr's Hill interchange	Active sett with 3 entrances showing fresh spoil and scratch marks. Latrine and badger paths identified nearby.

Sign Type	Sett Type	Activity	Townland / Habitat Feature	Note
Badger sett	One entrance	Active	Active badger sett within woodland embankment, immediately between existing M28 and Raffeen Quarry	One sett entrance. Fresh spoil, excavations outside entrance. Badger tracks and snuffle holes identified -/+ 50m west of sett. Roadkill badger identified on N28 roadside verge, north of Raffeen Quarry in February 2017. Potential Annex sett

Table 12.17 identifies badger signs and features identified within the proposed M28 route and its associated ZoI. Features listed include prints, trails, guard hairs, latrines and roadkill specimens.

Table 12.17: Badger Sign / Features Identified During Mammal Surveys

Sign / Feature	Townland / Habitat Feature	Note
Badger prints	Ballinrea	Badger prints along defined track west of existing N28
Badger guard hair	Ballinrea / Glounatouig Stream	Guard hair identified along woodland margins
Badger latrine	Ballinrea / Glounatouig Stream	Badger latrine located in proximity to main sett
Badger guard hair	Donnybrook Stream/ Woods, Donnybrook	Guard hair identified along woodland margins
Badger latrine	Donnybrook Stream / Woods, Donnybrook	Latrine within woodland copse west of the Donnybrook stream
Badger prints	Mount Oval Woodland	Badger tracks within woodland habitat
Badger prints	Shannonpark / Ballyhemiken	Badger prints along field margins
Badger prints	Ballyhemiken	Badger print west of Raffeen Quarry. Badger prints along entrance to Raffeen Quarry.
Roadkill	Ballyhemiken	Roadkill badger on N28 located 160m north of disused railway at Ballyhemiken
Badger latrine	Ringaskiddy	Badger latrine south of Ringaskiddy
Badger guard hair	Ringaskiddy	Badger guard hair within barbed wire fence along field boundary at Ringaskiddy
Roadkill badger	Castletreasure	Within the existing N28 at Castletreasure

12.5.3.4 Irish Hare (Lepus timidus hibernicus)

The Irish Hare is listed as an 'animal species of community interest whose taking in the wild and exploitation may be subject to management measures' in Annex V of the EU Habitats Directive and as a 'protected fauna species' in Annex III of Bern Convention. The Irish population is also protected under the Wildlife Acts 1976 and as amended and also listed in the 'Ireland Red List No. 3 Terrestrial Mammals' (Marnell et al., 2009) as being of least concern. The Irish Hare is present in all counties both in lowland and upland habitats. It is generally found in open habitats including upland heath and pasture. In previous surveys completed for this road project, a single Irish Hare was found in the Novartis site (Barnahely), just to the south of the proposed M28 route. No individuals were observed

or signs identified during the surveys undertaken in 2014, 2015 and 2017 and it is considered likely that this species occurs within the study area. There are two records for this species in the NPWS Rare and Protected Species Records and 15 records on the NBDC online database for the W76 hectad. Droppings and individuals were not recorded during field surveys.

12.5.3.5 Red Squirrel (*Sciurus vulgaris*)

The Red Squirrel is listed in Appendix III (protected fauna) of the Bern Convention, and is afforded legal protection in Ireland under the Irish Wildlife Acts, 1976 and as amended. They are found in mixed coniferous forests composed of Pine, particularly Scots Pine, and where Grey Squirrels are absent. This habitat type is their main stronghold in Ireland. A single Red Squirrel was recorded in Bloomfield Wood during a mammal survey completed in 2006. Bloomfield Wood is probably too small to support a Red Squirrel population by itself, but may support a population in combination with the woodland habitat in the grounds of the nearby Maryborough House Hotel and Douglas Golf Course. The mammal surveys completed for the project did not identify evidence of Red Squirrel within Bloomfield Wood. There is one record for this species in the NPWS Rare and Protected Species records and 10 records for this species on the NBDC database for hectad W76. The NBDC hold one record for this species within the tree/woodland habitats in Douglas Golf Club, an area supporting broadleaved and mixed broadleaved woodland habitats and another downstream of the project along the Donnybrook Stream at Ballybrack Woods. Garryduff Woods located less than 2km to the east of Bloomfield Woods, supports numerous records for Red Squirrel.

12.5.3.6 Pine Marten (*Martes martes*)

The pine marten has in recent times begun to colonise coniferous and mixed forest, particularly in the west of Ireland. They also like to hunt in areas of clear felled conifer plantation. The pine marten is listed in Annex V of the Habitats Directive as a species of European interest. They are also listed in Appendix III of the Bern Convention as a species requiring protection. In Ireland the species is protected under the Wildlife Acts 1976 and as amended meaning it is a criminal offence to kill, trap or disturb them intentionally. NPWS do not support records for pine marten in the study area of its environs. In addition, there is a lack of suitable habitat for pine marten in the study area and its immediate environs. No signs or individual pine marten were recorded during site walkover surveys.

12.5.3.7 Otter (Lutra lutra)

Otter are listed on Annex II and Annex IV of the EU Habitats Directive and are also protected by the Wildlife Acts (1976 as amended). Annex II species under the Habitats Directive require the designation of protected areas by Member States (Special Areas of Conservation) as set out in Articles 3, 4 and 6 of the Directive. Annex IV species require strict protection measures by Member States in accordance with Article 12 of the Directive, the Eurasian otter is also listed on Appendix 1 of CITES and Appendix II of the Bern Convention. The Irish population is also listed in the 'Ireland Red List No. 3 Terrestrial Mammals (Marnell et al., 2009) as being near threatened.

Otters are largely solitary, territorial and nocturnal animals and in many areas their distribution is scarce. They are rarely found far from water and tend to occupy linear home ranges along watercourses and coasts. They require suitable bankside vegetation as cover for their underground burrows termed 'holts' or above ground rest sites which are termed 'couches'. Otters mark their home ranges by depositing their droppings termed 'spraint', at distinct landmarks such as grassy

mounds, large rocks or ledges under bridges. These favoured sites are known as seats and are usually found at important locations i.e. access points to the water, good fishing grounds, etc.

The NPWS database for rare and protected species hold records of otters for hectad W76, including records from the Owenaboy River Estuary and downstream of the Glounatouig Stream at Monkstown Creek. In addition, the NBDC online database holds 10 records for otter from hectad W76. The NBDC also holds one record for roadkill otter along the N28 between Bloomfield Wood and Douglas in February 2016.

An otter survey of the Donnybrook Stream was completed in March 2015. The Donnybrook Stream and its adjoining habitats were walked from the stream's source at Ballinimlagh to Douglas, where the stream is canalised, culverted and eventually subterranean. Upstream of the Douglas area, the stream is largely unmodified, supporting suitable otter resting and refuge habitats. At Douglas and the Douglas River Estuary, the Donnybrook Stream is channelised and less suitable for otter navigation, foraging and commuting. North of Church Street, Douglas, the Donnybrook Stream is culverted for at least 100m under an expansive commercial development making it wholly unsuitable for otter usage, either as a commuting, foraging or feeding source. The Donnybrook Stream continues north to north-east interchanging between subterranean and surface stretches before discharging into the Douglas River Estuary. While otter may be present within the Douglas River Estuary, they are unlikely to utilise the Donnybrook Stream as a commuting, foraging or feeding source due to the absence of suitable habitat immediately upstream of its discharge point. This was reflected in the survey's findings which did not confirm otter activity along the Donnybrook Stream or its immediate environs.

North of the R610 and N28 intersection, the Woodbrook Stream has been heavily modified upstream of the Douglas Estuary. It is also culverted at three separate points near its southern end where it crosses the existing N28. These modifications result in the stream being largely unsuitable for otter prey items, in addition to its inherent unsuitability as a commuting route for this species. To this end, it is considered unlikely that otter would use the Woodbrook Stream within the project's ZoI as a commuting route or as a viable feeding source.

The Glounatouig Stream has been heavily modified by re-sectioning and realignment along much of its length and is spanned by the N28, the R610 and a number of local roads. A tributary draining the Ballinrea townland is culverted under the existing N28 joining with the main channel before continuing south towards Hilltown. South of Hilltown at Shannonpark, the stream crosses the existing N28 at Raffeen Bridge via a 140m long culvert continuing along the southern edge of the existing N28 adjoining Raffeen Quarry. East of Ballyhemiken, the stream is spanned by the R610 and a local road. This series of culverts and subterranean sections reduces the suitability of this stream to otter as a feeding source and as a commuting route. They are however likely to use the lower reaches of this stream, proximal to Monkstown Creek. Signs of otter were not confirmed within the Glounatouig Stream during any of the site walkover surveys completed.

Mammal surveys completed for the project noted otter spraint and an otter path on the western boundary of the wetland north of Lough Beg. However, mammal surveys but did not identify otter activity on any of the streams draining the study area. To this end, it is likely that otter use the other estuarine/coastal habitats that support connectivity with the route; Monkstown Creek, Lough Beg and the Douglas River Estuary.

12.5.3.8 Stoat (Mustela erminea subsp. hibernica)

The Irish Stoat is listed in Appendix III (protected fauna) of the Bern Convention, and is afforded legal protection in Ireland under the Irish Wildlife Acts, 1976 and as amended. It can be found in a number of habitats, including; woodlands, heathlands and farmlands. The Stoat is the smallest of our flesh-eating mammals. It is approximately 0.3m in length, and like the badger, is nocturnal. This species is known to be widespread throughout the country, though no specific studies have been carried out to date. It is likely that this species occurs within the study area, due to the presence of suitable habitat, however no signs of the species were recorded during site surveys. The NPWS hold historical records for this species in Carrigaline and Crosshaven Co. Cork while the NBDC hold three records for this species from the road project footprint and its immediate environs; to the east of the project at Ringaskiddy, south-west of the project at Ballinrea and an historic roadkill record from the Mulcon Valley in 1983. The Irish Stoat was not recorded during the site walkover surveys completed for the route and its environs.

12.5.3.9 Hedgehog (Erinaceus europaeus)

The Hedgehog is listed in Appendix III (protected fauna) of the Bern Convention, and is afforded legal protection in Ireland under the Irish Wildlife Acts, 1976 and as amended. Hedgehogs are found in woodlands, hedgerows, gardens, and meadows. Hedgehogs are mostly nocturnal, but juvenile or sick animals can sometimes be seen during the day. Hedgehog (*Erinaceus europaeus*) was not identified during the site walkover surveys but this species would be common and widespread where hedgerow and scrub woodland habitat is substantial. The NPWS Rare and Protected Species Database hold records for Hedgehog in the wider area, from Douglas, Carrigaline and Crosshaven while the NBDC online database (Irish Roadkill Survey) holds 13 records for Hedgehog in W76.

12.5.3.10 Pygmy Shrew (*Sorex minutus*)

The Pygmy Shrew is listed in Appendix III (protected fauna) of the Bern Convention, and is afforded legal protection in Ireland under the Irish Wildlife Acts, 1976, as amended. The Pygmy Shrew is Ireland's smallest mammal, ranging in weight from 3g in winter when food sources are low, to 6g for breeding adults in the summer. The pygmy shrew is common throughout the country where there is good ground cover in grassland, woodlands, hedgerows, and bogs. They build spherical nests from dried grass under ground cover, dead wood or rocks. The NPWS support historical records for this species (1970s) at both Carrigaline and Douglas. The habitats on site provide this species with suitable habitat. A dead pygmy shrew was identified on the access road leading to the Ringaskiddy Industrial Estate, east of Shanbally. Pygmy shrew is likely to be common throughout the proposed M28 and its associated ZoI.

12.5.3.11 Other Faunal Species

Faunal species not listed on Annex II Habitats Directive or Schedule 5 Wildlife Acts 1976 and 2000 were also recorded within the study area and are likely to occur throughout given the habitats present within the study area.

Rabbit (*Oryctolagus cuniculus*), Brown rat (*Rattus norvegicus*) and Wood Mouse (*Apodemus sylvaticus*) were noted throughout the study area. Rabbit activity was consistent and abundant throughout all parts of the route with the exception of urban and peri-urban habitats. Signs and evidence of Brown rat was confirmed along the Donnybrook Stream.

The house mouse (*Mus musculus domesticus*) is likely to be present at dwellings and farmsteads in the area, and may occur infrequently in the wider countryside. In addition, the study area is located within the range kept by the bank vole (*Clethrionomys glareolus*) and is likely to support this species. Fox (*Vulpes vulpes*) was observed foraging within the Lough Beg wetland complex and within an area of bracken scrub at Ringaskiddy while there was widespread evidence of fox (principally droppings) throughout the study area.

12.5.4 Avifauna

12.5.4.1 Over-Wintering Surveys – Line Transect Surveys

In 2014/2015, a total of 36 species were recorded during the over-wintering line transect surveys completed within the proposed study area. None of the species recorded were listed under Annex I of the EU Birds Directive. Four species identified were red listed in *BoCCI* (Colhoun and Cummins, 2013) including: Curlew, Meadow Pipit, Redshank and Yellowhammer. Twelve amber listed species were recorded including: Brent Goose, Coot, Cormorant, Goldcrest, Greenfinch, Little Grebe, Linnet, Oystercatcher, Robin, Shelduck, Snipe and Starling. The remaining species recorded were green listed or not listed (e.g. Feral Pigeon and Redwing). Seven of the species recorded are SCI species for Cork Harbour SPA including; Cormorant, Curlew, Grey Heron, Little Grebe, Oystercatcher, Redshank and Shelduck. With the exception of Little Grebe, all of these species were recorded within Transects 1 and 2, located between Lough Beg and Warren's crossroads (R613). With the exception of Curlew, peak numbers for these species did not exceed 2. A peak number of 56 Curlew was recorded in Transect 1, which is located immediately north of Lough Beg. Little Grebe was identified within Transect 4, which parallels Raffeen Quarry. Little Grebe was also identified utilising the wetland area within Raffeen Quarry during the habitat surveys completed in 2014.

In 2015/2016, a total of 47 species were recorded in the 0-25m and 25-100m distance bands along the transect counts with an additional six species recorded outside these distance bands, overflying the transects, or on return walks along the transect routes. Species lists include eight species that are red-listed in *BoCCI* including Curlew, Dunlin, Redshank, Black-headed Gull, Herring Gull, Grey Wagtail, Meadow Pipit and Yellowhammer. A further 16 BoCCI amber-listed species were recorded during these surveys: Shelduck, Teal, Sparrowhawk, Oystercatcher, Jack Snipe, Snipe, Common Gull, Stock Dove, Goldcrest, Skylark, Starling, Mistle Thrush, Robin, House Sparrow, Greenfinch and Linnet. As in the 2014/15 surveys, seven SCI species for Cork Harbour SPA were identified during the line transect surveys; Shelduck, Teal, Grey Heron, Oystercatcher, Curlew, Redshank and Black-headed Gull. These were all recorded within Transects 1 and 2, located north of Lough Beg and between Lough Beg and Warren's crossroads (R613). With the exception of Curlew (12) and Black-headed Gull (15), maximum numbers of birds recorded did not exceed 5.

BoCCI red and amber-listing can refer to large-scale declines in species population and distribution, and listed species may still be widespread and common. The red and amber listed species recorded on the transect counts are mainly species that are widespread in lowland agricultural landscapes in southern Ireland in winter, as well as a few waterbird species recorded along transects in most proximity to Lough Beg. The most notable species recorded was Jack Snipe. A single bird was flushed from improved grassland on the return walk in the Ballinimlagh and Moneygourney townlands, southwest of Carr's Hill. This is a widespread, but scarce, wintering species that typically occurs in freshwater marshes and wetlands. This record most likely refers to a casual visitor, as the habitat is not typical for the species and does not indicate the presence of a regular wintering population and is not of any conservation significance. During mammal surveys completed in February 2017, Woodcock, a red listed species, was flushed from an area of scrub in Ballinimlagh and from scrub

surrounding a Ringfort at Barnahely. In March 2017, a Grey Wagtail pair was identified within the Woodbrook Stream along the northernmost section of the Woodbrook Stream, suggesting that this species is breeding or attempting to breed along this watercourse. In addition, Yellowhammer was recorded within scrub on the eastern fringes of Raffeen Quarry in March 2017.

12.5.4.2 Over-Wintering Surveys – Field Feeding Surveys

Monthly site visits with respect to Curlew field feeding areas were undertaken during the over-wintering survey months (October – March inclusive) of 2014/2015 and 2015/2016. On each occasion, the location and number of birds feeding in fields to the north and in the environs of Lough Beg in addition to bird counts on Lough Beg were completed to ascertain the level of usage within these areas and their consequent importance to the avifaunal populations associated with nearby areas of Cork Harbour SPA.

The findings of the over-wintering surveys completed in 2014/2015 and 2015/2016 found that the field feeding areas do not support significant numbers of regularly occurring SCI species for Cork Harbour SPA. The findings of these surveys found occasional and sporadic occurrences of small species flocks of Common Gull, Black-headed Gull, Curlew and Oystercatcher within these expansive agricultural fields. The occasional occurrence of gull or Curlew flocks in these areas were attributed to opportunistic feeding following heavy rainfall periods that made prey more readily available.

12.5.4.3 Breeding Bird Surveys

Barn Owl Surveys

Several European studies have linked the increase in major road networks to a decline in the Barn Owl population. Due to their hunting behaviour, low flight and poor peripheral vision Barn Owls are especially vulnerable to collision with road traffic, particularly in the autumn when juveniles are dispersing. The collision and subsequent mortality of Barn Owl are common on road projects, especially along areas that are embanked or at grade with the surrounding landscape which result in species such as Barn Owl flying into direct contact with the road project. There are records for Barn Owl from hectad W76, however the NPWS, BirdWatch Ireland and the IRSG local staff were informally consulted to identify any Barn Owl sites in the locality and no records are available for this species. However, during non-statutory consultation with the NPWS, Barn Owl surveys were advised to be undertaken.

During the winter transect surveys, suitable habitats and structures to support Barn Owl nest sites were identified. Two structures were identified near the eastern end of the route in the Barnahely townland and environs. The first of these is Barnahely Castle. The castle has no roof but the walls of the building are still intact and potentially could offer a nest site for Barn Owls. The second is a collection of buildings close to the National School near Barnahely. There are two old buildings close to the school that are heavily covered in ivy, both no longer have the roof intact but do offer some potential for Barn Owl sites. It was not possible to access any of the buildings.

The Barnahely survey visits were undertaken on 10th and 29th July, 2014. The surveys were carried out between 9pm and 1am in the vicinity of the two potential locations identified above. The Barn Owl activity surveys comprised surveillance of suitable buildings in order to identify any potential Barn owl breeding activity. It also included driving around the lanes within the Barnahely area and the surveillance of the tidal inlet in the north-west corner of Lough Beg area where the habitat

displayed suitability for the Barn Owl. No Barn Owls were identified within the Barnahely area during the site surveys.

Peregrine Falcon in Raffeen Quarry

Habitat surveys of the Raffeen Quarry site in July 2014 confirmed the presence of Peregrine Falcon at Raffeen Quarry. Breeding activity was not confirmed but a female bird was flushed from a large aggregate mound located toward the centre of the quarry area.

Consultation undertaken as part of this EIS with locals and members of the IRSG confirmed that Peregrine Falcon have been known to breed in Raffeen Quarry. The nest site used in the past is on the south face of the quarry (IRSG, pers. comm.).

Site walkover surveys at Raffeen Quarry in June and July 2014, confirmed that a pair of Kestrels bred successfully in the quarry. Both birds were seen on both survey visits and a young bird was heard on the second survey. It is thought that the nest site was in the south-east of the quarry, possibly in the old Peregrine Falcon nest.

During the summer of 2014, two site walkover surveys were undertaken in Raffeen Quarry on 5th June and 11th July, 2014 by Tony Nagle (on behalf of Glas Ecology Ltd.) and David Rees (Glas Ecology Ltd.). No definite evidence of breeding was recorded on either occasion. On the first site visit, a male Peregrine Falcon was present and called frequently during the survey visit, indicating that there may have been a nest present, although breeding was not confirmed. This survey identified evidence of Peregrine usage within the exposed cliff face of the quarry area near the south-eastern corner of the quarry; i.e. perching rocks with droppings at several sites along the quarry face. The male Peregrine Falcon perched on the cliff face and gave several alarm calls. Peregrine Falcon was not identified during the second site visit.

Visits to Raffeen Quarry were completed in February and March 2017 to determine the presence and the level of usage of the cliff face areas by Peregrine Falcon. Peregrine falcon were not observed on either date and the vertical cliff face and potential nesting ledges did not exhibit signs of usage such as droppings, staining or accumulation of nest material. Kestrel was identified hunting near the western boundary of the site in February 2017.

Populations of Peregrine Falcon have made a considerable recovery since a ban was imposed on organochlorine pesticide usage in farming activities. Analysis of the breeding distribution change map for Peregrine Falcon presents a 200% range expansion since 1968-1972 and a subsequent 40% expansion since 1988-1991 (Balmer *et al*., 2013). In Ireland, gains in Peregrine Falcon breeding distribution status are concentrated in the southwest, including hectad W76, within which the proposed M28 Road Project is located. Furthermore, winter and breeding distribution gains have been noted at sites such as quarries and man-made sites (Madden *et al*., 2009). To this end, Peregrine Falcon breeding activity at Raffeen Quarry is likely to have benefited from the breeding and wintering distribution gain in addition to the generation of suitable nesting habitat through quarrying activities at Raffeen. Peregrine Falcon is Green listed under the BoCCI indicating that it is no longer a species of conservation concern in Ireland.

12.5.5 Reptiles and Amphibians

There are three species of amphibian in Ireland, common frog (*Rana temporaria*), smooth newt (*Lissotriton vulgaris*) and the natterjack toad (*Bufo calamita*) and is protected under the Wildlife Act, 1976, as amended and European Communities (Birds And Natural Habitats) Regulations 2011 as amended. Natterjack toad only occurs in Co. Kerry and Co. Wexford. The proposed study area supports localised areas of suitable habitat for common frog and smooth newt in particular the wetland area associated with the footprint of Raffeen Quarry and localised ditches in low lying or poor draining areas. No evidence of these species was recorded during the mammal and habitat surveys completed in 2014, 2015 and 2017. The NPWS do not hold records for smooth newt from hectad W76 however the NPWS do hold numerous records for Common frog from hectad W76. As outlined, suitable habitats for common frog such as localised or small scale ponding features or drainage channels are not abundant or widespread within the study area, the majority of which comprises free draining and extensive arable and pastoral field systems and peri-urban environments with little or no permanent or ephemeral water features.

12.5.6 Service Area – Fauna Survey Findings

The existing car park area within the proposed Service Area is unsuitable to sustain faunal populations, either as a viable nesting or burrowing site or a foraging or feeding habitat for faunal species.

This adjoining area of recolonising bare ground together with its nascent cover of scrub is bordered by man-made developments on three sides and Cork Harbour to the north. Nevertheless, this area of recolonising bare ground provides suitable burrowing and nesting sites for small mammals and passerine birds in the locality.

12.5.7 Ecological Receptors

A total of twenty-two Ecological Receptors (ERs) were recorded within the study area. **Table 12.18** to **Table 12.39** provide a description and valuation of these ecological receptors. These include sites designated for nature conservation both at a National (pNHAs) and International (SACs and SPAs) level and sites supporting habitats or habitat assemblages of county and local ecological value that are not afforded legal protection. The Ecological Receptor valuation system follows the NRA Geographic Context for Determining Value set out in the *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (NRA, 2009). In the context of national road projects, ecological resources not evaluated as being of 'Local Importance (higher value)' should not be selected as 'Key Ecological Receptors' (KER), for which detailed assessment is required. A total of twenty-one Ecological Receptors were selected as KER on this basis. The distribution of ERs along the proposed M28 route and its associated ZoI are presented in **Figure 12.5**[23].

[23] Due to spatial variance, Ecological Receptors 18-22 are not displayed on **Figure 12.5**.

Figure 12.5: Ecological Receptors 1-17 within the Proposed M28 Road Project and Zone of Influence

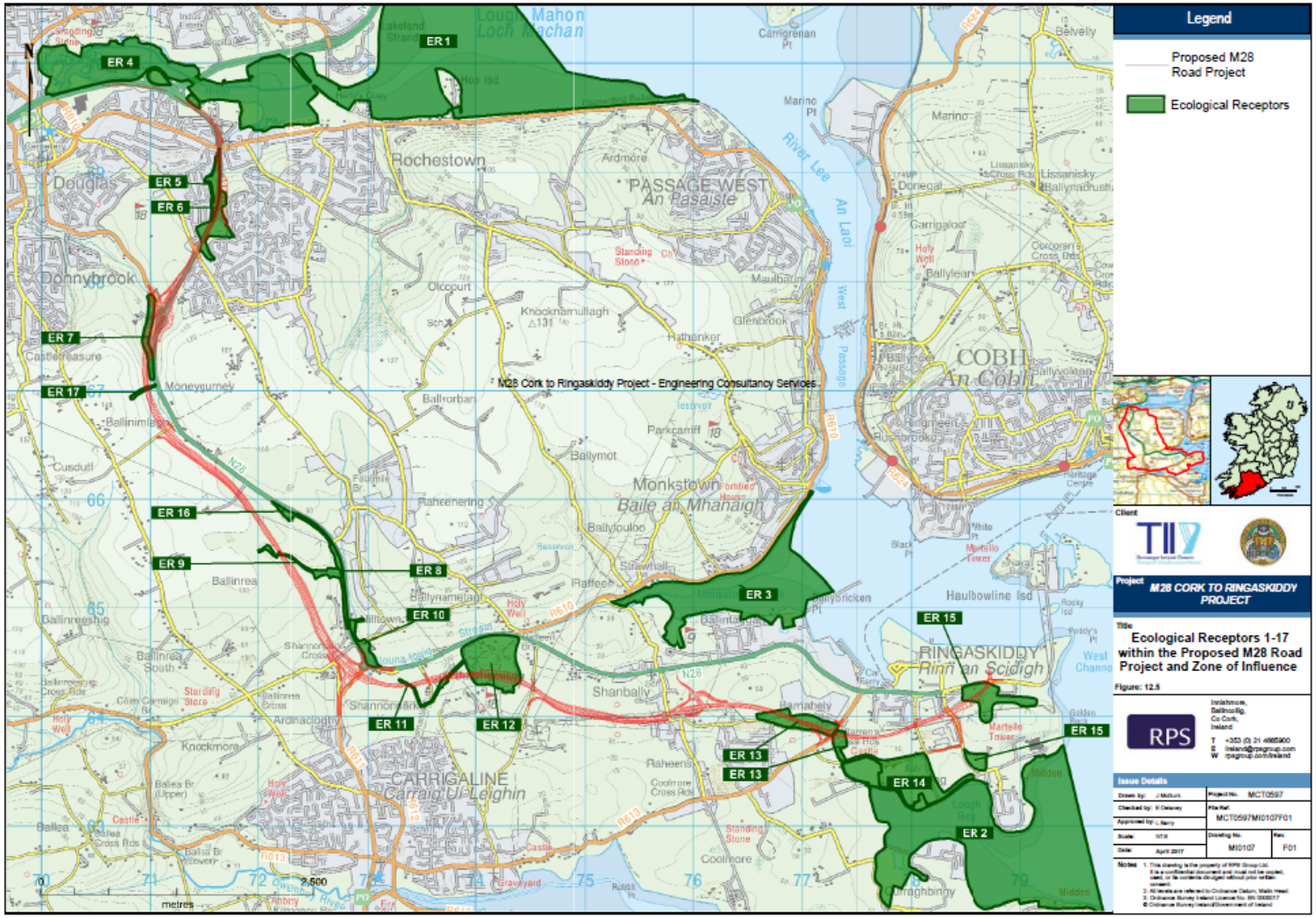


Table 12.18: Ecological Receptors along the Proposed Route and its Nearby Environs

Ecological Receptors Subject to Impacts Associated with the Proposed Road Project	Summary Descriptions of Ecological Receptors	Value of the Ecological Receptors	Selection as KERs[24]	Location within the Study Area
ER 1 - Cork Harbour SPA (Site Code 004030)[25]	Cork Harbour is of major ornithological significance, being of international importance for numbers of wintering birds. In addition, the site supports at least 18 wintering species that have populations of national importance, as well as a nationally important breeding colony of Common Tern (NPWS, 2015)[26].	This European site is considered to be of *International Importance*.	Yes	North of the proposed road project at Douglas River Estuary, via the Woodbrook and Donnybrook streams and south of the proposed road project at Lough Beg.
ER 2 - Lough Beg pNHA (Site Code 001066)	Lough Beg pNHA supports an assemblage of wetland terrestrial and intertidal habitats. The site intersects Cork Harbour SPA and its intertidal habitats such as mudflats and sandflats provide good quality feeding ground for overwintering avifauna associated with Cork Harbour SPA. The site is also likely to be of local importance for otter, a species listed on Annex II of the EU Habitats Directive. In addition this Ecological Receptor includes a coastal grazing marsh that supports an assemblage of coastal and terrestrial habitats such as wet grassland, scrub, marsh, saltmarsh, reed and large sedge swamp and tidal channels. This area is fringed by treelines, hedgerows and young broadleaved plantation woodland which are also considered to be of potential importance for bats in the locality.	This pNHA is considered to be of *National Importance*.	Yes	South of the proposed road project at Lough Beg.

[24] Ecological resources and receptors that are of Local Importance (Higher value) or greater.
[25] The open waters of Cork Harbour SPA also provide remote and tenuous connectivity between the scheme and Great Island SAC, situated 5.1km east of the project at its nearest point.
[26] National Parks and Wildlife Service (2015) Site synopsis for Cork Harbour SPA. National Parks and Wildlife Service, Dublin.

Ecological Receptors Subject to Impacts Associated with the Proposed Road Project	Summary Descriptions of Ecological Receptors	Value of the Ecological Receptors	Selection as KERs[24]	Location within the Study Area
ER 3 - Monkstown Creek pNHA (Site Code 001979)	Monkstown Creek pNHA supports an assemblage of intertidal habitats. The site intersects the bounds of Cork Harbour SPA and its intertidal habitats such as mudflats and sandflats provide good quality feeding grounds for overwintering avifauna associated with Cork Harbour SPA. The site is also likely to be of local importance for otter, a species listed on Annex II of the EU Habitats Directive.	This pNHA is considered to be of *National Importance*.	Yes	East of the proposed road project. Connectivity with the proposed road project through the Glounatouig Stream.
ER 4 – Impounded wetland adjoining Douglas River Estuary pNHA	This area directly adjoins the Douglas River Estuary pNHA and contains an impounded wetland that supports infrequently inundated sea club rush (*Bolboschoenus maritimus*), and other wetland / brackish species. The site directly abuts the Douglas Estuary a component part of the Cork Harbour SPA.	This pNHA is considered to be of *National Importance*.	Yes	Immediately north of the proposed road project.
ER 5 – Bloomfield Woods	Bloomfield Wood is a mixed broadleaved woodland (WD1). The dominant canopy species are mature beech, ash, Douglas fir, Scots pine, poplar, sycamore and oak. Other common components include hazel, hawthorn and holly. The wood supports a small stream channel (known as the Woodbrook Stream) with marginal or wet fringing channels and depressions supporting alder and grey willow. The woodland supports a relatively diverse ground layer whilst the site is also fringed by dense scrub. The site is a refuge for small mammals and woodland birds. Japanese knotweed was identified on the western margins of the woodland habitat (See **Figure 12.4**). The bat survey completed in summer of 2014 identified regular bat activity at Bloomfield Woods and its surrounding habitat assemblages.	Bloomfield Woods, the Woodbrook Stream and its riparian corridor and adjacent valley slopes are considered of *Local Importance (Higher Value)* because of the quality of the riparian fringes, woodland and scrub vegetation on the river's valley slopes. It also provides valuable connectivity, cover and refuge for a range of mammal and avifaunal species in the locality.	Yes	Immediately west of the proposed road project at Douglas.

Ecological Receptors Subject to Impacts Associated with the Proposed Road Project	Summary Descriptions of Ecological Receptors	Value of the Ecological Receptors	Selection as KERs[24]	Location within the Study Area
ER 6 – Mount Oval habitat mosaic	Mount Oval supports a habitat mosaic of mixed broadleaved woodland (WD1), scrub (WS1), semi-improved neutral grassland (GS1), grassy verge (GS2) and wet grassland (GS4). The presence of semi-natural grassland is notable for the locality and provides a valuable local resource for flora and fauna.	The scrub, woodland, grassy verge and wet grassland habitats do not support considerable ecological diversity however the small area of dry calcareous/neutral grassland (GS1) is of restricted occurrence in the locality and confers a higher conservation value to the site than would be warranted by the occurrence of the scrub alone. As a result this area is considered to be of *Local Importance (Higher Value)*.	Yes	Immediately east of Proposed M28 at Mount Oval, Douglas
ER 7 – Donnybrook Wood and Stream	The Donnybrook Wood and stream forms a valuable wildlife corridor that follows the riparian corridor of the Donnybrook Stream. This area was also noted for its potential to support routine bat and other faunal activity, including badger. Yellowhammer, a BoCCI red listed species, was also recorded in the arable fields and scrubland fringing this area.	The Donnybrook Stream and its riparian corridor and adjacent valley slopes are considered of *Local Importance (Higher Value)* because of the quality of the riparian fringes and woodland and scrub vegetation on the rivers valley slopes. The area of wet willow alder ash woodland comprises a large part of Donnybrook Wood and represents one of the few areas of contiguous and reasonably well developed semi-natural woodland habitats within the project footprint and its associated ZoI.	Yes	Intersected by the proposed road project at Carr's Hill

Ecological Receptors Subject to Impacts Associated with the Proposed Road Project	Summary Descriptions of Ecological Receptors	Value of the Ecological Receptors	Selection as KERs[24]	Location within the Study Area
ER 8 – Glounatouig Stream at Ballinrea	This area comprises an extensive linear habitat of scrub, dense bracken and riparian wet woodland habitat along the upper valley slopes of the Glounatouig Stream. This habitat assemblage is also considered to be of potential importance for bats and non-volant mammals in the locality. Yellowhammer, a BoCCI red listed species, was also recorded in the arable fields fringing this area.	The Glounatouig Stream, its riparian corridor and adjacent valley slopes are considered to be of *Local Importance (Higher Value)* because of the quality of the riparian fringes, woodland and scrub vegetation on the river valley slopes.	Yes	Intersected by the proposed road project at Ballinrea and Hilltown.
ER 9 – Glounatouig tributary	This area comprises a mosaic of mature woodland and riparian habitat along a tributary of the Glounatouig Stream including a mosaic of wet willow-alder-ash woodland in addition to ash dominated oak-ash-hazel woodland, scrub, dense bracken, treelines and hedgerows. This ER also supports an area of wet grassland and species such as Royal fern, both of which confers a high conservation status on this site.	The habitat assemblages associated with this ER are of intrinsically high conservation value both as a locus of native species assemblage and in the function of buffering areas of riparian habitat and screening proposed M28 route corridor. Therefore this site is considered to be of *Local Importance (Higher Value)*.	Yes	Ballinrea
ER 10 – Glounatouig Stream at Hilltown	This area supports woodland habitat on the valley margins of the Glounatouig Stream. In addition, well-developed treelines bordering fields to the east of the existing Shannonpark roundabout were considered to be of potential importance for bats in the local area.	The Glounatouig Stream, its riparian corridor and adjacent valley slopes are considered of *Local Importance (Higher Value)* because of the quality of the riparian fringes, woodland and scrub vegetation on the river's valley slopes.	Yes	Hilltown
ER 11 – Abandoned railway line with woodland copse, scrub and	This ER supports a linear woodland habitat overarching a now decommissioned railway embankment. To the east of the woodland, a small pond (FL8) is located in an old railway cutting. This pond is surrounded by scrub and tall emergent macrophytes. This ER supports an active badger sett within	This area is of high conservation interest because of the continuity of semi-natural habitats within this localised area. This continuity is a vital resource for local flora and fauna as a	Yes	Shannonpark/Ballyhemiken

Ecological Receptors Subject to Impacts Associated with the Proposed Road Project	Summary Descriptions of Ecological Receptors	Value of the Ecological Receptors	Selection as KERs[24]	Location within the Study Area
pond	the vegetated railway embankment.	viable refuge. This area is considered to be of *Local Importance (Higher Value)*.		
ER 12 – Raffeen Quarry	This Ecological Receptor is based around a limestone quarry (Raffeen Quarry) which is bound by vertical quarried cliff faces to the south, east and west. The quarry void supports a diverse wetland area (See **Section 12.5.1.3**). The margins of the quarry void are fringed by ruderal, semi-natural grassland (See **Section 12.5.2**) and scrub habitats that together comprise a regionally important habitat assemblage both for their botanical diversity and their cover and refuge importance for faunal species. This quarry also supports Peregrine Falcon and Kestrel, which use the exposed quarry cliff faces as a nesting area. Peregrine Falcon has been noted hunting to the east within the townland of Raffeen and onto Monkstown Creek. Scrub located along the eastern boundary of the quarry supports Yellowhammer, a red listed species on the *BoCCI* (Colhoun and Cummins, 2013). The assemblage of scrub and wetland within the quarry footprint supports Coot, Little Grebe and Moorhen. The quarry also supports pennyroyal (*Mentha pulegium*), a species protected under the Flora Protection Order, 2015. This was recorded during the site walkover surveys completed for this assessment in 2014 and 2017. The NPWS also hold records for the red listed bryophyte species *Weissia*	The assemblage of semi-natural habitats, especially the occurrence of dry calcareous/neutral grassland and wetland habitats at the site, which is very rare in the locality, confers a high conservation value to the site; i.e. this area is considered to be of *County Importance*.	Yes	Ballyhemiken/Raffeen

Ecological Receptors Subject to Impacts Associated with the Proposed Road Project	Summary Descriptions of Ecological Receptors	Value of the Ecological Receptors	Selection as KERs[24]	Location within the Study Area
	brachycarpa var. *obliqua* (Lockhart *et al*., 2012). This species is assigned a threat category of Data Deficient (DD)[27] This species was not identified during the site walkover surveys completed at Raffeen Quarry. Correspondence received from a local naturalist in 2014 included a species list of Dragonfly species recorded within the wetland habitats at Raffeen Quarry. The quarry habitat, especially the cliff faces and their associated crevices were considered to be of Moderate Suitability for bats in the locality (Collins, 2016).			
ER 13 – Barnahely and Castlewarren ruins	A series of expansive improved grassland and arable fields located between the grounds of the Novartis and the Janssen Biologics facilities are occasionally used by waders and wildfowl associated with Lough Beg during high tide. The ruins of Castlewarren support large mature trees with rotholes and crevices that are considered to be of potential importance for birds and bats in the locality.	This ER supports intermittent over-wintering bird feeding habitat, especially during or immediately following periods of high tide. The grounds of Castlewarren also provide valuable roosting habitat for bats in the locality. The site is not of very high botanical importance but is of local importance to avifauna and bats. This ER is considered to be of *Local Importance (Higher Value)*.	Yes	Glentocor/Barnahely
ER 14 – Dry calcareous and neutral grassland and	ER 14 supports dry calcareous/neutral grassland a poorly distributed habitat within the study area and its environs. It also supports mixed broadleaved woodland, comprising a young broadleaved woodland plantation.	Broadleaved woodland is likely to provide valuable cover and refuge for passerine birds and small mammals in the local landscape. Unimproved dry	Yes	Loughbeg

[27] Data Deficient (DD). A taxon is regarded as Data Deficient in Ireland if it is thought likely that future research will show that a threatened classification is appropriate and that it will be included in the Red List at some stage

Ecological Receptors Subject to Impacts Associated with the Proposed Road Project	Summary Descriptions of Ecological Receptors	Value of the Ecological Receptors	Selection as KERs[24]	Location within the Study Area
mixed broadleaved plantation woodland north of Lough Beg	This general area with its many derelict buildings, small sheltered fields and well-developed hedgerows and nearby pole stage ash plantation supports habitat assemblages of potential conservation importance for bats, birds and non-volant mammals.	calcareous and neutral grassland is not widespread within this area of Co. Cork. Given its relative botanical diversity and localised distribution it is considered to be of *Local Importance (Higher Value)*.		
ER 15 – Species rich scrub and woodland at Ringaskiddy	ER 15 supports a pocket of relatively species rich scrub, open woodland and dense bracken cover. Yellowhammer, a BoCCI red listed species, was also recorded this area. This ER was also considered to be of potential conservation importance for bats in the locality.	This area is of high conservation interest because of the continuity of semi-natural habitats within this localised area. This continuity is a vital foraging resource for local fauna as well as a refuge for various woodland flora and faunal species. As a result this area is considered to be of *Local Importance (Higher Value)*.	Yes	Ringaskiddy
ER 16 – Badger sett at Ballinrea	An area of scrub supporting numerous mammal paths and a large active sett.	Given the level of badger activity recorded and the main sett at this location it is considered that this area should be classified as *Local Importance (Higher Value)*.	Yes	Ballinrea
ER 17 - Buzzard nest within mature treeline	Buzzard nesting site within mature treeline located to the west of the N28 at Ballinimlagh townland.	This feature is considered to be of *Local Importance (Lower Value)*.	No	Ballinimlagh

Ecological Receptors Subject to Impacts Associated with the Proposed Road Project	Summary Descriptions of Ecological Receptors	Value of the Ecological Receptors	Selection as KERs[24]	Location within the Study Area
ER 18 - Annex II species (EU Habitats Directive) and Annex I species (EU Birds Directive)	Species listed on Annex II of the EU Habitats Directive – Otter[28] Species listed on Annex I of the Birds Directive identified within the 10km Grid Square W76 are presented in **Table 12.9.** With the exception of Peregrine Falcon and Kingfisher[29], these species are primarily associated with coastal areas of hectad W76. Some of the Annex I species are Species of Conservation Interest for Cork Harbour SPA such as Dunlin, Common Tern, Bar-tailed Godwit and Golden Plover.	All of these species are protected under EU law and are considered to be of International Importance.	Yes	Otter - Douglas Estuary and possible in areas proximal to Lough Beg and Monkstown Creek. Peregrine at Raffeen / Ballyhemiken Quarry Annex I Bird Species identified– Throughout W76.
ER 19 - Faunal species protected under the Irish Wildlife Acts	Species protected under Schedule 5 Wildlife Act 1976 (as amended) and occurring or potentially occurring within the proposed road project include badger, Bat species, Irish hare, hedgehog, pygmy shrew, otter, common frog, smooth newt and Irish stoat.	All of these species are protected under Irish Law and are considered to be of National Importance.	Yes	Throughout the route.
ER 20 - Flora Protection Order (FPO Species)	Species protected under the Flora Protection Order, 2015 previously recorded in hectad W76 include meadow barley, weasel's snout and pennyroyal. Therefore this ER has been subdivided to adequately assess each species separately.	All of these species are protected under Irish Law. Where they occur they are considered to be of National Importance.	Yes	Pennyroyal was identified within the footprint of Raffeen Quarry and within a materials holding area at Shanbally. No other FPO species have been identified within the proposed road project footprint or it's ZoI.
	Meadow barley – the NPWS support historical records (1845) for this species from the River Douglas. This species was not identified during the site walkover surveys completed for the			

[28] Species listed on Annex II of the EU Habitats Directive considered to potentially occur within the proposed scheme's zone of influence.
[29] Peregrine Falcon has been identified within Raffeen Quarry. Kingfisher is a bird of riparian habitat that supports vertical clay banks that serve as viable breeding sites. Watercourses draining the study area do not support suitable Kingfisher habitat; i.e. they are fast flowing and do not support vertical clay banks or similar that would serve as breeding habitats.

Ecological Receptors Subject to Impacts Associated with the Proposed Road Project	Summary Descriptions of Ecological Receptors	Value of the Ecological Receptors	Selection as KERs[24]	Location within the Study Area
	project.			
	Weasel's snout – the NPWS supports historic records for this species from Monkstown (1819) and Carrigaline Castle (1845). This species was not identified during the site walkover surveys completed for the project.			
	Pennyroyal – The NPWS support historical records for this species from the Great Island / Belvelly area (1850). This species occurs within Raffeen Quarry and within an area of recolonising bare ground previously utilised as a materials holding area at Shanbally.			
ER 21 - Avifauna listed on red and amber lists of BoCCI (Colhoun and Cummins, 2013)	Red and amber listed species on BoCCI identified in 10km grid square W76 (See **Table 12.9**).	These species are considered to be of conservation concern in Ireland and are consequently of National Importance.	Yes	Some of the Red and amber listed species identified in **Table 12.9** have been identified within the footprint and environs of the proposed road project.
ER 22 - Hedgerows and treeline network	▪ General floristic value, ▪ Bird nesting and foraging potential, ▪ Intrinsic value as wildlife corridors, and ▪ Value as foraging and navigational routes for bats.	*Local Importance (Higher Value).*	Yes	Located throughout the study area.

12.6 POTENTIAL IMPACTS

The impacts of the proposed M28 Road Project are considered in this section. The criteria for assessing impact significance are based on the NRA *Guidelines for Assessment of Ecological Impacts of National Road Scheme* (2009) and the CIEEM Guidelines for Ecological Impact Assessment in the UK and Ireland Terrestrial, Freshwater and Coastal, (2016). Impact significance is attributed at a defined geographic frame of reference as defined in **Table 12.1** (see **Section 12.2.4**).

This impact assessment investigates the impacts of the proposed M28 Road Project on the terrestrial habitats and species within the development footprint and it's ZoI.

The proposed M28 Road Project will pass through or supports connectivity to twenty-two KERs. This section will draw attention to potential impacts to these ecological features and their component habitats, species and general ecological features.

Chapters 3 Description of the Proposed Road Development of this EIS provides further details on the description of the proposed M28 Road Project.

12.6.1 Construction Phase

The key construction activities likely to give rise to ecological impacts are set out in **Table 12.19** below.

Table 12.19: Construction Stage Impacts

Construction Activity	Potential Ecological Impacts
Vegetation and soil stripping	The habitats within the study area comprises a mosaic of terrestrial and aquatic habitats including streams and drains, agricultural grassland, arable crops, semi-natural grassland, marsh, woodlands, and coastal habitats. Vegetation and soil stripping during site clearance will result in the loss of habitat; loss of habitat supporting protected species; destruction of bird nesting sites, bat roosts, badger setts and other mammal burrows; e.g. dens, warrens, etc. Vegetation and soil stripping could also influence the spread of invasive and noxious weeds species currently present within and adjacent to the proposed M28 corridor. Vegetation and soil stripping could also result in the loss of residential seed banks within the soil supporting semi-natural habitats, especially semi-natural grassland habitats. Soil stripping can also result in the loss of soil mycorrhizae, soil profile layers and structure. During periods of heavy rainfall silt laden surface waters from exposed soils can enter watercourses.
Woodland (including linear woodland) and scrub removal	Site clearance will result in the loss of woodland and scrub habitats from the proposed road project footprint and their immediate environs.
Other earthworks	Loss of habitat (e.g. improved grassland, arable crops, woodlands, hedgerows and treelines), potential pollution of watercourse and/or loss of habitats and species as a result of deposition of materials, and spread of invasive species.
Blasting and other excavations causing high levels of noise and vibration	Blasting of rock can cause disturbance of animals, especially significant during breeding season; destruction of badger setts, otter holts and bird nesting sites in the extended area due to the high level of vibration.

Construction Activity	Potential Ecological Impacts
	Blasting, excavations and other activities resulting in high levels of noise and vibration may result in the avoidance of the local area by faunal species during and immediately following blasting events. Drilling and blasting is proposed at a number of sites along the route. Detonation of explosives in or adjacent to watercourses may cause disturbance and injury to aquatic species and/or the harmful alteration, disruption or destruction of their habitats.
Quarrying	In the event that aggregate materials are extracted from the existing quarry at Raffeen to facilitate the proposed M28 road project, there is potential for indirect and cumulative impacts to sensitive receptors within Raffeen Quarry. This may include the loss and disturbance of habitat comprising recolonising bare ground (which supports the protected plant species *Mentha pulegium*), scrub and semi-natural grassland, in addition to the disturbance of faunal species associated with the quarry.
Construction of structures and hard surfaces	Loss of habitat; creation of an impermeable layer which will alter drainage patterns in the immediate vicinity and may lead to flooding. (Surface water and ground water impacts are discussed in **Chapter 11: Soils, Geology and Hydrogeology** and **Chapter 9: Hydrology and Drainage**).
Construction of barriers to wildlife movements such as berms, fences and median barriers	Impede access to or movement within wildlife territories.
Construction site drainage	Run-off of pollutants may have an indirect impact on habitats and species, especially those which are water-dependent. (Surface water and ground water impacts are discussed in **Chapter 11: Soils, Geology and Hydrogeology** and **Chapter 9: Hydrology and Drainage**).
Demolition operations	Loss of potential bat roosts or bird nests situated within buildings along the roadway footprint.
Air pollution and dust deposition	Localised air pollution and dust deposition may have a negative effect on any habitats or species of conservation value in the area. The principal pollutants of concern which originate from road developments are the nitrogen oxides (NOx), in terms of impact on sensitive ecosystems. Nitrogen oxides (NOx) may have a positive or negative impact by acting as a fertiliser or a phytotoxicant. Effects are mainly on vegetation growth, photosynthesis, and nitrogen assimilation/metabolism. The predicted nitrogen deposition levels as a result of the proposed M28 Road Project indicate levels of approximately 1.75 kg (N)/ha/year and show a slight decrease from the predicted deposition levels from the existing N28 alignment. (Air Pollution and Dust Deposition levels are assessed in **Chapter 13: Air & Climatic Factors**).
Work associated with site compounds and storage areas	Site compounds and storage areas used during the construction may lead to loss of, or damage to, habitats outside the land-take. However, the site compound proposed for the scheme will straddle areas of arable ground, improved grassland and a small section of species poor scrub. Impacts will result in the loss of these habitats of low ecological importance during the project's construction phase.
Temporary access routes and crossings	Access routes used during construction works may lead to loss or damage to habitats inside and outside the land-take.
Lighting	Lighting used during night working at the construction stage may cause disturbance to bats and other foraging mammals in the area such as otter and badger. Public lighting for the proposed M28's operational phase is discussed in **Chapter 3: Description of the Proposed Road Development**.

Construction Activity	Potential Ecological Impacts
	Artificial lighting can affect emergence and foraging regimes in addition to prey abundance/availability for bats. It can also affect greater predation rates for small mammals and avifauna.
Movement of plant and vehicles	Potential to cause disturbance to wildlife through noise and vibration pollution in addition to the destruction of habitats or species of conservation value especially where plant machinery is utilised to traverse watercourses.
Disturbance associated with the presence of construction staff	A general increase in human activity in the area may cause disturbance to wildlife.
New planting	Poor choice of species or locations for planting as part of landscape design and execution of landscaping works, e.g. planting of non-native, foreign provenance and or/invasive species or planting of trees/shrubs etc. in an environmentally sensitive area may lead to habitat damage or destruction. (Proposed landscaping is discussed in **Chapter 16: Landscape and Visual**).
Environmental incidents and accidents	A major environmental accident e.g. a large scale spillage of a contaminant such as diesel or cement which would have major negative and far-reaching impacts, especially on the aquatic environment. (Assessed in **Chapter 9 Hydrology and Drainage** & **Chapter 10 Aquatic Ecology:** of this EIS).

Linear woodland habitats located within the footprint of the proposed M28 Road Project are presented in **Figure 12.6** below.

Figure 12.6: Hedgerows and Treelines within the Footprint of the Proposed M28 Road Project

12.6.2 Operational Phase

Potential operational impacts include:-

- Physical presence of the new carriageway and the proposed SA and their potential to inhibit movement of wildlife in the realigned sections; i.e. fragmentation of habitat complexes and their respective species, increase in light levels within the proposed development area;
- Hydrological impact through discharge or road run-off and embankment loading;
- Management of the soft estate areas within the CPO line apart from the built/hard surfaces associated with the proposed road project and associated activities including ditch clearance, strimming and mowing;
- Disturbance of the soft estate through management or improvements associated with road safety strategies, including the provision of signage or lighting as well as ancillary equipment or services;
- Traffic related animal mortality; collisions, fragmentation of commuting routes, etc.; and
- Change in air quality resulting in increased nitrogen loading to natural and semi-natural ecosystems (See **Chapter 13: Air and Climatic Factors**).

12.6.3 Impacts on Key Ecological Receptors

The proposed road project and its environs comprise a mosaic of terrestrial and aquatic habitats, including woodlands, scrub, semi-natural grassland communities, streams, coastal habitats, improved agricultural grassland, arable crops, exposed rock and disturbed ground, amenity grassland and the existing road and roadside developments. Correspondence of habitats within the footprint and ZoI of the proposed Road Project to habitats listed on Annex I of the EU Habitats Directive 92/42/EC are addressed in **Section 12.5.2**.

Saltmarsh and littoral sediment habitats have also been identified within the proposed road project's ZoI and correspond to habitats listed on Annex I of the EU Habitats Directive. These habitats are associated with sites designated for nature conservation, predominantly Cork Harbour SPA.

The most significant loss and impact to habitats will be during the construction phase of the proposed road project. This will also have direct impacts on the species diversity and loss of feeding habitat for local animal populations. The ZoI in ecological terms extends beyond the footprint of the road, particularly in relation to water dependant habitats and over-wintering bird feeding habitats, such as the study areas watercourses. Impacts to watercourses and waterbodies within the proposed Road Project's ZoI are considered in greater detail under **Chapter: 10 Aquatic Ecology.**

In summary, there are twenty-two ERs potentially affected by the proposed Road Project. The significance of these impacts during the construction and operational phases, are set out in **Table 12.20** to **Table 12.39**. Each of the KERs is assessed in terms of impacts upon the principal elements of ecological value within the site.

Table 12.20: Characterisation of Potential Impacts to Cork Harbour SPA (ER 1) and Determination of Significance of Impacts

ER 1: Cork Harbour SPA[30]	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct impacts	None of the lands designated as part of Cork Harbour SPA will be directly impacted or removed as a result of the proposed project. The proposed road project is connected to Cork Harbour SPA via three watercourses draining the study area; i.e., the Woodbrook, Donnybrook and the Glounatouig streams.	The findings of the over-wintering surveys completed in 2014/2015 and 2015/2016 found that the field feeding areas located to the north of Lough Beg do not support significant numbers of regularly occurring SCI species for Cork Harbour SPA. These studies confirmed that there will be no loss of primary feeding habitat in areas proximal to Lough Beg. In addition, the findings of these surveys confirmed that the proposed development will not result in fragmentation of feeding sites or disturbance impacts to adjacent or nearby habitats associated with Lough Beg and Cork Harbour SPA.	This ER is considered to be of *International Importance*. None of the qualifying species of Cork Harbour SPA will be directly impacted by the proposed road project. Indirect disturbance or displacement to avifauna utilising pastoral lands to the north of Lough Beg are not considered significant in the context of Cork Harbour SPA. Occurrences of over-wintering avifauna in these areas are intermittent and numbers using these fields are not significant in the context of over-wintering avifaunal populations for Cork Harbour SPA. Feeding avifauna displaced by the proposed scheme will be able to relocate to proximal improved grassland habitats that offer similar field feeding opportunities, such as ground suitability, prey abundance, sightlines etc. As a result, the displacement of intermittently occurring avifauna is not considered significant in terms of the over-wintering population associated with Cork Harbour SPA.
Indirect impacts to this ER and its component habitats and	Temporary intermittent disturbance of avifauna feeding in pastoral and arable fields north of Lough Beg, causing them to abandon their habitat. Such disturbance events can result from	Potential impacts in the absence of mitigation include the deterioration in water quality of the proposed route's receiving streams resulting in indirect impacts to those	In the absence of mitigation, the deterioration of water quality entering Cork Harbour SPA will lead to indirect effects to feeding habitats at receiving areas such as Lough Beg and the Douglas River

[30] The open waters of Cork Harbour SPA provide remote and tenuous connectivity between the scheme and Great Island Channel SAC, situated 5.1km east of the project at its nearest point. To this end proposed construction and operational phase impacts associated with the project could also potentially impact upon the receiving Annex I habitats for which the Great Island Channel is designated.

ER 1: Cork Harbour SPA[30]	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
species	the increased noise and human activity levels associated with heavy machinery and the construction works. These disturbance events will be localised and are not significant in terms of species populations associated with Cork Harbour SPA. Studies completed across two over-wintering seasons confirmed that these grassland areas are not routinely used as a feeding habitat for species associated with Cork Harbour SPA. In addition, these studies concluded that there is, effectively, an unlimited supply of potentially suitable habitat in the vicinity of Lough Beg, although there may be variations in habitat quality. Therefore, in general, it is very likely that birds displaced by loss of grassland habitat will be able to find suitable alternative habitat. The alternative habitat may not be of as high quality as the habitat that they were displaced from, but would still be likely to be capable of supporting the displaced birds. There will be no fragmenting of bird feeding or roosting habitat associated with those Conservation Interests of Cork Harbour SPA.	downstream areas of Monkstown Creek and the River Douglas Estuary, both of which are designated as part of Cork Harbour SPA.	Estuary. Such impacts will result in knock on effects for species associated with these areas of Cork Harbour SPA. In the absence of mitigation, this is considered to be **Significant Negative at a Local Scale**.

Table 12.21: Characterisation of Potential Impacts to Lough Beg pNHA (ER 2) and Determination of Significance of Impacts

ER 2: Lough Beg pNHA	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct impacts	The lands designated as part of Lough Beg pNHA will not be directly impacted or removed as a result of the proposed road project.	The lands designated as part of Lough Beg pNHA will not be directly impacted or removed as a result of the proposed road project.	This ER is considered to be of *National Importance*. None of the qualifying habitats or species of Lough Beg pNHA will be directly impacted by the proposed Road Project – '**Not Significant**'.
Indirect impacts to this ER and its component habitats and species	Temporary disturbance of avifauna using the Lough Beg area may result from the increased noise and human activity levels associated with heavy machinery and the construction works.	There will be no indirect impacts to lands designated as part of Lough Beg pNHA during the proposed M28 Road Project's operational phase.	There will be a slight impact to these species in the form of temporary and sporadic disturbance during construction works, but this is not considered to be significant, even on a local level – '**Not Significant'**.

Table 12.22: Characterisation of Potential Impacts to Monkstown Creek pNHA (ER 3) and Determination of Significance of Impacts

ER 3: Monkstown Creek pNHA	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct impacts	The lands designated as part of Monkstown Creek pNHA will not be directly impacted or removed during the proposed M28 Road Project's construction phase.	The lands designated as part of Monkstown Creek pNHA will not be directly impacted or removed during the proposed M28' Road Project's operational phase.	This ER is considered to be of *National Importance*. None of the key ecological features of Monkstown Creek pNHA will be directly impacted by the proposed road project. In the absence of mitigation, indirect impacts on those habitats and species comprising Monkstown Creek pNHA could occur through the deterioration of waters within the Glounatouig Stream resulting in consequent impacts to the receiving flora and fauna of Monkstown Creek. Such impacts are considered to be **Significant Negative at a Local Scale**.
Indirect Impacts to this ER and its component habitats and species	Temporary disturbance of avifauna using Monkstown Creek may result from the increased noise and human activity levels associated with heavy machinery and construction works. Un-attenuated construction phase pollutants entering the Glounatouig Stream reaching Monkstown Creek pNHA.	As outlined, Monkstown Creek supports connectivity to the proposed road project through the Glounatouig Stream. Impacts to the water quality of the Glounatouig Stream during the operational phase (run-off of hydro-carbons, particulate matter etc.) could impact those habitats and species associated with Monkstown Creek pNHA.	

Table 12.23: Characterisation of Potential Impacts to Impounded Wetland Adjoining Douglas River Estuary pNHA (ER 4) and Determination of Significance of Impacts

ER 4: Douglas River Estuary pNHA	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct impacts	The lands designated as part of the Douglas River Estuary pNHA will not be directly impacted or removed as a result of the proposed works.	The lands designated as part of the Douglas River Estuary pNHA will not be directly impacted or removed as a result of the proposed works.	This ER is considered to be of *National Importance*. In the absence of mitigation, indirect impacts on those habitats and species comprising Douglas River Estuary pNHA could occur through the deterioration of water quality within the Donnybrook and Woodbrook streams resulting in consequent impacts to this ER's receiving flora and fauna. In addition, avifauna associated with the Douglas River Estuary could experience sporadic and temporary disturbance during the construction phase. Such impacts are considered to be **Significant Negative at a Local Scale**.
Indirect Impacts to this ER and its component habitats and species	Temporary disturbance of avifauna, potentially causing them to abandon their habitat, can result from increased noise and human activity levels associated with heavy machinery and the construction works. Potential impacts to water quality of those watercourses forming connectivity to the River Douglas Estuary pNHA.	As outlined, the River Douglas Estuary supports connectivity to the proposed M28 Road Project through the Woodbrook and Donnybrook streams. Impacts to the water quality of these streams during the operational phase (run-off of hydro-carbons, particulate matter etc.) could impact those habitats and species associated with Monkstown Creek pNHA.	

Table 12.24: Characterisation of Potential Impacts to Bloomfield Woods (ER 5) and Determination of Significance of Impacts

ER 5: Bloomfield Woods	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct impacts	There will partial land-take and associated habitat removal and disturbance to Bloomfield Woods during the construction phase. Direct impacts could also include direct collision of fauna such as bats with construction machinery; especially should night-time works be conducted. There is also potential impact to the water quality of the Woodbrook Stream which flows through the study area.	There are no direct impacts expected to this ER during the operational stage.	This ER is considered to be of *Local Importance (Higher Value)*. Though Bloomfield Woods is not a semi-natural woodland habitat, both the woodland and the Woodbrook Stream play an important role in acting as 'ecological corridors' and navigational/foraging routes for bats, avifauna and non-volant fauna in the locality. Impacts to this ER during the construction and operational phase will be '**Significant Negative at a Local Scale**' in the absence of avoidance and mitigation measures.
Indirect Impacts to this ER and its component habitats and species	Indirect impacts to this ER reside in potential impacts to the Woodbrook Stream through run-off of construction associated pollutants; i.e. sediments, wet concrete, hydrocarbons etc. In addition there may be disturbance of those habitats (outside of the projects LMA) during the construction phase. Indirect disturbance effects to mammals such as bats within Bloomfield Woods and its environs. Associated disturbance or disruption factors include potential wind blow and root compaction of trees and shrubs adjoining the proposed M28 Road Project alignment.	Indirect impacts associated with the proposed operational phase include run-off of unattenuated hydrocarbons, particulate matter and other road run-off to the Woodbrook Stream. Indirect impacts during the M28's operational phase include impact collision and mortality of fauna in the immediate environs in addition to disturbance to bats associated with lighting design proposed for the road project.	

Table 12.25: Characterisation of Potential Impacts to Mount Oval habitat mosaic (ER 6) and Determination of Significance of Impacts

ER 6: Mount Oval habitat mosaic	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct impacts	There will partial land-take and associated habitat removal, disturbance and partial fragmentation to those habitats comprising Mount Oval during the construction phase.	There are no direct impacts expected to this ER during the operational stage.	This ER is considered to be of *Local Importance (Higher Value)*. The habitats comprising this ER play an important role in acting as 'ecological corridors' and navigational/foraging routes for bats, avifauna and non-volant fauna in the locality. Impacts to this ER during the construction and operational phase will be **'Significant Negative at a Local Scale'** in the absence of avoidance and mitigation measures.
Indirect Impacts to this ER and its component habitats and species	Disturbance and disruption of habitats associated with construction activities.	Alteration of existing drainage regimes associated with this area.	

Table 12.26: Characterisation of Potential Impacts to Impounded wetland adjoining Donnybrook Wood and Stream (ER 7) and Determination of Significance of Impacts

ER 7: Donnybrook Wood and stream	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct impacts	There will partial land-take and associated habitat removal, fragmentation and disturbance to those habitats comprising this ER during and following the construction phase. Direct impacts could also include direct collision of fauna such as bats and badgers with construction machinery; especially should night-time works be conducted.	There will be no direct impacts to this ER during the operational phase.	This ER is considered to be of *Local Importance (Higher Value)*. Both the semi-natural woodland and the Donnybrook Stream play an important role in acting as 'ecological corridors' and navigational/foraging routes for bats, avifauna and non-volant fauna in the locality. Impacts to this ER during the construction and operational phase will be '**Significant Negative at a Local Scale**' in the absence of avoidance and mitigation measures.
Indirect Impacts to this ER and its component habitats and species	There will be no indirect impacts to this ER or its component terrestrial habitats. Indirect impacts to this ER reside in potential impacts to the Donnybrook Stream through run-off of construction	Indirect impacts associated with the proposed operational phase include run-off of unattenuated hydrocarbons and particulate matter to the Donnybrook Stream.	

ER 7: Donnybrook Wood and stream	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
	associated pollutants; i.e., sediments, wet concrete, hydrocarbons etc. Associated disturbance or disruption factors to woodland habitats fringing the Donnybrook Stream may include potential wind blow and root compaction of trees and shrubs adjoining the proposed M28 Road Project' alignment.	Road drainage may alter the local hydrological regime leading to drying out of adjacent wetland cover and scrub.	

Table 12.27: Characterisation of Potential Impacts to Glounatouig Stream at Ballinrea (ER 8), Glounatouig Tributary (ER 9) and the Glounatouig Stream at Hilltown (ER 10) and Determination of Significance of Impacts

ER8-10: Glounatouig Stream at Ballinrea (ER 8), Glounatouig tributary (ER 9) and the Glounatouig Stream and Hilltown (ER 10)	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct impacts	There will partial land-take and associated habitat removal, disturbance and fragmentation to those habitats comprising these ERs during the construction phase. Direct impacts could also include direct collision with fauna (badgers, fox, rabbit and bats) with construction machinery; especially should night-time works be conducted. Run-off of deleterious construction phase pollutants, such as sediments, wet concrete and hydrocarbons associated to the Glounatouig Stream and its tributaries.	There are no direct impacts to the Glounatouig Stream. These ERs support consistent badger activity. As a result, there is the potential for direct impacts during the M28's operational phase including impact collision and mortality of badger populations in the locality.	These ERs are considered to be of *Local Importance (Higher Value)*. The assemblage of semi-natural woodland and scrub cover and the Glounatouig Stream play an important role in acting as 'ecological corridors' and navigational/foraging routes for bats, avifauna and non-volant fauna in the locality. Impacts to these ERs during the construction and operational phase will be '**Significant Negative at a Local Scale'** in the absence of avoidance and mitigation measures.

ER8-10: Glounatouig Stream at Ballinrea (ER 8), Glounatouig tributary (ER 9) and the Glounatouig Stream and Hilltown (ER 10)	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Indirect Impacts to ERs and its component habitats and species	Indirect impacts to these ERs reside in potential impacts to the Glounatouig Stream through run-off of construction associated pollutants; i.e. sediments, wet concrete, hydrocarbons etc. There will also be potential disturbance and displacement impacts to fauna associated with these ERs during the projects construction phase.	Indirect impacts associated with the proposed operational phase include run-off of unattenuated hydrocarbons and particulate matter from the operational M28 to the Glounatouig Stream. In addition, indirect impacts associated with the proposed operational phase will include barrier effects and the loss of badger foraging and commuting routes. The loss and disruption of such features could result in increases in badger collision and road mortality along the proposed M28 Road Project.	

Table 12.28: Characterisation of Potential Impacts to Abandoned Railway Line with Woodland Copse and Scrub (ER 11) and Determination of Significance of Impacts

ER 11: Abandoned railway line with woodland copse, scrub and pond	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct impacts	There will partial land-take and associated habitat removal, fragmentation and disturbance to those habitats comprising this ER during the construction phase. There is also the potential for direct collision, disturbance or removal of badger setts and badger foraging territory/commuting routes.	Direct impacts associated with the projects operational phase include impact collision and mortality of badger populations associated with this route.	This ER is considered to be of *Local Importance (Higher Value)*. Woodland and scrub cover plays an important role in acting as 'ecological corridors' and navigational/foraging routes for bats, avifauna and non-volant fauna (such as badger) in the locality. Impacts to this ER during the construction and operational phase will be '**Significant Negative at a Local Scale**' in the absence of avoidance and mitigation measures.
Indirect Impacts to this ER and its component habitats and species	Indirect impacts to this ER reside in potential disturbance and barrier impacts to mammals within the locality, especially the badger population associated with this ER.	Indirect impacts associated with the proposed operational phase will include barrier effects and the loss of badger foraging and commuting routes. The loss and disruption of such features could result in increases in badger collision and road mortality within the proposed M28 Road Project. Road drainage may alter the local hydrological regime leading to drying out of in-situ ephemeral wetland / pond.	

Table 12.29: Characterisation of Potential Impacts to Raffeen Quarry (ER 12) and Determination of Significance of Impacts

ER 12: Raffeen Quarry	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct impacts	There will be land-take and associated habitat removal, fragmentation and disturbance to those semi-natural habitats comprising this ER during the construction phase; i.e., exposed calcareous rock (ER2), dry calcareous and neutral grassland (GS2), scrub (WS1) and other artificial lakes and ponds (FL8), recolonising bare ground (ED3) supporting Pennyroyal and associated wetland species such as dragonflies and damselflies. The construction phase will also result in the removal of faunal nesting and burrowing habitat including suitable Peregrine Falcon eyrie habitat within the footprint and immediately south of the route. Direct impacts could also include direct collision of faunal species with construction machinery; especially should night-time works be conducted.	There will be no direct impacts to this Ecological Receptor during the operational phase.	This ER is considered to be of *County Importance*. Impacts to this ER during the construction and operational phase will be '**Significant Negative at the County Level**' in the absence of avoidance and mitigation measures. Cross reference to ER 18 for impacts to Peregrine Falcon.
Indirect Impacts to this ER and its component habitats and species	Indirect impacts to this ER reside in disturbance or disruption of semi-natural habitats and species associated with this ER located outside of the footprint of the proposed M28 Road Project to include pennyroyal semi-natural habitats.	Indirect impacts during the projects operational phase include ongoing disturbance and avoidance of this area by faunal species in the locality. Should Peregrine Falcon remain within the environs during the operational phase, there remains a potential collision risk to Peregrine Falcon given the proposed alignments proximity to suitable nesting / eyrie sites. The operational phase of the proposed M28 could result in indirect impacts to	

ER 12: Raffeen Quarry	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
		proximal sensitive ecosystems such as other artificial lakes and ponds (FL8) and dry calcareous and neutral grassland (GS1) in the form of Nitrogen Oxide (NOx) deposition. Impacts associated with NOx deposition can result in the eutrophication of semi-natural habitats resulting in the loss of habitat diversity due to the proliferation of species that thrive in enriched soils such as stout tussocky grasses and mono-dominant stands of wetland vegetation. The proliferation and dominance of species within a habitat, to the reduction of another species will result in a decrease in plant species diversity within the effected habitat. Effects of NOx on sensitive ecosystems, such as European sites and semi-natural habitats are considered in **Chapter 13: Air and Climatic Factors** and the accompanying **Natura Impact Statement**. Road drainage may alter the local hydrological regime leading to drying out of adjacent wetland habitat.	

Table 12.30: Characterisation of Potential Impacts to Barnahely and Castlewarren ruins (ER 13) and Determination of Significance of Impacts

ER 13: Barnahely and Castlewarren ruins	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct impacts	There will be partial land-take and associated habitat removal and disturbance to those pastoral habitats and field boundaries comprising this ER during the construction phase. Removal of potential foraging and feeding habitat for avifauna and bats.	Direct impacts during the project's operation phase will include habitat fragmentation for local species of flora and fauna using this ER.	This ER is considered to be of *Local Importance (Higher Value)*. The ruins of Castlewarren, in addition to the areas adjoining network of stone walls, treeline and hedgerows provide 'ecological corridors' and navigational/foraging routes for bats, passerine avifauna and non-volant fauna (such as badger) in the locality. Impacts to the expansive pastoral fields associated with this ER during the construction phase will be '**Significant Negative at a Local Scale**' in the absence of avoidance and mitigation measures.
Indirect Impacts to this ER and its component habitats and species	Indirect impacts may include disturbance to faunal species that utilise these areas for foraging and feeding purposes.	Indirect impacts during the project's operational phase include ongoing disturbance and avoidance of this area by faunal species in the locality.	

Table 12.31: Characterisation of Potential Impacts to Dry calcareous grassland and mixed broadleaved woodland north of Lough Beg (ER 14) and Determination of Significance of Impacts

ER 14: Dry calcareous grassland and mixed broadleaved woodland north of Lough Beg	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct impacts	There will be no direct impacts to this ER during the construction phase.	There will be no direct impacts to this ER during the operational phase.	This ER is considered to be of *Local Importance (Higher Value)*. There will be **no impacts** to this ER (direct or indirect), even in the absence of best practice measures.
Indirect Impacts to this ER and its component habitats and species	There will be no indirect impacts to this ER during the construction phase.	There will be no indirect impacts to this ER during the operational phase.	

Table 12.32: Characterisation of Potential Impacts to species rich scrub at Ringaskiddy (ER 15) and Determination of Significance of Impacts

ER 15: Species rich scrub and woodland at Ringaskiddy	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct Impacts	There will be direct land-take, habitat loss, disturbance and consequent fragmentation associated with site clearance works to this ER during the construction phase. There is also the potential for direct collision, disturbance or removal of badger setts and badger foraging territory/commuting routes. Direct impacts could also include direct collision of faunal species (badger, fox, rabbit and bat species) with construction machinery; especially should night-time works be conducted.	Direct impacts during the project's operational phase could include direct collision and mortality of fauna associated with this ER.	This ER is considered to be of *Local Importance (Higher Value)*. Impacts to this ER during the construction and operational phase will be '**Significant Negative at a Local Scale**' in the absence of avoidance and mitigation measures.
Indirect Impacts to this ER and its component habitats and species	There may be indirect disturbance to faunal species and habitats associated with this ER during the construction phase. Such disturbance events could lead to fauna avoiding this ER throughout the projects construction phase.	Indirect impacts to this ER associated with the proposed M28 include fragmentation of the surrounding landscape, inhibiting commuting and foraging routes for bats and avifauna. The loss and disruption of such features could result in increases in badger collision and road mortality within the proposed M28 Road Project.	

Table 12.33: Characterisation of Potential Impacts to Badger sett at Ballinrea (ER 16) and Determination of Significance of Impacts

ER 16: Badger Setts within Connecting Hedgerows and Treelines at Ballinrea	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct Impacts	Potential direct impacts could include direct collision with construction machinery; especially should night-time works be conducted. Construction phase impacts could also include land-take in addition to habitat removal, disturbance and fragmentation of the areas semi-natural habitats and their component badger setts during the construction phase.	Potential disturbance to faunal commuting and foraging routes. Reduction in foraging and breeding ranges within the environs of the proposed road project.	This ER is considered to be of *Local Importance (Higher Value)*. Impacts to this ER during the construction and operational phase will be '**Significant Negative at a Local Scale**' in the absence of avoidance and mitigation measures.
Indirect Impacts to this ER and its component habitats and species	Indirect impacts during the construction phase may include temporary disturbance associated with proximal and sustained construction activity, causing badgers to abandon their setts. Other indirect impacts include fragmentation of the localised landscape during the construction phase thereby restricting suitable foraging habitat in the locality.	Indirect impacts to this ER during the operational phase include fragmentation of the localised landscape and the subsequent restriction in foraging and breeding activities. Such foraging efforts may result in badger entering the M28 mainline, thus resulting in further collision and mortality of badger populations.	

Table 12.34: Characterisation of Potential Impacts to Buzzard Nest within Mature Treeline (ER 17) and Determination of Significance of Impacts

ER 17: Buzzard Nest within Mature Treeline	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct Impacts	Potential direct impacts include the removal and disturbance of treeline which is a nesting and foraging habitat for Buzzard in this area.	There will be no direct impacts to this ER during the operational phase.	This ER is considered to be of *Local Importance (Lower Value)*. Impacts to this ER are considered to be '**Significant Negative at the Receptor Level**'; i.e. the Buzzard population associated with this ER.
Indirect Impacts	Indirect impacts during the construction phase may include temporary disturbance associated with proximal and sustained construction activity, causing Buzzards to abandon this area. Other indirect impacts include fragmentation of the localised landscape during the construction phase thereby restricting suitable foraging habitat in the locality.	Indirect impacts to this ER during the operational phase include fragmentation of the localised landscape and the subsequent restriction in foraging activities. Proximity of the proposed road project and associated increases in traffic noise in this area may also result in disturbance or avoidance of this area as a future breeding habitat for Buzzard.	

Table 12.35: Characterisation of Potential Impacts to Species listed on Annex II of the EU Habitats Directive and Annex I of the EU Birds Directive (ER 18) and Determination of Significance of Impacts

ER 18: Species listed on Annex II (EU Habitats Directive) and Annex I (EU Birds Directive)	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Annex II species Otter: Direct impacts	Otter activity was not recorded within the proposed M28 road alignment or those watercourses draining the proposed project; i.e. the Glounatouig, the Donnybrook and the Woodbrook streams. Nonetheless, proximal and connected coastal areas such as Monkstown Creek, Lough Beg and the Douglas River Estuary support historical otter records and are likely to support otter activity. The NBDC supports one record for roadkill otter between Bloomfield Woods and Douglas from February 2016. Direct impacts to otter during the construction phase include disturbance, physical obstructions in watercourses, loss of riparian habitat and road mortalities.	Direct impacts during the operational phase may include collision with road traffic associated with proposed M28 with otter associated with the study area.	This ER is considered to be of *International Importance*. Otter is listed on Annex II of the EU Habitats Directive is likely to occur along the fringes of the study area. Though there will be no direct impacts to this species, the potential loss of foraging habitat and potential increase in mortality through road kill would have an impact on the population within this area. This impact is therefore considered to be '**Significant Negative on Local Level**' in the absence of avoidance and mitigation measures.
Annex II species Otter: Indirect impacts	Indirect impacts may occur resulting from the release of construction phase pollutants to receiving watercourses and waterbodies in the area that would have an indirect temporary impact on this species, as it would reduce the quality of its foraging habitat. In the absence of mitigation, there is a probable chance of this impact occurring.	Indirect impacts may include the further fragmentation of the localised landscape and the further restriction in foraging and breeding opportunities along the watercourses draining the proposed project. Such foraging and commuting constraints may result in these species entering the M28 mainline, thus resulting in potential collision and mortality. In addition, a release of contaminants to watercourses in the area would have an	

ER 18: Species listed on Annex II (EU Habitats Directive) and Annex I (EU Birds Directive)	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
		indirect temporary impact on this species, as it would reduce the quality of its foraging habitat. In the absence of mitigation, there is a probable chance of this impact occurring.	
Species Listed on Annex I of the Birds Directive (See **Table 12.9**) – Direct Impacts	There will be direct impacts to Peregrine Falcon at Raffeen Quarry during the project's construction phase. Part of the vertical cliff faces used by Peregrine Falcon (an Annex I species on the EU Birds Directive) for nesting purposes will be removed under the footprint of the proposed M28 route. The proposed M28 construction will not impact other Annex I species identified within hectad W76. Potential impacts to Annex I avifaunal species associated with Cork Harbour SPA are considered as part of the NIS prepared for this project. There will be no direct loss or disturbance of feeding or roosting habitat that are considered to be of conservation importance for those species associated with Cork Harbour SPA.	In the absence of mitigation, there is potential for direct operational phase impacts to Peregrine Falcon, through vehicular collision and direct disturbance and avoidance of potential breeding and nesting areas.	Peregrine Falcon is of International Conservation Importance as it is protected under Annex I of the EU Habitat Directive. Peregrine Falcon at Raffeen Quarry is likely to be impacted through habitat loss and direct disturbance under the footprint of the proposed M28 Road Project. The loss of suitable nesting habitat for Peregrine Falcon at Raffeen Quarry will impact a localised population of this species, restricted to the proposed study area and surrounding locality. The proposed project will not impact the breeding or over-wintering status of this species on an international or national scale rather a local population associated with the proposed project area and the surrounding locality. This impact is therefore considered to be '**Significant at the Local Level**' in the absence of avoidance and mitigation measures.
Species Listed on Annex I of the Birds Directive (See **Table 12.9**) – Indirect Impacts	The construction phase of the proposed project may result in indirect impacts to Peregrine Falcon in the form of indirect disturbance and consequent avoidance from Raffeen Quarry and its environs as a result of sustained construction activities. The construction phase may result in indirect disturbance impacts to Annex I species associated with Cork Harbour SPA that may	Indirect operational phase impacts to Peregrine Falcon may include disturbance and avoidance of this species from habitats previously utilised as foraging, hunting and breeding sites. Other Annex I species identified within hectad W76 are primarily associated with coastal and intertidal habitats which will not be impacted by the	

ER 18: Species listed on Annex II (EU Habitats Directive) and Annex I (EU Birds Directive)	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
	occur in the environs of Lough Beg. However it should be noted that species associated with Cork Harbour SPA only utilise these areas in small numbers and intermittently such as periods following extensive or prolonged wet weather conditions. Potential impacts to Annex I bird species associated with Cork Harbour SPA are considered in greater detail as part of the accompanying NIS.	proposed route.	

Table 12.36: Characterisation of Potential Impacts to Faunal species protected under the Irish Wildlife Acts (ER 19) and Determination of Significance of Impacts

ER 19: Faunal Species Listed under the Irish Wildlife Acts - Principal Elements of Ecological Value	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
ER19a – Badger, Irish Hare, Hedgehog, Pygmy Shrew and Irish Stoat – Direct and Indirect Impacts	Potential direct impacts to these non-volant mammal species could include direct collision with construction machinery; especially should night-time works be conducted. Land-take and habitat removal, disturbance and fragmentation of semi-natural habitats and their component burrowing / resting sites during the construction phase. Indirect impacts during the construction phase may include temporary disturbance associated with proximal and sustained construction activity, causing species to abandon their burrowing and foraging habitats. Other indirect impacts include fragmentation of the localised landscape during the construction phase thereby restricting suitable foraging habitat in the locality.	Potential direct impacts include potential disturbance to established commuting and foraging routes in addition to the reduction in foraging and breeding ranges within the environs of the proposed road project. Indirect impacts may include fragmentation of the localised landscape and the subsequent restriction in foraging and breeding activities. Such foraging efforts may result in these species entering the proposed M28 mainline, thus resulting in potential collision and mortality.	These species are protected under the Irish Wildlife Acts as they occur within the study area are considered to be of *National Importance*. The loss of breeding and dwelling sites and foraging habitat in addition to habitat fragmentation would represent a significant impact on local populations which is considered to be **'Significant on a Local Level'** in the absence of avoidance and mitigation measures.
ER19b - Bat Species – Direct and Indirect Impacts To be updated based on March 2017 surveys	Direct Impacts - The woodland, hedgerows and treelines within the proposed M28 Road Project and its environs provide roosting, foraging and commuting opportunities for bats. Also, large deciduous trees on or adjacent to the proposed M28 may harbour bats occasionally, especially if ivy covered or if they support suitable crevices or apertures. Felling of these trees may result in loss of	Direct Impacts during the project's operational phase will include potential disturbance to established commuting and foraging routes in addition to the reduction in foraging and breeding ranges within the environs of the proposed M28 Road Project. Indirect Impacts - The operation of the proposed M28 Road Project will result in	Bat species as they occur within the study area are considered to be of *National Importance*. Numerous potential impacts to bat species have been identified. Therefore, this impact is considered to be **'Significant on a Local Level'** in the absence of avoidance and mitigation measures.

ER 19: Faunal Species Listed under the Irish Wildlife Acts - Principal Elements of Ecological Value	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
	potential bat roosts and a Permanent Significant impact. There is a near certain chance of these impacts occurring. Indirect Impacts - Lighting during night-works may cause some temporary disruption of local bat populations' flight paths and emergence regimes. Pollution of watercourses may also result in indirect impacts to bats.	fragmentation of the localised landscape and the subsequent restriction in foraging activities. Such foraging efforts may result in bats entering the M28 road projects mainline and environs, thus increasing potential collision and mortality.	
ER19 – Common Frog and Smooth Newt	Evidence of common frog or smooth newt was not found during the site walkover surveys. The restriction and poor distribution of permanent, seasonal and ephemeral ponding areas within the study area influences the abundance and distribution of these species. The removal and disturbance of suitable amphibian wetland habitat within Raffeen Quarry may present potential construction phase impacts to this species.	The proposed operational phase may result in greater road mortality rates of common frog and smooth newt. Road drainage may alter the local hydrological regime leading to drying out of adjacent wetland habitat.	This species as it occurs in the study area is considered to be of *National Importance*. Potential loss of habitat and pollution of watercourses during the construction and operation of the proposed M28 would have an impact on the population of common frog and smooth newt along the proposed M28 Road Project. Impact to common frog and smooth newt in the study area are considered to be **'Significant on a Local Level'** in the absence of avoidance and mitigation measures.

Table 12.37: Characterisation of Potential Impacts to Flora Protection Order (FPO Species) (ER 20) and Determination of Significance of Impacts

ER 20: Flora Species Protected under the Irish Wildlife Acts- Principal Elements of Ecological Value	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct Impacts	Pennyroyal (*Mentha pulegium*) was identified at Raffeen Quarry and in an area of recolonising bare ground previously utilised as a materials holding area in Shanbally. In the absence of best practice design and mitigation, the construction phase of the proposed M28 could result in direct impacts from disturbance and habitat removal. No other species protected under FPO were identified within the footprint or the immediate environs of the proposed M28 route.	Direct impacts to this ER will be realised during the projects construction phase. There will be no direct operational phase impacts to this ER.	This ER is considered to be of *National Importance*. Potential impacts to the pennyroyal population at Raffeen Quarry and Shanbally are considered to be **'Significant on a National Level'** in the absence of best practice design, avoidance and mitigation measures.
Indirect Impacts	Indirect impacts to adjoining populations of pennyroyal at Raffeen Quarry and Shanbally in the absence of best practice could result in indirect impacts such as disturbance or disruption of this species outside of the road project footprint.	Indirect impacts to this species during the project's operational phase could result in species or population fragmentation with a consequent impact of plant colony genetic diversity. Other impacts may result in indirect disturbance through proposed M28 run-off, maintenance, air pollution, or the loss of habitat through the proliferation of grassland and/or scrub habitats within this area.	

Table 12.38: Characterisation of Potential Impacts to Avifauna listed on BoCCI (Colhoun and Cummins, 2013) and Determination of Significance of Impacts Avifauna listed on BoCCI (Colhoun and Cummins, 2013) (ER 21)

ER 21: Avifauna listed on BoCCI (Colhoun and Cummins, 2013)	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Direct Impacts	The construction phase of the proposed M28 Road Project will result in displacement of avifauna in addition to the direct loss of potential foraging and nesting habitats for avifaunal of red and amber listed of BoCCI, in particular passerine species associated with pastoral and arable lands (such as Yellowhammer) associated with the proposed M28 Road Project.	The operational phase of the proposed M28 Road Project will result in displacement of avifauna in addition to the direct loss of potential foraging and nesting habitats for avifaunal of red and amber listed of BoCCI, in particular passerine species such as Yellowhammer associated with pastoral and arable lands associated with the proposed M28 Road Project.	This ER is considered to be of *National Importance*. Impacts to species associated with this ER are considered to be '**Significant at the Local Scale'** in the absence of avoidance and mitigation measures.
Indirect Impacts	Indirect impacts to red and amber listed avifauna during the project's construction phase will include disturbance effects to avifauna in the locality.	Indirect impacts to red and amber listed avifauna during the project's operational phase will include disturbance effects to avifauna in the locality.	

Table 12.39: Characterisation of Potential Impacts to Hedgerows and treelines (ER 22) and Determination of Significance of Impacts Avifauna listed on BoCCI (Colhoun and Cummins, 2013) (ER 21)

ER 22– Hedgerow and Treelines: Principal Elements of Ecological Value	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
General floristic value	The construction phase of the proposed M28 Road Project will result in direct loss of some of the hedgerow and treeline habitats within the land-take. Disturbance or disruption factors associated with the projects construction phase include potential wind blow and root compaction of trees and shrubs adjoining the proposed M28 Road Project alignment.	These will be no impacts to the general floristic value of the hedgerow network during the operational phase. Maturation of the landscape planting during the operational phase may enhance these habitats botanical diversity.	This ER is considered to be of *Local Importance (Higher Value)*. Though the hedgerows and treelines recorded within the study area were not found to be particularly species-diverse. However these features play an important role in acting as 'ecological corridors' and navigational/foraging routes for bats, avifauna and small mammals. The loss of many hedgerows and treelines within the study area is therefore considered to be '**Significant Negative at a Local Scale**' in the absence of avoidance and mitigation measures.
Bird nesting potential	If the felling of hedgerow and treeline habitats during the construction phase is not timed appropriately, nests containing eggs or young chicks could be destroyed.	No impacts on habitats of bird nesting potential are expected during the operational stage. Landscaping measures proposed for the project are expected to establish and mature during the operational phase, replacing bird nesting habitat lost during the construction phase.	
Value as 'wildlife corridors'	Hedgerows and treelines provide an intrinsic connectivity and wildlife corridor function for the proposed M28 Road Project and its immediate surrounds. The construction of the proposed project would result in the direct loss of many of these linear features and their associated value as wildlife corridors	'No impacts' on the value of hedgerows as 'wildlife corridors' is expected at the operational stage.	

ER 22– Hedgerow and Treelines: Principal Elements of Ecological Value	Construction Phase Impacts	Operational Phase Impacts	Ecological Significance of Impact in the Absence of Avoidance or Mitigation Measures
Value as foraging and navigational routes for bats	The role of hedgerows as navigational and foraging routes for bats is an important element of their ecological value. The construction of the proposed M28 Road Project would result in the direct loss of many of these navigational/foraging routes. In the absence of mitigation as proposed there is near certain chance that this impact would occur.	'No impacts' on the value of hedgerows for foraging and navigational routes for bats is expected at the operational stage.	

Potential impacts from the Service Area include habitat loss, disturbance and disruption during the project's construction phase. The ecological impacts associated with the loss of the existing hardstanding areas habitat will be minimal given that this area is currently of negligible ecological importance. Construction of the Service Area will also result in habitat loss of recolonising bare ground habitats to the north. This semi-natural habitat is considered to be of Local Importance (Lower value); therefore potential impacts are considered to be '**Significant Negative at a Local Scale**' in the absence of avoidance and mitigation measures.

There will be no further habitat loss or land-take during the operational phase. Landscaping proposals for the site may compensate in part for loss of habitat and may improve the site as a feeding/foraging ground for passerine birds. The main impacts associated with the project's operational phase includes run-off to nearby areas of Cork Harbour SPA from hardstanding areas that may support hydrocarbons and other deleterious materials associated with the Service Area's forecourt, service station and vehicle parking areas.

12.6.4 Do-Nothing Scenario

If the proposed road project were not to proceed, ongoing activities would continue within the study area to include pastoral and arable farming, localised quarrying (including quarrying at Raffeen Quarry) and the potential progression of residential, commercial and industrial developments at Douglas and Carrigaline. The current owners of Raffeen Quarry have planning permission to continue quarrying activities. Therefore, quarrying works at Raffeen Quarry may continue under the Do-Nothing Scenario resulting in negative impacts to the semi-natural habitat and species assemblages present. These activities would be likely to result in localised, small scale and potential cumulative impacts to the various ERs within the proposed study area.

If the proposed Service development were not to proceed, ongoing activities would continue in this area. It is likely that the areas of recolonising bare ground would further develop and possibly generate into areas of grassland or scrub. Use of the existing hard standing area would continue under present conditions.

12.7 MITIGATION MEASURES

12.7.1 Construction Phase

12.7.1.1 General

Mitigation measures are proposed to address the potential adverse effect on the ERs identified within the ZoI of proposed M28 Road Project. These measures will ensure that potential impacts affecting sensitive ERs will be minimised and avoided. General mitigation measures are also outlined and provided below. Specific measures for each of the ERs are provided in **Table 12.40** to **Table 12.60**.

12.7.1.2 Mitigation Measures to Control of Airborne Pollutants during Construction Activities

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 receptors locations and whether the wind can carry the dust to these locations. The implementation of a Dust Minimisation Plan during the construction phase of the project will include standard measures such as:-

- Site roads shall be regularly cleaned and maintained as appropriate. Hard surface roads shall be swept to remove mud and aggregate materials from their surface while any un-surfaced roads shall be restricted to essential site traffic only.
- Any site roads with the potential to give rise to dust will be regularly watered, as appropriate, during dry and/or windy conditions (also applies to vehicles delivering material with dust potential).
- All vehicles exiting the site shall make use of a wheel wash facility prior to entering onto public roads, to ensure mud and other wastes are not tracked onto public roads. Wheel washes should be self-contained systems that do not require discharge of the wastewater to water bodies.
- Public roads outside the site shall be regularly inspected for cleanliness, and cleaned as necessary. The Contractor will be required to submit for approval, from the Local Authority, his methodology for monitoring dust emissions both on and beyond the site boundary.
- Material handling systems and site stockpiling of materials shall be designed and laid out to minimise exposure to wind.
- Water misting or sprays shall be used as required if particularly dusty activities are necessary during dry or windy periods.

Additional measures to mitigate emission dust are discussed in greater detail in **Section 13.5.1**.

12.7.1.3 Mitigation Measures for Protection of Waterbodies during Construction Activities

The project has been designed to avoid impacts to watercourses (refer to **Section 3.6 of Chapter 3: Description of the Proposed Road Development).** Detailed and site specific mitigation measures for all watercourses within the proposed project's ZoI are provided in **Section 3.13 of Chapter 3: Description of the Proposed Road Development**, **Chapter 9: Hydrology and Drainage** and **Chapter 10: Aquatic Ecology**.

12.7.1.4 Mitigation Measures for Noise and Vibration during Construction Activities

The extent of the blasting operations is discussed as part of the Noise and Vibration Chapter (**Chapter 14**) which describes the noise assessment and mitigation measures to be undertaken in relation to noise and vibration impacts.

12.7.1.5 Mitigation Measures for Invasive Plant Species

Five non-native invasive species, traveller's joy, cherry laurel, Japanese knotweed, butterfly bush and three cornered garlic were recorded within the study area, the locations of which are outlined in **Table 12.13**. The presence of non-native invasive species within the study area provides the potential for the spread of these species by the proposed works. These species are highly invasive and out-compete native flora to form single species stands. In the case of Japanese knotweed, its presence along watercourses is particularly significant, as contaminated soil or vegetative material washed from an infected area can result in the spread of this species downstream. Appropriate mitigation measures including management and control measures are required at all sites within the proposed works area where this species is encountered for the prevention of spread of these species. The following guidelines will be followed in relation to non-native invasive plant species:

- *Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads* (NRA, 2010),
- *Guidelines for the Management of Waste from National Road Construction Project* (NRA, 2014),
- *The Knotweed Code of Practice. Managing Japanese Knotweed on Development sites*. UK Environment Agency Environment Agency (2013). Inland Fisheries Ireland guidance regarding aquatic invasive species control (http://www.fisheriesireland.ie/Research/invasive-species), and
- Invasive Species Ireland guidance (http://invasivespeciesireland.com).

An Invasive Species Management Plan (**Appendix 12C** in **Volume 4**) has been prepared for this project to address the following deliverables:

- The eradication of IAS within the proposed CPO line of the road development in advance of construction commencing,
- Tasks associated with the project's construction phase to avoid the risk of transporting or spreading IAS, including measures in the event that any remaining IAS should be found within the CPO line, and
- The landscaping / re-vegetation phase on completion of construction to avoid the risk of IAS re-establishing within the CPO line.

The objectives of this plan are as follows:-

- To present an overview of IAS along and in the vicinity of the M28 Cork to Ringaskiddy Road Project,
- To provide an effective management approach for the eradication of IAS within the proposed CPO line prior to the commencement of construction, and where feasible, adjacent to the CPO to prevent recolonisation,
- To set out a protocol for the inspection of all areas to be used for the sourcing of material and the eradication of any IAS therefrom prior to their use as a source of material,
- To provide prescriptive measures to avoid the accidental transfer of IAS during the construction of the M28 road project including the introduction of any new species. This will include specific measures to deal with any remaining IAS found within the CPO boundary during the construction phase, and
- To provide prescriptive measures to avoid the risk of re-introduction or re-establishment of IAS during the landscaping following the phased construction of the road development.

12.7.1.6 Non-volant Mammals

All mitigation measures to be implemented for the protection of badgers and otters are based on the NRA *Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes* (2006a), *NRA Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes* (2006b) and *NRA Guidelines for Crossing of Watercourses During the Construction of National Road Schemes* (2005) and refer to the existing specimen design for the proposed M28.

An approach of multiuse mitigation will be employed which involves the effective use of all structures including culverts etc. for wildlife passage and protection. Mitigation measures proposed for non-volant mammals will be put in place and completed before the road is open to traffic.

Mammal surveys completed in early 2014 and validated in March 2015 and 2017, yielded a total of 4 active and a number of inactive badger setts, some of which are inhabited by rabbits, within the ZoI of the proposed route alignment. Given their proximity, each of these setts will require site specific mitigation measures. The mitigation measures for each sett are separated into two stages; mitigation measures during fence-line construction or vegetation clearance, and mitigation measures prior to and during construction. This takes account of the potential for the vegetation clearance/fence-line construction to be carried out well in advance of the commencement of the construction works.

12.7.1.7 Pre-Construction Mammal Surveys

In addition to those already found, otters and badgers may also create new holts or setts in advance of road construction. To this end, if 36 months have lapsed from the time the baseline surveys were completed for this EIS and the grant of planning permission and commencement of construction, a pre-construction badger survey will be completed in accordance with the *NRA Guidelines* (2006a & 2006b).

The pre-construction surveys will check for any otter holts within or close to the alignment (at least 200m upstream and downstream of the crossing point) at all watercourse crossings. Any holts found to be present will be subject to monitoring and mitigation as set out in the *NRA Guidelines* (2006b) and this chapter.

12.7.1.8 Monitoring during Site Clearance

Where dense vegetation prevents adequate determination of the presence or absence of holts or setts, these areas will require monitoring during vegetation clearance to ensure that any setts present will be found and treated appropriately.

12.7.1.9 Protection of Badger

No construction machinery will be used within 30m of badger setts (extended to 50m for active setts during the breeding season, December – June inclusive). During the pre-construction survey, setts located adjacent/close to the CPO boundary (within 50m) will be clearly marked and the extent of bounds prohibited for vehicles clearly marked by fencing and signage, if deemed necessary. Such marker fencing will be sufficiently durable and robust to cover the period of construction. Neither blasting nor pile-driving will be undertaken within 150m of active setts during the breeding season.

Landscaping activities after the M28 construction phase can also affect badger setts, and care will be taken to ensure that setts safeguarded on or near the site are not interfered with at this stage and that access to foraging areas is not restricted.

Evacuation and destruction of active badger setts will be carried out under the supervision of an appropriately qualified ecologist under licence from the NPWS. Evacuation and destruction will be undertaken during the period 1st July to 30th November. All active setts will be protected from interference or disturbance by an exclusion zone of 30m (50m during the breeding season - December to June inclusive) within which no machinery or vegetation removal will take place. Sett tunnels can extend for over 20m from sett entrances and use of any vehicles, digging, or heavy machinery can cause collapse of tunnels and cause mortality of badgers. Light work, such as hand digging or scrub clearance will not take place within 10m of sett entrances.

The setts will be clearly marked and the area from which vehicles are prohibited will be clearly marked by timber post and rail fencing (and appropriate signage) which will allow badgers to move in and out freely. To ensure that accidental damage to setts does not occur, it is important that there is a transfer of information between construction personnel at all levels. The mitigation measures and procedures required in relation to badgers will be included in the Environmental Operating Plan prepared for the proposed M28 Road Project.

Exclusion of badgers from disused or currently inactive setts is not seasonally restricted and can be conducted at any time subject to licence from the Wildlife Licencing Unit of the NPWS.

12.7.1.10 Other Mitigation Measures

The location of any depots, spoil heaps or other additional site usage during clearance and construction will avoid any disturbance to the location of active badger setts and will also avoid areas identified for the installation of mammal underpasses and mitigation.

12.7.1.11 Protection of Otter

Otters are likely to use the lower reaches of the watercourses draining the study area especially where they form direct connectivity to larger waterbodies such as the Douglas River Estuary and Monkstown Creek. In addition, Lough Beg and its proximal complex of wetland habitats support suitable otter feeding and commuting habitat. Otters do not limit their movements to watercourses and can enter hinterlands to search for prey species, such as frogs and newts where available.

If holts are found to be inactive, exclusion of holts may be carried out during any season under licence from the NPWS. No wheeled or tracked vehicles (of any kind) will be used within 20m of active, but non-breeding, otter holts. Light work, such as digging by hand or scrub clearance will not take place within 15m of such holts, except under licence. The prohibited working area associated with otter holts will be fenced and appropriate signage erected. Where breeding females and cubs are present no evacuation procedures of any kind will be undertaken until after the otters have left the holt, as determined by a specialist. Breeding may take place at any season, so activity at a holt must be adjudged on a case by case basis, where required. Exclusion and destruction will be undertaken under licence, in accordance with the NRA *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes* (2006b). This process involves the installation of one-way gates on the entrances to the holt and a monitoring period of 21 days to ensure the otters have left the holt prior to removal.

12.7.1.12 Bats

The following mitigation measures for the protection of bats are in line with the NRA *Guidelines on provisions for the conservation of bats during the planning and construction of roads* (2006). Reference is made to the NRA Guidelines (*Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes* and the *Guidelines for the Treatment of Bats during the Construction of National Road Schemes*) and will be implemented by the Contractor.

The mitigation measures include limiting the season of disturbance to trees and vegetation (1st March to 31st August inclusive) so as to reduce impacts on breeding species and to provide like for like habitat replacement as necessary. Proactive enhancement measures are presented below to improve habitats as potential roots and foraging areas within the project ZoI.

Buildings

Structures with potential to support bat roosting and foraging potential that are scheduled for removal, shall be re-surveyed by a suitably qualified bat specialist immediately prior to demolition to determine if any bats are present as, due to the passage of time between survey and construction of the road, bats may move into previously inspected buildings. If a roost is discovered in a building to be removed then a sufficient number of Schwegler bat boxes or similar shall be erected adjacent to the site one month prior to works to provide alternative roost sites for the bats.

Any work on, or demolition of these structures shall preferably be undertaken between November and March, as bat numbers are then known to be fewer in buildings during this time. In addition buildings will be searched prior to demolition to reduce impact to bats present on-site.

To mitigate the loss of the roosts, three Schwegler bat boxes shall be erected in the immediate area of each roost at least one month prior to demolition of the building to provide alternative roosting

sites for its bats. Any demolition shall be done carefully, in the presence of a bat specialist, and with the expectation that bats may be found. The roof of the structures shall be manually removed to protect any animals which may be beneath. If discovered, the bat specialist shall remove the animal and place it into an on-site, previously erected bat box or retain it in a secure box until dusk when it shall be released on-site.

Removal of Deciduous Trees

Mature broadleaved trees that need to be felled under the proposed M28 footprint must first be surveyed for bat presence by a suitably experienced specialist (bat ecologist). If bats are found, an application for a derogation licence must be made to the NPWS to allow its legal removal. Such trees will be felled in the period late August to late October, or early November, in order to avoid disturbance of any roosting bats as per *NRA Guidelines* (NRA 2006a and 2006b) and also to avoid the bird breeding seasons. Tree felling will be completed by Mid-November at the latest as bats roosting in trees are very vulnerable to disturbance during their hibernation period (November - April). Trees with ivy-cover, once felled, will be left intact onsite for 24 hours prior to disposal to allow any bats beneath foliage to escape overnight.

Landowners must be advised that the timber from felled trees will remain for their use. This will prevent trees being felled prematurely.

Retention of Trees

Several species of bats roost in trees. Treelines and mature trees that are located immediately adjacent to the realignment route or are not directly impacted shall be avoided and retained intact. Overall impacts on these sites will be reduced through modified design and sensitivity during construction. Any trees and treelines along approach roads and planned site access tracks shall be retained. Retained trees will be protected from root damage by machinery by an exclusion zone of at least 7 metres or equivalent to the tree canopy drip zone. Such protected trees will be fenced off by adequate temporary fencing prior to other works commencing.

Landscape Planting of Woodland, Linear Woodland and Scrub Replacement for Loss of Commuting Routes

Linear features such as hedgerows and treelines serve as commuting corridors for bats (and other wildlife). Mitigation measures are set out below to compensate for the loss of these features. These measures will also compensate for habitat loss and provide continuity in the landscape.

Severed linear features such as hedgerows and treelines shall be reconnected to the specific landscape measures and ecological landscape measures using semi-mature trees under-planted with hedgerow species to compensate for the loss of treelines and hedgerows. The exact locations of such planting are outlined in the Habitat and Species Management Plan (See **Appendix 12B** in **Volume 4**) and the Landscape and Visual Assessment chapter (**Chapter 16**). Native species will be used as they support more insect life than non-native varieties. Species to be used within proposed woodland areas include; pedunculate oak (Quercus robur), Scots pine (*Pinus sylvestris*), hawthorn (*Crataegus monogyna*), hazel (*Corylus avellana*), holly (*Ilex aquifolium*), Blackthorn (*Prunus spinosa*), Goat Willow (*Salix caprea*), grey willow (*Salix cinerea*), alder (*Alnus glutinosa*), rowan (*Sorbus aucuparia*) and birch (*Betula pubescens*).

Compensatory planting of trees and shrubs will preferably be completed during the pre-construction phase to provide hedgerow/tree growth prior to completion of the project. This would ensure that bats commuting in the area have prior knowledge of newly planted landscape features as well as ensuring the newly planted hedgerows/treelines are well established prior to completion of the proposed road project.

Habitat replacement and landscaping will compensate for or add to the wildlife value of the area and also provide areas of aesthetic as well as wildlife interest. Further pro-active habitat restoration measures are considered below.

Habitat Retention, Replacement and Landscaping

In general, best practice design will aim to retain the quality of the landscape and ensure its protection within the landscaping programme.

The overall design of the project includes for replacement planting of existing woodland, hedgerow, treeline and scrub habitats with native trees and shrubs. **Chapter 16 Landscape and Visual Impact** has specified for 16 landscaping measures along the project route to include screen woodland mix planting in addition to SLM 04 which comprises a large area of woodland planting to replace woodland lost due to construction in Mulcon Valley. Native species as outlined will be chosen in all landscaping schemes. Planting schemes will link in with existing wildlife corridors (hedgerows and treelines) to provide continuity of wildlife corridors.

Habitats proposed for translocation and recreation and part of the road project are discussed in **Table 12.7**.

Table 12.40: Proposed Semi-Natural Habitats to be Replaced as Part of the Proposed Roads Project

Semi-Natural Habitats lost Under the Proposed Road Project	Habitats to be Translocated or Recreated	Habitats to be Recreated / Replanted
Dry calcareous and neutral grassland (GS1)	Portions of this grassland located under the footprint of the proposed road project at Raffeen quarry. To be translocated to a proposed receptor site within the CPO immediately south of Raffeen quarry.	n/a
Woodlands (WD/ WN) and Scrub (WS1)	-	Woodland habitat to be created as part of the landscape management plan and habitat and species management plan using native tree and shrub species. This planting will compensate for and enhance woodland cover within the study areas ZoI.
Linear Woodlands (WL1 & WL2)	-	Woodland planting established as screen planting and ecological landscape planting to be tie into / connected with the adjoining and interconnecting linear woodland habitats.

Semi-Natural Habitats lost Under the Proposed Road Project	Habitats to be Translocated or Recreated	Habitats to be Recreated / Replanted
Other artificial lakes and ponds (FL8)	Wetland habitat under the footprint of the proposed road project to be recreated north of the proposed M28 within Raffeen Quarry	-

Bat Boxes

The loss of potential roosting features and foraging/commuting habitat coupled with the wider loss of commuting territory surrounding the projects lands will necessitate the installation of bat boxes to compensate for potential roost loss. It is recommended that bat boxes are attached to suitable trees or buildings along the route but outside the area of clearance. The principle recommended type is the Schwegler 1FF bat box. Boxes shall be erected in pairs and all boxes placed in sites that will be protected from disturbance. These boxes shall be away from any felling or trimming to ensure that they are not accidentally damaged or removed. Bat boxes shall be clear of scrub and away from ivy encroachment as well as lighting and traffic. These boxes shall be away from any felling or trimming to ensure that they are not accidentally damaged or removed. The appropriate number of bat boxes to compensate for loss of potential roosting features shall be calculated following pre-construction Potential Roost Feature (PRF) inspection/presence absence surveys.

Measures to control run-off associated with construction activities to nearby areas of Cork Harbour are outlined in **Chapter 10: Aquatic Ecology.**

12.7.2 Operational Phase

12.7.2.1 Mammal Ledges and Underpasses

Badgers typically follow the same pathways between setts, feeding/foraging areas and latrines. Such pathways are identified on the basis of the presence of tracks, snuffle areas and feeding scrapes. In most cases, these pathways occur along features such as watercourses, hedgerows, treelines as well as woodland and scrub margins.

To mitigate any barrier effect on otters and to avoid mammal road casualties, mammal ledges and underpasses will be constructed adjacent to regular crossing points on the proposed M28. Mammal underpass locations were informed by mammal surveys completed for the project which confirmed current mammal activities within and surrounding the study area. Where mammal underpasses could not be secured onto existing structures such as culverts, pipes etc., this was determined by underlying engineering constraints, that included flood risk, suitability of the structure to facilitate retrofitting, health and safety issues with securing and maintaining retrofit structures and costs associated with retrofitting in-situ structures and are provided in **Table 12.41** below. Mammal mitigation measures such as ledges and underpasses have been designed in accordance with the TII Standard Construction Design. The locations of proposed mammal underpasses for the proposed M28 Road Project are displayed in **Figure 12.7**.

Table 12.41: Badger/Mammal Ledges and Underpasses for the Proposed M28 Road Project

Mammal Underpass (MUP) No	Chainage Location	Underpass type	Target Species	Justification
MUP01	Ch. 2+550	900mm Pipe culvert	Badger	Mammal activity found throughout area and territory will be severed by new alignment. There is a requirement to provide an underpass under the old N28 alignment at this location.
MUP02	Ch. 3+150	900mm Pipe culvert	Badger and Otter	
MUP03	Ch. 4+900	Ledge	Badger and Otter	Badger activity recorded throughout woodland and scrub adjoining Glounatouig stream tributary. Provision of mammal ledge or dry pass at crossing of the Glounatouig stream tributary.
MUP04	Ch. 5+950	900mm Pipe culvert	Badger	Badger activity recorded on either side of the proposed M28 route alignment.
MUP05	Ch. 7+150	900mm Pipe culvert	Badger	Badger activity recorded along disused railway embankment. Active 2 entrance sett is directly impacted by the new alignment. An artificial sett is also proposed in this area to mitigate the loss.
MUP06	Ch. 8+675	Pipe	Badger	Historical records of badger activity recorded in the area in the woodland copse to the north. Potential severance of territory and foraging grounds
MUP07	Ch. 12+400	Pipe	Badger	Badger activity recorded in locality. Active sett directly impacted by the new alignment. Artificial sett also required at Ch 12+325 (ABS04).

Underpasses and ledges will be constructed in accordance with the NRA Guidelines (NRA, 2006a and 2006b). Additional advice on the construction and location of mammal underpasses is available in the Highways Agency document *Design Manual for Roads and Bridges* (Highways Agency, 2001a and b).

The following general guidelines for underpasses will be adhered to:-

- The exit and entrance to tunnels will be flush with mammal-proof fencing and the invert set at ground level. A concrete surround will provide a solid connection to the uprights of the fence and inhibit any efforts by badgers to dig under the pipe. Drainage will be adequate to prevent water-logging at the entrances during wet weather, and
- Specific design of underpasses will be tailored to individual locations and will be carried out at the detailed design stage.

Placement of mammal underpasses through sections of cut creates engineering difficulties. Where engineering difficulties arise, underpasses will be moved to the nearest suitable location, but not more than 250m away. Final design and placement will be advised at detailed design stage by a qualified ecologist.

Ledges are walkways that allow mammals to cross under a road at water crossings. Ledges shall be at least 500mm wide, constructed at least 150mm above the 1 in 5 year flood event, and allow at least 600mm headroom. They are usually constructed of solid concrete on one or both sides of a bridge or culvert, but may also be made of wooden or metal planks, sometimes bolted onto the structure's sides. The ledges will be installed in accordance with the NRA Guidelines (NRA, 2006a and 2006b).

These culverts/underpasses will also serve other wildlife movement under the road. Similarly, existing, proposed accommodation roads and railway tunnels under the proposed road project will also serve to facilitate badger passage.

Where it is not possible to install mammal underpass facilities in areas where the road will be in cut, any over-bridges along the proposed M28 Road Project will allow passage of mammals between areas cut by the road.

12.7.2.2 Mammal Fencing

Mammal resistant or mammal proof fencing will be required to guide badgers and other mammals to passage facilities and to prevent animals crossing the new roadway. The specification for mammal resistant fencing is given in the NRA Guidelines (NRA 2006a and 2006b). Fencing will be recessed and tied into bridge, culvert and mammal underpass locations to guide badgers and other mammals safely under the road and prevent them accessing the road carriageway. Dedicated mammal crossings will be more readily used if the approach is softened through the use of appropriate planting. Mammal resistant fencing will be incorporated at the earliest possible stage during road-construction, preferably during erection of the permanent fenceline with gaps left at locations specified for underpasses. Gaps shall be subsequently closed after underpasses have been constructed.

Gates entering onto farm access roads will require concrete sills and mammal resistant mesh attached to the gate to exclude badgers from accessing the proposed M28. The location of gates on farm access roads requiring this modification will be determined at detail design stage.

Where there is an overlap of stock-proof fencing and mammal resistant fencing at culvert/underpass locations, stock-proof fencing must be adjusted to allow for unimpeded access to the underpass. This involves modification of the lower section of the stock-proof fence. The fence will be adjusted so that the bottom rail and wire mesh are removed and chain-link is not fixed to the ground at the location of the underpass. This allows for the animals to see a break in the fence line and thus clear access to the underpass nearby. Detail of this can be seen in Figure 1 of NRA Guidelines 2006a.

12.7.2.3 Artificial Setts

In order to compensate for the direct loss and disturbance of badger setts within the footprint and in proximity to the project, it is proposed to create and secure 4 no. artificial setts within the LMA/CPO line. Artificial setts will be established in proximity to existing setts currently under the footprint or potential disturbed by the proposed M28 Road Project and its associated construction activities. The locations of artificial setts proposed are shown in **Figure 12.7**.

12.7.2.4 Post-Construction Monitoring and Mitigation

The success of the mitigation measures for mammals will be monitored for a period after construction, and measures taken to enhance use of underpasses where required. Quarterly monitoring will be carried out to determine the success of the measures employed. Monitoring will be continued for a minimum of one year after construction ceases, in accordance with the NRA Guidelines.

Periodic maintenance will be completed to ensure the long term effectiveness of mammal resistant fencing and mammal ledges and underpasses. Maintenance activities will be completed in accordance with the NRA Guidelines (NRA 2006a and 2006b).

12.7.2.5 Lighting Restrictions for Bats and Other Taxa

In general, artificial light creates a barrier to commuting bats so lighting will be minimised along the proposed road especially at areas of interest for bat species. Lighting will especially be avoided beneath new bridges over water as this would impact on bat foraging and commuting activities, especially that of Daubenton's bats which presently use the various water courses. Where lighting is required, directional lighting (i.e., lighting which only shines on roads and not nearby countryside) shall be used to prevent overspill. This will be achieved by the design of the luminaire and by using accessories such as hoods, cowls, louvers and shields to direct the light to the intended area only. Public lighting for the project's operational phase is discussed in **Chapter 3: Description of the Proposed Road Development**.

12.7.2.6 Amphibians

Whilst frogs and smooth newt may be present within the study area environs, the project will not affect any identified specific breeding pools or wetland habitats for amphibians. Therefore, mitigation is not considered necessary for amphibians.

12.7.2.7 Birds

The principal legislation governing the protection of wildlife in Ireland is the Wildlife Acts 1976 to 2012 and any subsequent amendments. Therefore, site clearance during the bird nesting season will generally be avoided. If works must proceed during this season a derogation licence will be applied for from the Wildlife Licencing Unit of the NPWS.

The following protective measures for nesting and breeding birds will be adopted as part of the proposed works:

- Avoid clearing vegetation during the bird nesting season, March 01st to August 31st inclusive;
- Where vegetation clearance is required during this period, vegetation will be surveyed by an ecologist in advance of any construction works taking place in order to determine the presence of nests;
- Where nests, etc., are present, then a buffer zone will be cordoned off; and, the nests, etc., will either be left in-situ until the end of the bird nesting season or dealt with in accordance the terms of a licence sought from and issued by the Minister for Arts, Heritage, Regional, Rural and Gaeltacht Affairs; and
- The contracting authority and the appointed contractor will endeavour to make all reasonable efforts to avoid tree felling and scrub clearance during the peak nesting season, thereby avoiding direct impacts to breeding birds during the proposed project's construction phase.

12.7.2.8 Landscape Planting

As part of the landscape mitigation, screen planting within targeted sections of the route (See **Chapter 16: Landscape and Visual and Figure 16.5**) will be established and will form an integral part of the overall project. The landscaping along the route will provide nesting and feeding habitat for a range of passerine bird species of the countryside and will partially mitigate for loss of hedgerow sections. Specific Landscape Measure 04 proposes tree planting within the Mulcon Valley to compensate for the loss of trees along the footprint of the route (See **Chapter 16: Landscape and Visual**). The establishment and maturation of the planted trees and screen planting will partially compensate for the loss of trees along the route and will provide viable bird nesting and foraging habitat in the short to medium term. As the screen planting continues to mature and establish, these areas will support viable refuge for volant and non-volant mammal species over the medium to long term.

In addition, it is proposed to establish landscape planting along both embankments of the proposed M28 Road Project as it passes through Raffeen quarry; i.e. between chainages 7,525 and 7750. Landscape planting will include Individual Tree Planting (heavy standards) at the top of the embankment with Screening Woodland Mix Planting on the lower sections of the embankment. Such planting will direct Peregrine Falcon associated with adjacent cliff face habitats over the road project therefore avoiding vehicular collision with the proposed road project. This is considered in greater detail in the Species and Habitat Management Plan presented in **Appendix 12B** in **Volume 4**.

12.7.3 Drainage

A robust surface water drainage system (in compliance with TII Standards DN-DNG-03065 and other relevant guidelines as listed in **Chapter 9: Hydrology and Drainage**) has been designed to limit the potential for contaminated surface water runoff, including suspended solids and hydrocarbons to reach the receiving watercourses and marine environment at Cork Harbour from the proposed road project (See **Chapter 9: Hydrology and Drainage**).

12.7.4 Mitigation Measures for Ecological Receptors

The design has been developed with an overall objective of minimising the impact on ecologically sensitive sites identified through environmental surveys and consultation with statutory bodies including the NPWS. Mitigation measures for the protection of habitats and species associated with ERs selected for the route and its ZoI are included in **Table 12.42** to **Table 12.61** below.

Figure 12.7: Mammal Mitigation Measures for the Proposed M28 Road Project

Table 12.42: Avoidance/Mitigation Measures and Residual Impact Assessment for Cork Harbour SPA (ER 1)

Cork Harbour SPA (ER 1)[31]: Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Land-take	There will be no works within Cork Harbour SPA and therefore no requirement for avoidance/mitigation measures.	Direct and indirect impacts on all qualifying species of Cork Harbour SPA will be avoided (or are negligible) through project design and associated mitigation measures. Indirect disturbance or displacement to avifauna utilising pastoral lands to the north of Lough Beg are not considered significant in the context of Cork Harbour SPA. Occurrences of over-wintering avifauna in these areas are intermittent and numbers using these fields are not significant in the context of over-wintering avifaunal populations for Cork Harbour SPA. Feeding avifauna displaced by the proposed scheme will be able to relocate to proximal improved grassland habitats that offer similar field feeding opportunities, such as ground suitability, prey abundance, sightlines etc. As a result, the displacement of intermittently occurring avifauna is not considered significant in terms of the over-wintering population associated with Cork Harbour SPA. Mitigation measures for Cork Harbour SPA are presented and assessed in greater detail as part of the accompanying NIS. The provision and implementation of mitigation and avoidance measures will not result in residual Impacts to Cork Harbour SPA. Therefore residual impacts are considered to be '**Not Significant'**.
Receiving habitats and species	There will be no direct impacts to those habitats and species associated with Cork Harbour SPA. Indirect impacts through the deterioration of watercourses that support connectivity with proximal sections of Cork Harbour SPA such as Monkstown Creek and the River Douglas Estuary are avoided through the drainage design as described in **Chapter 9: Hydrology and Drainage** / and mitigated through those mitigation measures outlined in **Chapter 10: Aquatic Ecology**. The proposed project will not impact over-wintering populations associated with nearby or proximal parts of Cork Harbour SPA. Potential impacts associated to Cork Harbour SPA are considered in greater detail in the accompanying NIS.	

[31] The open waters of Cork Harbour SPA provide remote and tenuous connectivity between the scheme and Great Island Channel SAC, situated 5.1km east of the project at its nearest point. To this end mitigation measures proposed for the project to avoid impacts to Cork Harbour SPA (principally water quality impacts to Cork Harbour SPA), will by extension, avoid impacts to the Great Island Channel SAC. Potential impacts to the Great Island Channel and consequent mitigation measures are addressed in the accompanying NIS for the project.

Table 12.43: Avoidance/Mitigation Measures and Residual Impact Assessment for Lough Beg pNHA (ER 2)

Lough Beg pNHA (ER 2): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Land take	There will be no works within Lough Beg pNHA nor does the proposed project support connectivity to Lough Beg pNHA. Therefore there is no requirement to apply avoidance / mitigation measures to avoid potential direct impacts.	There will be no impacts to this ER (direct or indirect), even in the absence of best practice measures. Residual impacts to this ER will be '**Not Significant**'.
Receiving habitats and species	There will be no works within Lough Beg pNHA nor does the proposed project support connectivity to Lough Beg pNHA. Therefore there is no requirement to apply avoidance / mitigation measures to avoid potential direct impacts.	

Table 12.44: Avoidance/Mitigation Measures and Residual Impact Assessment for Monkstown Creek pNHA (ER 3)

Monkstown Creek pNHA (ER 3): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Land take	There will be no works within the bounds of Monkstown Creek pNHA nor does the proposed project support connectivity to Monkstown Creek pNHA. Therefore there is no requirement to apply avoidance/mitigation measures to avoid potential direct impacts.	Potential impacts on Monkstown Creek will be avoided (or are negligible) through the proposed M28 Road Project design and associated mitigation measures. The provision of mitigation and avoidance measures will ensure that there will be no residual Impacts to Monkstown Creek pNHA. Therefore these impacts are considered to be '**Not Significant'**.
Receiving habitats and species	Indirect impacts through the deterioration of water quality within the Glounatouig Stream and consequently Monkstown Creek are avoided through the drainage design as described in **Chapter 9: Hydrology and Drainage** and mitigated through those mitigation measures outlined in **Chapter 10: Aquatic Ecology**.	

Table 12.45: Avoidance/Mitigation Measures and Residual Impact Assessment for the Impounded Wetland Adjoining Douglas River Estuary pNHA (ER 4)

Douglas River Estuary pNHA (ER 4): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Land take	There will be no works within the bounds of Douglas River Estuary pNHA nor does the proposed project support connectivity to Douglas River Estuary pNHA. Therefore there is no requirement to apply avoidance / mitigation measures to avoid potential direct impacts.	Potential impacts on the Douglas River Estuary pNHA will be avoided through the proposed M28 design and associated mitigation measures. The implementation of best practice construction design and mitigation measures will not result in residual impacts to the Douglas River Estuary pNHA. Therefore potential residual impacts are considered to be '**Not Significant'.**
Receiving habitats and species	There will be no direct impacts to the receiving habitats and species of the Douglas River Estuary pNHA. Indirect impacts to the Douglas River Estuary and its associated habitats and species are possible should the aqueous pollutants enter the Donnybrook and Woodbrook streams. However such potential pollutants are avoided through the drainage design principles adopted in the design of the project (**Section 3.6 and Chapter 9: Hydrology and Drainage**) and construction management measures that will be followed (**Section 3.13**) and mitigated through those mitigation measures outlined in **Chapter 10: Aquatic Ecology**.	

Table 12.46: Avoidance/Mitigation Measures and Residual Impact Assessment for Bloomfield Woods (ER 5)

Bloomfield Woods (ER 5): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
General floristic value	Protective barriers will be put in place prior to tree felling, in order to avoid damage to adjoining woodland habitat outside the land-take. These works will be carried out in accordance with the appropriate NRA Guidelines. These measures will avoid indirect damage to the woodland outside the landtake of the proposed project and have a probable chance of success.	Trees and scrub removed from Bloomfield Wood during site clearance will be replaced by proposed landscape planting measures with species compositions that reflect the existing woodland. This will be completed under Specific Landsape Measure 04 (See **Section 16.5** of the EIS). Plant material of native local provenance will be utilised. This will minimise the impacts on the general floristic and biodiversity value of the woodlands. Residual impacts in terms of tree and scrub removal are considered to be **'Not Significant'.** Particular attention will be paid to bat commuting routes. Mitigation measures outlined in **Sections 12.7.1** and **12.7.2** will be implemented at these sites. The mitigation measures outlined for trees with bat roosts or bat roost potential means that there will be no residual impact on the bat population in the area – **'No Impact'**. Detailed mitigation and best practice design measures have been provided in **Section 12.7.1** and **Section 12.7.2** for badger and other terrestrial mammals within the project's ZoI. The implementation of these mitigation measures will not result in residual impacts to badgers and other terrestrial mammals. Therefore these impacts are not expected to be significant, even on a local level – **'Not Significant'.** The implementation of best practice, avoidance and mitigation measures outlined in **Chapter 10: Aquatic Ecology** will restrict all potential impacts to the watercourses and waterbodies of the receiving environment. Therefore the residual impacts to the aquatic environment of these watercourses are considered to be **'Not Significant'.** The residual impact to this ER is therefore considered to be **'Not Significant'.**
Bird nesting potential	Site clearance during the bird nesting season will generally be avoided. If works must proceed during this season a derogation licence will be applied for from the Wildlife Licencing Unit of the NPWS. The following protective measures for nesting and breeding birds will be adopted as part of the proposed works: ▪ Avoid clearing vegetation during the bird nesting season, March 01st to August 31st inclusive; ▪ Where vegetation clearance is required during this period, vegetation will be surveyed by an ecologist in advance of any construction works taking place in order to determine the presence of nests; ▪ Where nests, etc., are present, then a buffer zone will be cordoned off; and, the nests, etc., will either be left in-situ until the end of the bird nesting season or dealt with in accordance the terms of a licence sought from and issued by the Minister for Arts, Heritage, Regional, Rural and Gaeltacht Affairs; and ▪ The contracting authority and the appointed contractor will endeavour to make all reasonable efforts to avoid tree felling and scrub clearance during the peak nesting season, thereby avoiding direct impacts to breeding birds during the proposed project's construction phase.	

Bloomfield Woods (ER 5): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Bat species in the area	The above mitigation measures in relation to the woodland, tree and scrub clearance would also serve to minimise impacts on bat species in the area. These measures have a probable chance of success.	
Badgers and other terrestrial mammals	A pre-construction terrestrial mammal survey will be carried out in order to ensure that no new badger setts or mammal burrows have become established in the area. If any new badger setts are found within the alignment or its environs, a derogation licence of the Minister of the AHRRGA will be applied for through the NPWS Wildlife Licensing Unit, to exclude and excavate the setts. Only on the granting of licence can the sett be removed prior to the commencement of construction works. All works will be carried out in accordance with the NRA *Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes* (NRA, 2006a).	
Water quality	Detailed mitigation measures on pollution prevention of watercourses within the ZoI, including the Woodbrook Stream are outlined in **Section 3.6 and 3.13 of Chapter 3: Description of the Proposed Road Development**, **Chapter 9: Hydrology and Drainage** and **Chapter 10: Aquatic Ecology.**	
Invasive species	Japanese knotweed occurs along the western margins of Bloomfield Wood. Management and control measures for invasive species such as Japanese knotweed are detailed in **Section 12.7.1.5.**	

Table 12.47: Avoidance/Mitigation Measures and Residual Impact Assessment for Mount Oval Habitat Mosaic (ER 6)

Mount Oval habitat mosaic (ER 6): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
General floristic value	Protective barriers will be put in place prior to felling, in order to avoid damage to adjoining woodland habitat outside the land-take. These works will be carried out in accordance with the NRA Guidelines. These measures will avoid indirect damage to the woodland outside the landtake of the proposed road project.	Scrub will be removed during site clearance will be compensated for by landscape planting measures with species compositions that reflect the in-situ woodland. Plant material of native local provenance will be utilised. This will minimise the impacts on the general floristic and biodiversity value of the woodlands. Particular attention will be paid to bat commuting routes. Mitigation measures outlined in **Sections 12.7.1** and **12.7.2** will be implemented at these sites. The mitigation measures outlined for trees with bat roosts or bat roost potential means that there will be no residual impact on the bat population in the area – **'No Impact'.** The residual impact to this ER is therefore considered to be **'Not Significant'.**
Bird nesting potential	Site clearance during the bird nesting season will generally be avoided. If works must proceed during this season a derogation licence will be applied for from the Wildlife Licencing Unit of the NPWS. The following protective measures for nesting and breeding birds will be adopted as part of the proposed works: ▪ Avoid clearing vegetation during the bird nesting season, March 01st to August 31st inclusive; ▪ Where vegetation clearance is required during this period, vegetation will be surveyed by an ecologist in advance of any construction works taking place in order to determine the presence of nests; ▪ Where nests, etc., are present, then a buffer zone will be cordoned off; and, the nests, etc., will either be left in-situ until the end of the bird nesting season or dealt with in accordance the terms of a licence sought from and issued by the Minister for Arts, Heritage, Regional, Rural and Gaeltacht Affairs; and ▪ The contracting authority and the appointed contractor will endeavour to make all reasonable efforts to avoid tree felling and scrub clearance during the peak nesting season, thereby avoiding direct impacts to breeding birds during the proposed project's construction phase.	

Mount Oval habitat mosaic (ER 6): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Bat species in the area	The above mitigation measures in relation to the woodland would also serve to minimise impacts on bat species in the area.	

Table 12.48: Avoidance/Mitigation Measures and Residual Impact Assessment for Donnybrook Wood and Stream (ER 7)

Donnybrook Wood and Stream (ER7): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
General floristic value	Protective barriers will be put in place prior to felling, in order to avoid damage to adjoining woodland habitat outside the land-take. These works will be carried out in accordance with the NRA Guidelines. These measures will avoid indirect damage to the woodland outside the landtake of the proposed road project.	Areas of Donnybrook Wood removed during site clearance will be compensated for by the planting of new woodland areas with species compositions that reflect the in-situ woodland. Plant material of native local provenance will be utilised. This will minimise the impacts on the general floristic and biodiversity value of the woodlands. Replacement planting will compensate in part but the woodland's fragmentation will present a residual '**Significant Negative Impact at Local Scale**' over the short to medium term. Particular attention will be paid to bat commuting routes. Mitigation measures outlined in **Sections 12.7.1** and **12.7.2** will be implemented at these sites. The mitigation measures outlined for trees with bat roosts or bat roost potential means that there will be no residual impact on the bat population in the area – **'No Impact'.** Detailed mitigation and best practice design measures have been provided in **Section 12.7.1** and **Section 12.7.2** for badger and other terrestrial mammals within the project's ZoI. Therefore the residual impact to badgers and other terrestrial mammals are not expected to be significant, even on a local level – **'Not Significant'.** The best practice, avoidance and mitigation measures, as outlined in **Chapter 10: Aquatic Ecology** will restrict potential impacts to receiving watercourses. Therefore the likelihood of impacts to the aquatic environment of these watercourses is decreased from 'Significant on a Local Level' to **'Not Significant'.**
Bird nesting potential	Felling of trees and clearance of hedgerows, treelines and scrub will not be carried out during the bird nesting season between 1st March and 31st August (inclusive), unless under licence from the NPWS.	
Bat species in the area	The above mitigation measures in relation to the woodland would also serve to minimise impacts on bat species in the area.	
Badgers and other terrestrial mammals	A pre-construction terrestrial mammal survey will be carried out in order to ensure that no new badger setts or mammal burrows have become established in the area. If any new badger setts are found within the alignment or its environs, a derogation licence of the Minister of the AHRRGA will be applied for through the NPWS Wildlife Licensing Unit, to exclude and excavate the setts. Only on the granting of licence can the sett be removed prior to the commencement of construction works. All works will be carried out in accordance with the NRA *Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes* (NRA, 2006a).	
Water Quality	Detailed mitigation measures on pollution prevention of watercourses within the ZoI, including the Donnybrook Stream are outlined in **Section 3.6 and 3.13 of Chapter 3: Description of the Proposed Road Development**, **Chapter 9: Hydrology and Drainage** and **Chapter 10: Aquatic Ecology.**	

Table 12.49: Avoidance and Mitigation Measures and Residual Impact Assessment for the Glounatouig Stream at Ballinrea (ER 8), Glounatouig Tributary (ER 9) and the Glounatouig Stream at Hilltown (ER 10)

Glounatouig Stream at Ballinrea (ER 8), Glounatouig Tributary (ER 9) and the Glounatouig Stream and Hilltown (ER 10): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Water Quality	Detailed mitigation measures on pollution prevention are outlined in **Section 3.6 and 3.13 of Chapter 3: Description of the Proposed Road Development**, **Chapter 9: Hydrology and Drainage** and **Chapter 10: Aquatic Ecology.**	Areas of woodland and scrub removed during site clearance will be compensated for by landscape planting comprising species compositions that reflect the in-situ woodland. Plant material of native local provenance will be utilised. This will minimise the impacts on the general floristic and biodiversity value of the woodlands. – **'Not Significant'.** Particular attention will be paid to bat commuting routes. Mitigation measures outlined in **Sections 12.7.1** and **12.7.2** will be implemented at these sites. The mitigation measures outlined for trees with bat roosts or bat roost potential means that there will be no residual impact on the bat population in the area – **'No Impact'.** Detailed mitigation and best practice design measures have been provided in **Section 12.7.1** and **Section 12.7.2** for badger and other terrestrial mammals within the proposed project's ZoI. Therefore the residual impact to badgers and other terrestrial mammals are not expected to be significant, even on a local level – **'Not Significant'.** The best practice, avoidance and mitigation measures, as outlined in **Chapter 10** will restrict potential impacts to receiving watercourses. Therefore the likelihood of impacts to the aquatic environment of these watercourses is decreased from 'Significant on a Local Level' to **'Not Significant'.** The residual impact to this ER is therefore considered to be **'Not Significant'.**
Aquatic species within the watercourses (including the Annex II species Otter)	Detailed mitigation measures on pollution prevention of watercourses including the Glounatouig Stream are outlined **in Section 3.6 and 3.13 of Chapter 3: Description of the Proposed Road Development**, **Chapter 9: Hydrology and Drainage** and **Chapter 10: Aquatic Ecology**. In addition, best practice design and species specific mitigation measures for otter are provided in **Sections 12.7.1** and **12.7.2**.	
General floristic value	Protective barriers will be put in place prior to felling, in order to avoid damage to adjoining woodland, scrub, hedgerow, treeline and semi-natural grassland habitat outside the land-take. These works will be carried out in accordance with the NRA Guidelines. These measures will avoid indirect damage to the woodland, scrub, treeline and hedgerow habitats outside the landtake of the proposed road project.	
Bird nesting potential	Felling of trees and clearance of hedgerows, treelines and scrub will not be carried out during the bird nesting season between 1st March and 31st August (inclusive), unless under licence from the NPWS.	
Bat species in the area	The above mitigation measures in relation to the woodland habitats would also serve to minimise impacts on bat species in the area.	
Badgers and other terrestrial mammals	A pre-construction terrestrial mammal survey will be carried	

Glounatouig Stream at Ballinrea (ER 8), Glounatouig Tributary (ER 9) and the Glounatouig Stream and Hilltown (ER 10): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
	out in order to ensure that no new setts have become established in the area. If any new setts are found within the alignment, a derogation licence of the Minister of the AHRRGA will be applied for through the NPWS Wildlife Licensing Unit, to exclude and excavate the setts. Only on the granting of licence can the sett be removed prior to the commencement of construction works. All works will be carried out in accordance with the NRA *Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes* (NRA, 2006a). Upgraded water crossings will provide more accessible route if compared to badger crossing under the road. These have a 'high' likelihood of success.	

Table 12.50: Avoidance and Mitigation Measures and Residual Impact Assessment for the Abandoned Railway Line with Woodland Copse, Scrub and Pond (ER 11)

Abandoned railway line with woodland copse, scrub and pond (ER 11): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Bird nesting potential	Felling of trees and clearance of hedgerows, treelines and scrub will not be carried out during the bird nesting season between 1st March and 31st August (inclusive), unless under licence from the NPWS. These measures have a probable chance of success.	Sections of woodland and removed during site clearance will be compensated for by landscape planting comprising species compositions that reflect the in-situ woodland. Plant material of native local provenance will be utilised. This will minimise the impacts on the general floristic and biodiversity value of the woodlands – **'Not Significant'.** Particular attention will be paid to bat commuting routes. Mitigation measures outlined in **Sections 12.7.1** and **12.7.2** will be implemented at these sites. The mitigation measures outlined for trees with bat roosts or bat roost potential means that there will be no residual impact on the bat population in the area – **'No Impact'.** Detailed mitigation and best practice design measures have been provided in **Sections 12.7.1** and **12.7.2** for badger and other terrestrial mammals within the proposed project's ZoI. Residual impacts to these receptors are not expected to be significant, even on a local level – **'Not Significant'.** The residual impact to this Ecological Receptor is therefore considered to be '**Not Significant**'.
General floristic value	Protective barriers will be put in place prior to felling, in order to avoid damage to adjoining woodland, scrub, hedgerow, treeline and semi-natural habitats outside the land-take. These works will be carried out in accordance with the NRA Guidelines. These measures will avoid indirect damage to the woodland outside the landtake of the proposed road project. They have a probable chance of success.	
Bat species in the area	The above mitigation measures in relation to the woodland habitats would also serve to minimise impacts on bat species in the area. These measures have a probable chance of success.	
Badgers and other terrestrial mammals	A pre-construction terrestrial mammal survey will be carried out in order to ensure that no new setts have become established in the area. If any new setts are found within the alignment, a derogation licence of the Minister of the AHRRGA will be applied for through the NPWS Wildlife Licensing Unit, to exclude and excavate the setts. Only on the granting of licence can the sett be removed prior to the commencement of construction works. All works will be carried out in accordance with the NRA *Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes* (NRA, 2006a). Upgraded water crossings will provide more accessible route crossings if compared to badger crossing under the road. These have a 'high' likelihood of success.	

Table 12.51: Avoidance and Mitigation Measures and Residual Impact Assessment for Raffeen Quarry (ER 12)

Raffeen Quarry (ER 12): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Dry calcareous grassland	Approximately 0.75ha ha of scrub (WS1) / dry neutral and calcareous grassland (GS1) mosaic and dry neutral calcareous grassland (GS1) is located within the footprint of the proposed road project at Raffeen Quarry. Approximately 1.7 ha of dry calcareous grassland is located immediately south of the road project, within the project CPO line but outside of the road development footprint. To mitigate potential disturbance and loss of these habitats turves supporting dry calcareous grassland will be removed from the road and embankment footprint and translocated to suitable areas within the proposed route's CPO line. Translocation of the turves comprising areas of dry calcareous grassland will be completed prior to commencement of fencing works for the proposed road project. Removal of turves from the semi-natural grassland habitat will be completed using a mini digger and hand held tools. Turve translocation will take place in autumn to avoid summer drought events and their associated stresses on the turve vegetation community. Autumn translocation will also facilitate root establishment and growth where soils will still be relatively warm and moist. Further details covering the translocation of dry calcareous grassland at Raffeen Quarry are presented in the Habitat and Species Management Plan provided in **Appendix 12B** in **Volume 4**.	The impact(s) on this ER is considered to be '**Significant on a County Level**'. Habitat translocation and recreation proposals will reduce the likelihood of impacts to the calcareous grassland, wetland habitats and pennyroyal habitats comprising this ER. With the implementation of avoidance and mitigation measures, potential impacts to these components will be reduced from a Significant Impact on a County Level' to '**Significant Impact on a local Level**'. Establishment and maturation of mitigation measures (such as calcareous grassland, wetlands and pennyroyal;) for this ER will further reduce the impact magnitude over the short to medium term to **Negligible** as the grassland, pennyroyal and wetland areas establish and mature.
Pennyroyal	Undertake botanical survey of the Raffeen Quarry site to establish the abundance and distribution and subsequently map pennyroyal populations within the site, prior to the initiation of construction works for the M28 road project. Using the findings of this survey, avoid pennyroyal populations at Raffeen outside of the works area throughout the project's construction phase. To avoid potential indirect impacts associated with the project's construction phase, translocation of pennyroyal	

Raffeen Quarry (ER 12): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
	populations from within the proposed footprint alignment to an area of recolonising bare ground at Shanbally. This area supports an existing population of pennyroyal and also supports comparable habitat/edaphic conditions to those present at Raffeen Quarry; i.e. bare/sparsely vegetated ground that supports localised ephemeral ponding and abundances of bryophyte growth. Details on the translocation of this species are detailed in the Species and Habitats Management Plant provided in **Appendix 12B** in **Volume 4**.	
Wetland habitats	Creation of wetland habitats within the roadway CPO line similar to those currently present with the quarry footprint. Harvesting of wetland species and macrophytes currently in-situ within the wetland areas for translocation to created wetland habitats. Encourage the establishment of emergent aquatic macrophytes in addition to floating and submerged aquatics within the pond and its environs. The creation of compensatory wetland habitats within the immediate environs of the proposed road project will provide suitable habitat for invertebrates such as dragonflies and damselflies. Created wetlands will recreate those wetland areas currently in-situ at Raffeen Quarry. The wetland habitats will support varying water depths and vegetation cover and will support adjoining areas of scrub and rough grassland to facilitate both the larval and adult stages of the dragonfly and damselfly life cycle. Details and sequencing in relation to decommissioning/drawdown of the existing wetland habitat and the subsequent creation of a wetland habitat are presented in the Species and Habitat Management Plan provided in **Appendix 12B** in **Volume 4**.	
Peregrine	The proposed route is located within the footprint of confirmed Peregrine Falcon breeding habitat at Raffeen Quarry. However, a section of suitable cliff face habitat will remain following the construction of the road and accompanying embankment in this area. Therefore it is proposed to mitigate for the loss of suitable Peregrine Falcon habitat by facilitating ongoing usage of adjoining or	Peregrine Falcon using the Raffeen Quarry site is considered to be an ER of International Importance. Mitigation measures are proposed to facilitate continued Peregrine Falcon nesting activity to the south of the road. It is proposed to maintain this site as a viable nesting site that would not endanger these birds or their young through collision, disturbance and /

Raffeen Quarry (ER 12): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
	nearby habitat, by reducing the risk of disturbance and collision associated with the nearby road project. In order to avoid direct and indirect disturbance of ongoing breeding activity within the quarry, it is proposed to undertake construction works in this area outside of the breeding season, March 1st to August 31st inclusive. The proposed construction works will not compromise the structural integrity or suitability of the remaining cliff face habitats located to the south of the road footprint. During the project's operational phase, landscaping measures are proposed to screen the proposed M28 from the cliff habitat while directing Peregrine Falcon movements away from theM28 footprint and adjoining embankments. It is proposed to landscape the infill embankments on both sides of the M28 as it passes through Raffeen Quarry. These landscaping proposals will direct Peregrine Falcon to either (a) fly south or away from the proposed M28 or (b) over the footprint of the proposed M28 footprint. To do this, heavy standard trees will be planted on the higher embankment areas grading down to whips/feathered transplant trees and shrubs within the lower embankment areas. Further details of landscape mitigation at Raffeen Quarry are presented in the Species and Habitat Management Plan provided in **Appendix 12B** in **Volume 4**.	or disruption. In addition, it is proposed to establish artificial Peregrine Falcon nesting habitats, through securing nesting trays/ledges and nest boxes, in the local area to provide alternative nesting/breeding habitats during the project's construction phase. The construction phase of the project will result in the direct loss of suitable nesting and breeding habitat which is considered to be '**Significant Impact on a Local Level**' over the short term. The provision of alternate nesting habitat will enable continued breeding activities of Peregrine Falcon over the short to medium term. Additionally, the maintenance of cliff face habitat to the south of the road, in addition to the establishment of landscaping and screening planting measures will enable continued breeding activities of Peregrine Falcon over the short to medium term resulting in a '**Negligible to Not Significant**' impact.

Table 12.52: Avoidance and Mitigation Measures and Residual Impact Assessment for Barnahely and Castlewarren Ruins (ER 13)

Barnahely and Castlewarren Ruins (ER 13): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Castlewarren Ruins	Direct impacts to the ruins of Castlewarren and its associated stone wall network will not occur. Tree and hedgerow planting associated with the proposed project and its environs will provide more commuting, feeding and foraging routes for mammals and avifauna associated with Castlewarren.	There will be no residual impact to Castlewarren Demesne, its associated treeline and hedgerow networks and their inherent value to local flora and fauna – '**Not Significant'**.

Table 12.53: Avoidance and Mitigation Measures and Residual Impact Assessment for Dry Calcareous Grassland and Mixed Broadleaved Woodland North of Lough Beg (ER 14)

Dry calcareous grassland and mixed broadleaved woodland north of Lough Beg (ER 14): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Dry calcareous grassland and mixed broadleaved woodland	The proposed M28 route will avoid this area. There will be no impacts to this ER and thus no need for Avoidance/Mitigation measures.	This ER is considered to be of *Local Importance (Higher Value)*. There will be no impacts to this ER (direct or indirect), even in the absence of best practice measures. Therefore residual impacts to this ER are considered to be '**Not Significant'**.

Table 12.54: Avoidance and Mitigation Measures and Residual Impact Assessment for Species Rich Scrub at Ringaskiddy (ER 15)

Species rich scrub woodland at Ringaskiddy (ER 15): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
General floristic value	Protective barriers will be put in place prior to felling, in order to avoid damage to adjoining woodland habitat outside the land-take. These works will be carried out in accordance with the NRA Guidelines. These measures will avoid indirect damage to the woodland outside the landtake of the proposed road project.	Scrub removed during site clearance will be compensated for by the planting of new trees, shrubs and woodland areas with species compositions that reflect the in-situ woodland. Plant material of native local provenance will be utilised. This will minimise the impacts on the general floristic and biodiversity value of the woodlands. – '**Not Significant**'. Particular attention will be paid to bat commuting routes. Mitigation measures outlined in **Sections 12.7.1** and **12.7.2** will be implemented at these sites. The mitigation measures outlined for trees with bat roosts or bat roost potential means that there will be no residual impact on the bat population in the area – **'No Impact'.** Detailed mitigation and best practice design measures have been provided in **Sections 12.7.1** and **12.7.2** for badger and
Bird nesting potential	Felling of trees and clearance of hedgerows, treelines and scrub will not carried out during the bird nesting season between 1st March and 31st August (inclusive), unless under licence from the NPWS.	
Bat species in the area	The above mitigation measures in relation to the woodland would also serve to minimise impacts on bat species foraging and commuting within this ER.	
Badgers and other terrestrial mammals	A pre-construction terrestrial mammal survey will be carried out in order to ensure that no new setts have become established in the area. If any new setts are found within the alignment, a derogation	

Species rich scrub woodland at Ringaskiddy (ER 15): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
	licence of the Minister of the AHRRGA will be applied for through the NPWS Wildlife Licensing Unit, to exclude and excavate the setts. Only on the granting of licence can the sett be removed prior to the commencement of construction works. All works will be carried out in accordance with the *NRA Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes* (NRA, 2006a). Upgraded water crossings will provide more accessible crossing points if compared to badger crossing under the road.	other terrestrial mammals within the proposed project's ZoI. Residual impacts to these receptors are not expected to be significant, even on a local level – **'Not Significant'.** Residual impacts to this ER are considered to be '**Not Significant'**.

Table 12.55: Avoidance and Mitigation Measures and Residual Impact Assessment for Badger Sett at Ballinrea (ER 16)

Badger sett at Ballinrea (ER 16): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Badgers and other terrestrial mammals	A pre-construction terrestrial mammal survey will be carried out in order to ensure that no new setts have become established in the area. Setts found within the alignment or fragmented by the proposed alignment will require exclusion under a derogation licence from the Minister of the DAHRRGA. This will be applied for through the NPWS Wildlife Licensing Unit, to exclude and excavate the setts. Only on the granting of licence can the sett be removed prior to the commencement of construction works. All works will be carried out in accordance with the NRA *Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes* (NRA, 2006a). Upgraded water crossings will provide more accessible if compared to badger crossing under the road.	This ER is considered to be of *Local Importance (Higher value).* Detailed mitigation and best practice design measures have been provided in **Sections 12.7.1** and **12.7.2** for badger and other terrestrial mammals within the project's ZoI. Residual impacts to these receptors are not expected to be significant, even on a local level – **'Not Significant'.** Residual impacts to this ER are considered to be '**Not Significant'**.

Table 12.56: Avoidance and Mitigation Measures and Residual Impact Assessment for Buzzard Nest within Mature Treeline (ER 17)

Buzzard nest within mature treeline (ER 17): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Treeline supporting Buzzard nesting habitat	Protective barriers will be put in place prior to felling, in order to avoid damage to adjoining trees habitat outside the land-take. These works will be carried out in accordance with the NRA Guidelines. These measures will avoid indirect damage to treeline areas outside the land-take of the proposed road project. They have a probable chance of success. Site clearance during the bird nesting season will generally be avoided. If works must proceed during this season a derogation licence will be applied for from the Wildlife Licencing Unit of the NPWS. The following protective measures for nesting and breeding birds, such as Buzzard will be adopted as part of the proposed works: ▪ Avoid clearing vegetation during the bird nesting season, March 01st to August 31st inclusive; ▪ Where vegetation clearance is required during this period, vegetation will be surveyed by an ecologist in advance of any construction works taking place in order to determine the presence of nests; and ▪ Where nests, etc., are present, then a buffer zone will be cordoned off; and, the nests, etc., will either be left in-situ until the end of the bird nesting season or dealt with in accordance the terms of a licence sought from and issued by the Minister for Arts, Heritage, Regional, Rural and Gaeltacht Affairs. The contracting authority and the appointed contractor will endeavour to make all reasonable efforts to avoid tree felling and scrub clearance during the peak nesting season, thereby avoiding direct impacts to breeding birds during the proposed project's construction phase. The above mitigation measures in relation to the woodland would	This ER is considered to be of *Local Importance (Higher value)*. Sections of treelines removed during site clearance will be compensated for by landscape planting comprising species compositions that reflect the in-situ treeline habitat. Plant material of native local provenance will be utilised. In spite of the mitigation measures utilised, the loss of this treeline habitat will remain 'Significant Negative at the Receptor Level' over the short to medium term. As planted treeline and woodland areas establish and mature over the medium to long term, these impacts will improve to '**Not Significant'.** The residual impact to this ER is therefore considered to be '**Significant at the Local Level'.**

Buzzard nest within mature treeline (ER 17): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
	also serve to minimise impacts on bat species using this feature as a foraging and/or commuting route.	

Table 12.57: Avoidance and Mitigation Measures and Residual Impact Assessment for Species Listed on Annex II of the EU Habitats Directive and Annex I of the EU Birds Directive (ER 18)

Species listed on Annex II of the EU Habitats Directive and Annex I of the EU Birds Directive (ER 18): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Species listed on Annex II of the EU Habitats Directive and Annex I of the EU Birds Directive	Detailed mitigation measures on pollution prevention outlined in **Section 3.6 and 3.13 of Chapter 3: Description of the Proposed Road Development**, **Chapter 9: Hydrology and Drainage** and **Chapter: 10 Aquatic Ecology** will avoid all impacts to water based and water dependent annexed species. Upgraded water crossings will be more accessible to otter crossing under the road. The existing natural riparian protection buffer zone vegetation cover shall be retained and extended to a minimum of 5.0m. Other landscaping measures shall be undertaken, to ensure that watercourses may continue as a contiguous natural habitat for this species. All mitigation in relation to otters will be conducted in line with the NRA *Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes (NRA, 2006b)*. In addition where species are present or are downstream, the works will be supervised by a suitably qualified ecologist, to ensure the protection of the species. This has a 'high' likelihood of success. Peregrine Falcon, an Annex I species on the EU Birds Habitats Directive has been confirmed breeding within the cliff face habitats of Raffeen Quarry. The proposed route is located within the footprint of confirmed Peregrine Falcon habitat at Raffeen Quarry. However, a section of suitable cliff face habitat will remain following the construction of the M28 and accompanying embankment in this area. Therefore it is proposed to mitigate for the loss of suitable Peregrine Falcon habitat by facilitating ongoing usage of adjoining or nearby habitat, by reducing the risk of disturbance and collision associated with the nearby road project. In order to avoid direct and indirect disturbance of ongoing breeding	Peregrine Falcon using the Raffeen Quarry site is considered to be an ecological receptor of International Importance. Mitigation measures are proposed to facilitate continued Peregrine Falcon nesting activity to the south of the road. It is proposed to maintain this site as a viable nesting site that would not endanger these birds or their young through collision, disturbance and / or disruption. In addition, it is proposed to establish artificial Peregrine Falcon nesting habitats, through securing nesting trays / ledges and nest boxes, in the local area to provide alternative nesting / breeding habitats during the project's construction phase. The construction phase of the development will result in the direct loss of suitable nesting and breeding habitat which is considered to be '**Significant Impact on a Local Level**' over the short term. The provision of alternate nesting habitat will enable continued breeding activities of Peregrine Falcon over the short to medium term. Additionally, the maintenance of cliff face habitat to the south of the road, in addition to the establishment of landscaping and screening planting measures will enable continued breeding activities of Peregrine Falcon over the short to medium term resulting in a '**Negligible to Not Significant**' impact. Residual impacts will be '**Not Significant**' to other species listed on Annex II of the EU Habitats Directive and Annex I of the EU Birds Directive.

Species listed on Annex II of the EU Habitats Directive and Annex I of the EU Birds Directive (ER 18): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
	activity within the quarry, it is proposed to undertake construction works in this area outside of the breeding season, March 1st to August 31st inclusive. The proposed construction works will not compromise the structural integrity or suitability of the remaining cliff face habitats located to the south of the road footprint. During the project's operational phase, landscaping measures are proposed to screen the proposed M28 from the cliff habitat while directing Peregrine Falcon movements away from the road footprint and adjoining embankments. It is proposed to landscape the infill embankments on both sides of the road as it passes through Raffeen Quarry. These landscaping proposals will direct Peregrine Falcon to either (a) fly south or away from the proposed road or (b) over the footprint of the proposed road footprint. To do this, heavy standard trees will be planted on the higher embankment areas grading down to whips/feathered transplant trees and shrubs within the lower embankment areas (See **Appendix 12B** in **Volume 4**). The proposed project will not impact those other species listed on Annex I of the EU Birds Directive (see **Table 12.9**). Annex I bird species identified for hectad W76 are primarily associated with coastal, intertidal or wetland habitats, none of which will be impacted by the proposed project. Annex I species that are of Conservation Interest for Cork Harbour SPA will not be impacted by the proposed project. Impacts to species associated with Cork Harbour SPA are considered in greater detail in the accompanying NIS. The establishment and maturation of landscape planting in the medium to long term may benefit local avifaunal populations that may utilise areas of scrub, shrub and woodland planting proposed for the project.	

Table 12.58: Avoidance and Mitigation Measures and Residual Impact Assessment for Species Listed for Faunal Species Protected under the Irish Wildlife Acts (ER 19)

Faunal species protected under the Irish Wildlife Acts (ER 19): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Faunal species protected under the Irish Wildlife Acts	Detailed mitigation measures on pollution prevention outlined in **Section 3.6 and 3.13 of Chapter 3: Description of the Proposed Road Development**, **Chapter 9: Hydrology and Drainage** and **Chapter: 10 Aquatic Ecology** will avoid the likelihood of impacts to water based and water dependent species. Detailed mitigation measures for other species protected under the Irish Wildlife Act (1976) (including bats, otters and bats) are provided in **Sections 12.7.1** and **12.7.2**.	This ER is deemed to be of National Importance. With the implementation of appropriate mitigation and avoidance measures, the residual impact to these species are not expected to be significant, even on a local level – '**Not Significant**'.

Table 12.59: Avoidance and Mitigation Measures and Residual Impact Assessment for Flora Protection Order (FPO Species) (ER 20)

Flora Protection Order (FPO) Species (ER 20): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Species protected under the Flora Protection Order with W76 Meadow barley, Weasel's snout, Pennyroyal	Pennyroyal (*Mentha pulegium*) is located within the footprint and to the north of the proposed M28 Road Project where it intersects Raffeen Quarry. A separate population of pennyroyal occurs within the footprint of the proposed M28 Road Project at Shanbally within an area of recolonising bare ground, previously used as a materials holding area. Both populations of pennyroyal are located within the footprint and immediate environs of the proposed M28 Road Project as it passes through Raffeen Quarry and the Shanbally holding area. These populations will be translocated, under licence, to nearby suitable habitats identified as receptor habitats. Proposals to translocate pennyroyal from the footprint of the proposed M28 road at Raffeen and Shanbally are presented in greater detail in	This ER is deemed to be of National Importance. Mitigation measures in the form of habitat recreation and species translocation are proposed for Pennyroyal populations within the footprint of the proposed road project. Therefore will be no residual impact to these species – '**Not Significant**'.

Flora Protection Order (FPO) Species (ER 20): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
	Appendix 12B in **Volume 4**. All remaining species listed on the FPO identified within W76 are not located within the footprint or the immediate environs of the proposed M28.	

Table 12.60: Avoidance and Mitigation Measures for Avifauna Listed on the BoCCI (Colhoun and Cummins, 2013) (ER 21)

Avifauna listed on the BoCCI (ER 21): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Avifauna listed as species of high conservation concern on the BoCCI (see **Table 12.9**)	The clearance and disturbance of hedgerows, treelines and scrub from the proposed project's footprint will be completed outside of the over-wintering breeding bird season March to August inclusive (See **Section 12.7.2.7**). The proposed works will not be located within or within proximity to designated intertidal areas such as Lough Beg, which could potentially support many of the BoCCI species listed in **Table 12.9**. Clearance of hedgerows and treelines within the land-take of the proposed road project will be compensated for by the provision of planting as part of the landscaping master plan. A species-rich selection of native trees and shrubs will be selected. The species assemblages will reflect that of the existing treelines. Salvaged plants, cuttings or seedlings from the existing treelines will be used, in order to minimise the introduction of plant genotypes not local to the area. Treeline and hedgerow planting will seek to create continuous and contiguous coverage to woodland habitats. Treelines and hedgerows adjoining cereal fields are of local importance to Yellowhammer as viable breeding habitats. Treeline and/or hedgerow loss in these areas will be targeted for replacement and integration into the landscaping design for the	The timing of vegetation clearance and the establishment and maturation of proposed landscape measures such as linear woodland features, scrub and woodlands will reduce the impact magnitude to this ER over the short to medium term. With the implementation of appropriate mitigation and landscape planting measures, the residual impact to these species are not expected to be significant, even on a local level – **'Not Significant'**. The maturation of woodland planting along the proposed project may result in a net positive impact at the local level.

Avifauna listed on the BoCCI (ER 21): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
	proposed road project. The establishment and maturation of landscape planting in the medium to long term may benefit local avifaunal populations, particularly passerine populations that may utilise areas of scrub, shrub and woodland planting proposed for the project.	

Table 12.61: Avoidance/Mitigation Measures and Residual Impact Assessment for Hedgerows and Treelines within the Study Area (ER 22)

Hedgerows and treelines within the Study Area (ER 22): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
General floristic value	Clearance of hedgerows and treelines within the land-take of the proposed road project will be compensated for by the provision of planting as part of the landscaping master plan. A species-rich selection of native trees and shrubs will be selected. The species assemblages will reflect that of the existing treelines. Salvaged plants, cuttings or seedlings from the existing treelines will be used, in order to minimise the introduction of plant genotypes not local to the area.	Linear woodland features removed during site clearance will be compensated for by proposed landscape planting with species compositions that reflect the existing treelines. Plants of native local provenance will be utilised. This will minimise the impacts on the general floristic and biodiversity value of the treelines. Particular attention will be paid to bat commuting routes and mitigation measures outlined in **Sections 12.7.1** and **12.7.2** will be implemented at these sites. The implementation of mitigation measures will ensure that the residual impact of the road project on hedgerows and treelines in the study area will no longer be significant, even on a local level – '**Not Significant'**.
Value as 'wildlife corridors'	Planting of tree and shrub 'whips' of Irish provenance as part of the landscaping mitigation will provide alternative corridors for wildlife. Site clearance during the bird nesting season will generally be avoided. If works must proceed during this season a derogation licence will be applied for from the Wildlife Licencing Unit of the NPWS. The following protective measures for nesting and breeding birds, such as Buzzard will be adopted as part of the proposed works: ▪ Avoid clearing vegetation during the bird nesting season, March 01st to August 31st inclusive;	

Hedgerows and treelines within the Study Area (ER 22): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
	▪ Where vegetation clearance is required during this period, vegetation will be surveyed by an ecologist in advance of any construction works taking place in order to determine the presence of nests; ▪ Where nests, etc., are present, then a buffer zone will be cordoned off; and, the nests, etc., will either be left in-situ until the end of the bird nesting season or dealt with in accordance the terms of a licence sought from and issued by the Minister for Arts, Heritage, Regional, Rural and Gaeltacht Affairs; and ▪ The contracting authority and the appointed contractor will endeavour to make all reasonable efforts to avoid tree felling and scrub clearance during the peak nesting season, thereby avoiding direct impacts to breeding birds during the proposed project's construction phase. Existing hedgerows and treelines within the CPO but not within the proposed M28 Road Project footprint will be incorporated into the scheme landscaping plan for enhancement by under planting to affect a greater structural diversity and longevity for these habitats.	
Value as foraging and navigational routes for bats	Planting of tree and shrub whips of Irish provenance as part of the landscaping mitigation will provide alternative corridors for wildlife. Linear features such as hedgerows and treelines serve as commuting corridors for bats (and other wildlife) and these shall be retained and/or replaced. Any bank side vegetation along watercourses requiring removal shall be replaced with native shrubs/trees after works. Native plant species attract more insects then non-native species. This is especially important adjacent to bridges identified as having bat roosting potential. Specific mitigation measures in relation to bats are outlined in **Sections 12.7.1** and **12.7.2** above. All bat mitigation will be conducted in line with the NRA *Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes* (NRA, 2006c).	

Hedgerows and treelines within the Study Area (ER 22): Principal Elements of Ecological Value	Avoidance/Mitigation Measures	Residual Impact
Potential as bat roosts	All trees will be inspected for roosts prior to felling. Any roosts within the land-take will be removed (under licence of the Minister of the AHRRGA, applied for through the NPWS Wildlife Licensing Unit) by a bat specialist. Bat boxes will be provided to compensate for any trees with roost potential lost. These will be installed prior to site clearance. Tree-felling will be undertaken in the period late August to late October/early November. During this period bats are capable of flight and may avoid the risks of tree-felling if proper measures are undertaken. If a tree containing a known bat roost must be felled outside the optimum period (under licence of the Minister of the AHRRGA, applied for through the NPWS Wildlife Licensing Unit), the bat specialist must endeavour to remove any bats to safety. These mitigation measures will be conducted in accordance with the NRA *Guidelines for the Treatment of Bats During the Construction of National Road Schemes* (NRA, 2006c). Further mitigation for bat species in the area is outlined in **Sections 12.7.1** and **12.7.2** above.	

12.8 RESIDUAL IMPACTS

12.8.1 Construction Phase

The proposed M28 Road Project will potentially impact upon 3 KERs which are considered of conservation importance (1 at County level, 1 at Local Importance (higher value) and 1 at Local Importance - receptor level). The impact is considered significant to these three receptors mainly due to habitat loss, species disturbance and abandonment and habitat fragmentation. Elsewhere along the route corridor, the ecological impacts on terrestrial habitats are not considered significant. A list of likely residual impacts for the project is as follows:-

- Net loss of 0.7ha and fragmentation of semi-natural woodland habitat associated with Donnybrook Wood and stream,
- Loss of treeline habitat for use as nesting habitat by Buzzard, and
- Temporary disturbance of Peregrine Falcon nesting habitat, temporary disturbance of semi-natural grassland and pennyroyal populations within CPO line at Raffeen Quarry. Temporary disturbance to avifaunal and invertebrate species associated with wetland habitat and net loss of 0.63ha from wetland habitat under the footprint of the proposed road project.

Construction of the proposed Road Project will result in the loss of semi-natural scrub and grassland habitats along the proposed road project route including the service area. This loss will be significant at the local scale. The implementation of landscape planting may compensate in part for the loss of these semi-natural habitats, over the medium to long term, as these landscaping features continue to establish and mature.

The implementation of mitigation measures will prevent long-term significant impacts on the remaining species of conservation interest present in the study area, such as badgers, bats, otters and avifauna. All species of flora and fauna described in this report would be expected to maintain a presence in the immediate area of the proposed M28 Road Project.

Areas of habitats to be replaced or translocated as part of the proposed works are addressed in greater detail in the accompanying Habitat and Species Management Plan in **Appendix 12B** in **Volume 4**.

12.8.2 Operational Phase

Residual impacts associated with the operational phase of the proposed M28 Road Project will be mitigated through the implementation of mitigation and design measures during the project's construction phase. This will include retention and attenuation of road drainage, the continued functioning of mammal mitigation measures (including mammal proof fencing) and the establishment and maturation of landscape measures along the proposed road project. Robust and functioning surface water drainage system that includes the regulation and retention of suspended solids and hydrocarbons draining the Service Areas hard standing areas will ensure no residual impacts will occur from the Service Area.

12.9 MONITORING

The below monitoring measures will be undertaken during the project construction and operational phase to ensure the efficacy of the mitigation measures proposed for the scheme. These monitoring efforts will be completed in association with the monitoring proposed as part of the Habitat and Species Management Plan (See **Appendix 12B** in **Volume 4**).

- Monitoring of mammal proof fencing to determine defects, gaps and weaknesses;
- Monitoring of mammal underpasses to determine usage, efficacy and functionality for mammals in the surrounding locality;
- Monitoring of tree, woodland and landscape planting established for the project;
- Monitoring of bat boxes erected along the road project in addition to a condition assessment of landscape planting. Seasonal inspection of bat boxes shall be undertaken (excluding mid-June to mid-August, the lactation period of females, where any disturbance at this time can be detrimental to survival of young) to monitor bat usage and in wintertime for general wear and tear and to remove droppings following use the previous summer. This shall be undertaken by a licensed bat-handler[32].
- Monitoring of habitat creation measures at Raffeen Quarry;
- Monitoring of invasive species populations within the project and environs; and
- Monitoring of attenuation and mitigation measures, such as silt traps and hydrocarbon interceptors to attenuate run-off to watercourses and waterbodies.

[32] National Roads Authority (2006d): Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes. National Roads Authority, Dublin.

13. AIR AND CLIMATIC FACTORS

13.1 INTRODUCTION

This chapter should be read in conjunction with the site layout plans (**GA Series** in **Volume 5**) and **Chapters 1 to 3** of this EIS.

This assessment was prepared having regard to the EPA Guidelines on the Information to be contained in Environmental Impact Statements (EPA 2002), Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements) (EPA, 2003); the Revised Guidelines on the Information to be contained in Environmental Impact Statements (Draft September 2015) and the Advice Notes for Preparing Environmental Impact Statements (Draft September 2015]; the NRA Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes (Rev. 1) (NRA 2011).

13.2 METHODOLOGY

13.2.1 General Approach

Site specific baseline air quality monitoring has been carried out along the route corridors of the existing N28 and proposed road project to supplement the existing air quality data available from the EPA National Air Quality Monitoring Programme. The site specific monitoring identifies the existing pollutant trends in the area and establishes compliance with relevant ambient air legislation. Screening and detailed air dispersion models have been prepared in order to predict the future air quality trends as a result of traffic variations with the route corridors of the existing N28 and proposed M28 Road Project. An estimation of greenhouse gas (GHG) emissions from construction activities and operational traffic has also been included in this assessment.

13.2.2 Baseline Air Quality Data

Baseline air quality data has been derived from site specific monitoring undertaken along the existing N28 and proposed M28 Road Project coupled with reference to the EPA National Air Quality Monitoring Programme, Air Quality Zone B: Greater Cork Area.

As a result of the proximity of key receptors to the proposed road project and the potential for traffic derived emissions, the following parameters were monitored in the site specific baseline assessment:-

- Nitrogen Dioxide (NO_2) at 14 locations;
- Volatile Organic Compounds (BTEX) at 14 locations; and
- Particulate Matter (PM_{10}) at 1 location.

The locations used for the baseline monitoring survey are presented in **Table 13.1** and in **Figure 13.1**. At each of the sites A1 to A14, levels of nitrogen dioxide (NO_2) and Volatile Organic Compounds (VOCs) were measured using Diffusion Tubes, which were left at key kerbside locations for a period of one to three months. The tubes were then analysed at a UKAS accredited laboratory, giving an average concentration over the period. All results have been corrected for bias and annualised as per the procedures outlined in the NRA Guidelines.

At location A15, a BAM1020 Continuous Beta-attenuation Particulate Monitor was installed to measure fine particulate matter (PM_{10}). Measurements were carried out on a continuous basis for a period of circa one month.

Table 13.1: Description of Site Specific Baseline Air Quality Monitoring Locations

Reference	Type	Description	Duration and Timeframe
A1	Kerbside (local road)	Ringaskiddy on the L2545	**Survey 1**: 20th January 2015 to 10th March 2015
A2	Kerbside (local road)	Ringaskiddy (Shamrock Place)	
A3	Kerbside (regional road)	Warrens Cross Roads	
A4	Kerbside (local road)	Shanbally Mews	
A5	Kerbside (local road)	Raffeen	
A6	Kerbside (regional road junction)	Shannonpark Roundabout	
A7	Kerbside (local road)	Ballinrea Road	
A8	Kerbside (national primary road - dual carriageway)	N28-R609 Junction	
A9	Kerbside (national primary road - dual carriageway)	N28 Entrance to Mount Oval Village Estate	
A10	Kerbside (regional road junction)	R610 Rochestown Road	**Survey 1**: 20th October 2016 to 25th November 2016 **Survey 2**: 25th November 2016 to 13th January 2017 **Survey 3**: 13th January 2017 to 22nd February 2017
A11	Suburban Background	Rochestown Rise Estate	
A12	Suburban Background	Maryborough Heights Estate	
A13	Suburban Background	Rowan Hill Estate	
A14	Kerbside (local road)	Rock Road, Carrigaline	
A15	Kerbside (national primary road - dual carriageway)	Mount Oval (10 metres from N28 kerb)	**Survey 1**: 23rd March 2017 to 30th April 2017

In addition to the site specific baseline assessment, monitoring data for nitrogen oxides (NO_x) particulate matter (PM_{10} and $PM_{2.5}$) and benzene are reported by the EPA on a continuous basis at a series of monitoring stations in the Cork area (Zone B). The EPA monitoring during 2014 and 2015 at South Link Road (on the former landfill site in the south of the city) is referenced in this assessment as a representative background given the proximity of this location to the N40 and the N27 road networks. Reference to baseline data gathered during the preparation of the EIA for the Ringaskiddy Resource Recovery Centre facility over the period August 2014 to July 2015 is also referred to in establishing the baseline.

Figure 13.1: Baseline Air Quality Monitoring Locations

Baseline Climate

Existing climate data for the study area has been derived from the Met Éireann 30 year averages. While is it not possible to apportion the changes in GHG emissions from this project with specific climate impacts, existing trends in transport related GHG emissions are noted with reference to the targets outlined in *Ireland's National Policy Position on Climate Action and Low Carbon Development*. In this regard, GHG emissions are quantified but it is not possible to predict the resultant climate impact from this project.

13.2.3 Construction Phase

Dust Emissions

Construction dust has the potential to cause local impacts through dust nuisance at the nearest sensitive receptors and also to sensitive ecosystems. The potential for dust generation from the construction activities associated with the proposed M28 road project and the Service Area (SA) is assessed on the basis of a review of the proposed methodologies and the proximity of these activities to sensitive receptors.

Construction activities such as stone importation, excavation, earth moving and backfilling may generate quantities of dust, particularly in dry weather conditions. The extent of any dust generation depends on the nature of the dust (soils, peat, sands, gravels, silts etc.) and the nature of the construction activity. In addition, the potential for dust dispersion and deposition depends on local meteorological factors such as rainfall, wind speed and wind direction.

In addition to the road construction along the proposed alignment, in the event that material is extracted from the quarry at Raffeen to facilitate the proposed road project and avoid the need to import material from offsite there is potential for indirect dust impacts on the nearest sensitive receptors.

The potential for dust emissions from the construction phase of the project, including the quarry operation under its current planning permission, is addressed qualitatively in accordance with the NRA Guidelines.

Greenhouse Gas Emissions

The construction phase climate assessment was carried out to identify sources and quantify total GHG emissions generated from the construction activities associated with the proposed M28 Road Project. This assessment was carried out using the carbon calculator for construction activities developed by the Environment Agency (EA) in the UK. The carbon calculator calculates the embodied carbon dioxide (CO_2) of materials plus CO_2 associated with their transportation. It also considers personal travel, site energy use and waste management.

13.2.4 Operational Phase

Air Quality Exposure Index from Road Traffic

The air quality exposure assessment was carried out using the methodology outlined in the NRA Guidelines and the UK Highways Agency Design Manual for Roads and Bridges (UK DMRB 2007), Volume 11, Section 3, Air Quality Assessment (referred to hereafter as the UK DMRB).

The general exposure to the change in concentrations is quantified using the UK DMRB Regional Air Quality Assessment tool. The UK DMRB Regional Air Quality Assessment spreadsheet is used to calculate the concentrations of nitrogen dioxide and particulate matter within 50m of the centreline of each alignment (existing N28 and proposed road project), as per the NRA Guidelines.

The aim of this assessment is to estimate the overall change in people's exposure to the pollutants nitrogen dioxide (NO_2) and particulate matter (PM_{10}) as a result of the proposed M28 road project. The aggregated results are then calculated by the addition of the assessment index for each pollutant on the existing and proposed networks. If there is a decrease in the pollutant concentrations and resultant improvement in air quality, a negative value is assigned. If there is an increase in concentrations and thus deterioration in air quality a positive value is assigned.

Road Traffic Emissions – Local Impact

A prediction of ground level concentrations of traffic derived pollutants from the proposed road was carried out using the procedures outlined in the NRA Guidelines. Modelling has been undertaken using both the UK DMRB Local Air Quality Assessment and CAL3QHCR predictive modelling tool.

Emission factors for each road link have been calculated using the Department for Environment Food & Rural Affairs (DEFRA) Emissions Factors Toolkit (EFT, Version 7) utilising the traffic flows, fraction HGVs and the minimum modelled speeds for each of the road links in the network. User specific Euro Class vehicle proportions for the Republic of Ireland for 2015 have been employed to allow for generation of national base emissions factors for the national fleet. The current fraction of HGVs as well as the predicted increase in HGV fraction with the development of the Port of Cork are both accounted for by the traffic predictions employed in the model.

In addition, the HGV emissions for the southbound section of the route between Bloomfield and Carr's Hill have been modified to account for the additional emissions anticipated with the incline in this area. This has been carried out using the procedures listed in the LAQM Technical Guidance (England) 2016 for accounting for gradient.

For all modelling exercises future predictions of the main polluting emissions, i.e. oxides of nitrogen (NO_x) and particulate matter (PM_{10} and $PM_{2.5}$) were carried out and the results compared against the relevant assessment criteria (refer **Tables 13.2 to 13.6**). For each section of the road, modelling was undertaken for a future scenario years for the 'Do-Minimum' (no road change) and 'Do-Something' (M28 road goes ahead) scenarios. The following scenarios have been modeled:-

- 2020 Do-Minimum (road remains as per existing N28 alignment);
- 2020 Do-Something (proposed M28 in operation);

- 2035 Do-Minimum (road remains as per existing N28 alignment); and
- 2035 Do-Something (proposed M28 in operation).

Currently, the environs surrounding the location of the proposed M28 road project are predominately rural in nature with scattered residential dwellings and areas of higher residential density at Rochestown, Maryborough Hill and Douglas to the north of the proposed road and Shanbally and Ringaskiddy to the south of the proposed road. Predictions of future air quality were undertaken at these residential locations (receptors) in the region of the existing N28 and proposed M28 road project. In addition, all designated protected areas for flora and fauna have been identified to quantify the potential impact of the 'Do-Something' scenario on the wider environment.

Background concentrations have been incorporated into the model taken from the EPA Air Quality Monitoring. Future background concentrations for the 2020 and 2035 scenario years have been devised following the procedures outlined in Appendix 5 of the NRA Guidelines.

Impacts from the Service Area (SA)

Specific impacts from the operation of the proposed Service Area are identified through a detailed review of the proposed operation of this facility and the risk of impact on local receptors.

Sensitive Ecosystems

The impact of oxides of nitrogen (NO_x) on sensitive ecosystems is a concern in relation to road projects. The NRA has developed a mechanism for the assessment of the significance of this impact. The NRA Guidelines state that should the predicted concentrations exceed 90% of the annual NO_x limit (30μg/m^3 as specified in S.I. 180 of 2011 – **Table 13.2**) or predict an increase of 2μg/m^3 in the annual average, then the sensitivity of the relevant species should be assessed by the project ecologist. The impacts of road traffic on all sensitive ecosystems during construction and operation and within 200m of the existing and proposed M28 routes are assessed as per the NRA methodology.

Emissions of Greenhouse and Acidifying Gases

The potential impact of the proposed M28 road project during the operational phase in terms of GHG emissions (CO_2) and acidifying gas emissions (NO_x) was addressed by calculating the speed and distance of traffic volumes on the existing N28 and proposed M28 road project. These predictions were carried out using the procedures outlined in the UK DMRB regional model.

Climate Change Adaption

In addition to GHG generation as described above, the adaptability of the proposed M28 road project to climate change has also been assessed. In particular, the impacts of flooding in the area on the proposed M28 road project are addressed through consultation with the CFRAM mapping for the area and interaction with the drainage specialist on the project.

13.2.5 Impact Assessment Criteria

During the construction phase, dust is considered the principle pollutant to atmosphere. However, there is no Irish or European Union or Commission guideline or legislative limits for total suspended particles, so the limits provided by the TA Luft guidance *Technical Instructions on Air Quality Control* (TA Luft, 2002) are employed. Under this guidance the Main Contractor will be required to maintain monthly dust levels below the guideline limit of 350mg/m^2/day as an annual average at sensitive residential receptors. Below this threshold, the potential for dust nuisance to impact people in the nearest residential, commercial or other structures will be minimised.

In addition to the potential for human impact, dust or particles falling onto plants can physically smother the leaves affecting photosynthesis, respiration and transpiration. The DMRB has reported that based on a literature review the most sensitive species (Epiphytic lichen and Sphagnum dominated communities) appear to be affected by dust deposition at levels above 1000mg/m^2/day which is significantly greater than the level at which dust deposition may start to cause a perceptible nuisance to humans (350mg/m^2/day).

In May 2008, the European Commission introduced a Directive on ambient air quality and cleaner air for Europe (2008/50/EC), which has been transposed into Irish Legislation through the revised Air Quality Standards Regulations (S.I. 180 of 2011). These Air Quality (AQ) Standards are presented in **Table 13.2**. The legislation specifies limit values in ambient air for sulphur dioxide (SO_2), lead (Pb), benzene (C_6H_6), particulate matter (PM_{10} and $PM_{2.5}$), carbon monoxide (CO), nitrogen dioxide (NO_2) and oxides of nitrogen (NO_x). These limits are mainly for the protection of human health and are largely based on review of epidemiological studies on the health impacts of these pollutants.

In addition, the Air Quality Standards Regulations (S.I. 180 of 2011) specify limits that apply to the protection of the wider environment including ecological receptors.

The NRA Guidelines specifies the significance criteria for determining air quality impacts. The predicted increases or decreases from the key areas along the route have been recorded to determine the significance of any impact in relation to the NRA criteria as presented in **Tables 13.3, 13.4** and **13.5**.

Table 13.2: Air Quality Standards Regulations (Source: S.I. 180 of 2011)

Pollutant	Criteria	Value
Nitrogen Dioxide (NO_2)	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 μg/m^3 NO_2
	Annual limit for protection of human health	40 μg/m^3 NO_2
	Annual limit for protection of vegetation	30 μg/m^3 NO + NO_2
Benzene (C_6H_6)	Annual limit for protection of human health	5 μg/m^3
Carbon Monoxide (CO)	Maximum daily 8-hour running mean	10 mg/m^3
Lead (Pb)	Annual limit for protection of human health	0.5 μg/m^3
Sulphur Dioxide (SO_2)	Hourly limit for protection of human health - not to be exceeded more than 24 times/year	350 μg/m^3
	Daily limit for protection of human health - not to be exceeded more than 3 times/year	125 μg/m^3
	Annual limit for protection of vegetation	20 μg/m^3

Pollutant	Criteria	Value
Particulate Matter (PM_{10})	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 $\mu g/m^3$ PM_{10}
	Annual limit for protection of human health	40 $\mu g/m^3$ PM_{10}
Particulate Matter ($PM_{2.5}$)	Annual target value for the protection of human health (Stage 1 to be achieved by 2018)	25 $\mu g/m^3$ $PM_{2.5}$
	Indicative limit for the protection of human health (Stage 2 to be achieved by 2020)	20 $\mu g/m^3$ $PM_{2.5}$

Table 13.3: Definition of Impact Magnitude for Changes in Ambient Air Pollutant Concentrations (Source: NRA, 2011)

Magnitude of Change	Annual Mean NO_2/PM_{10}	No. of Days with PM_{10} Concentration greater than 50$\mu g/m^3$	Annual Mean PM
Large	Increase/decrease ≥4$\mu g/m^3$	Increase/decrease >4 days	Increase/decrease ≥2.5$\mu g/m^3$
Medium	Increase/decrease 2 - <4$\mu g/m^3$	Increase/decrease 3 of 4 days	Increase/decrease 1.25 - <2.5$\mu g/m^3$
Small	Increase/decrease 0.4 - <2$\mu g/m^3$	Increase/decrease 1 or 2 days	Increase/decrease 0.25 - <1.25$\mu g/m^3$
Imperceptible	Increase/decrease <0.4$\mu g/m^3$	Increase/decrease <1 day	Increase/decrease <0.25$\mu g/m^3$

Table 13.4: Air Quality Impact Descriptors for Changes in Annual Mean Nitrogen Dioxide and PM_{10} and $PM_{2.5}$ Concentrations at a Receptor (Source: NRA, 2011)

Absolute Concentration in Relation to Objective/Limit Value	Changes in Concentration		
	Small	Medium	Large
Increase with Proposed M28 Road Project			
Above Objective/Limit Value with M28 (≥40$\mu g/m^3$ of NO_2 or PM_{10}) (≥25$\mu g/m^3$ of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value with the M28 (36-<40$\mu g/m^3$ of NO_2 or PM_{10}) (22.5-<25$\mu g/m^3$ of $PM_{2.5}$)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value with the M28 (30-<36$\mu g/m^3$ of NO_2 or PM_{10}) (18.75-<22.5$\mu g/m^3$ of $PM_{2.5}$)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value with the M28 (<30$\mu g/m^3$ of NO_2 or PM_{10}) (<18.75$\mu g/m^3$ of $PM_{2.5}$)	Negligible	Negligible	Slight Adverse
Decrease with Proposed M28 Road Project			
Above Objective/Limit Value with the M28 (≥40$\mu g/m^3$ of NO_2 or PM_{10}) (≥25$\mu g/m^3$ of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial

Absolute Concentration in Relation to Objective/Limit Value	Changes in Concentration		
	Small	Medium	Large
Just Below Objective/Limit Value with the M28 (36-<40μg/m^3 of NO_2 or PM_{10}) (22.5-<25μg/m^3 of $PM_{2.5}$)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value with the M28 (30-<36μg/m^3 of NO_2 or PM_{10}) (18.75-<22.5μg/m^3 of $PM_{2.5}$)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value with the M28 (<30μg/m^3 of NO_2 or PM_{10}) (<18.75μg/m^3 of $PM_{2.5}$)	Negligible	Negligible	Slight Beneficial

Table 13.5: Air Quality Impact Descriptors for Changes in Number of Days with PM_{10} Concentrations Greater than 50μg/m^3 at a Receptor (Source: NRA, 2011)

Absolute Concentration in Relation to Objective/Limit Value	Changes in Concentration*		
	Small	Medium	Large
Increase with Proposed M28 Road Project			
Above Objective/Limit Value with the M28 (≥35days)	Slight Adverse	Moderate Adverse	Substantial Adverse
Just Below Objective/Limit Value with the M28 (32-<35days)	Slight Adverse	Moderate Adverse	Moderate Adverse
Below Objective/Limit Value with the M28 (26-<32days)	Negligible	Slight Adverse	Slight Adverse
Well Below Objective/Limit Value with the M28 <26 days)	Negligible	Negligible	Slight Adverse
Decrease with Proposed M28 Road Project			
Above Objective/Limit Value with the M28 (≥35days)	Slight Beneficial	Moderate Beneficial	Substantial Beneficial
Just Below Objective/Limit Value with the M28 (32-<35days)	Slight Beneficial	Moderate Beneficial	Moderate Beneficial
Below Objective/Limit Value with the M28 (26-<32days)	Negligible	Slight Beneficial	Slight Beneficial
Well Below Objective/Limit Value with the M28 <26 days)	Negligible	Negligible	Slight Beneficial

In addition to the statutory limits for the protection of human health listed in Air Quality Standards Regulations (S.I. 180 of 2011), the World Health Organisation (WHO) has published a set of air quality guidelines for the protection of human health. The key publication is the "*WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide, Global update 2005 Summary of risk assessment*". The WHO guidelines are based on reducing the risk to human health and in some cases the levels differ from the EU statutory limits as these limits are based on balancing health risks with technological feasibility, economic considerations and various other political and social factors in the EU.

The 2005 WHO guidelines are presented in **Table 13.6** and illustrate that while the NO_2 levels are analogous to those in S.I. 180 of 2011 (excluding the tolerance levels for the 1-hour averages), the annual average PM_{10} and $PM_{2.5}$ levels specified by the WHO are half of the limits specified in the legislation. The WHO note that these are the lowest levels at which total, cardiopulmonary and lung cancer mortality have been shown to increase with more than 95% confidence in response to long-term exposure to $PM_{2.5}$. The EPA has called for movement towards the adoption of these stricter WHO guidelines as the legal standards across Europe and in Ireland.

Table 13.6: WHO 2005 Air Quality Guidelines

Pollutant	Criteria	Value
Nitrogen Dioxide (NO_2)	Hourly level for protection of human health	200 $\mu g/m^3$ NO_2
	Annual level for protection of human health	40 $\mu g/m^3$ NO_2
Sulphur Dioxide (SO_2)	10 minute level for protection of human health	500 $\mu g/m^3$
	Daily level for protection of human health	20 $\mu g/m^3$
Particulate Matter (PM_{10})	24-hour level for protection of human health	50 $\mu g/m^3$ PM_{10}
	Annual level for protection of human health	20 $\mu g/m^3$ PM_{10}
Particulate Matter ($PM_{2.5}$)	24-hour level for protection of human health	25 $\mu g/m^3$ $PM_{2.5}$
	Annual level for protection of human health	10 $\mu g/m^3$ $PM_{2.5}$

Appendix 1 of the NRA Guidelines are based on achieving compliance with the limits specified in S.I. 180 of 2011 (in particular oxides of nitrogen and particulate matter), i.e. the limits specified in **Table 13.2**. However, for completeness the baseline levels and predicted impacts in this assessment are also compared to WHO Guidelines (**Table 13.6**) for reference.

13.3 RECEIVING ENVIRONMENT

13.3.1 Existing Sources and Receptors

In summary, the route corridor of the proposed M28 road project runs between the Bloomfield Interchange of the N40 South Ring Road in the south of Cork City to the east of the village of Ringaskiddy on the Ringaskiddy Peninsula in County Cork. The upgrade is on-line between Bloomfield and Carr's Hill. South of Carr's Hill the route runs on the eastern side of the existing N28 to Shannonpark where it veers to an easterly direction, staying south of the existing road as far as the R613 at Barnahely and onwards to Ringaskiddy.

There are various types of receptors located along the proposed route including both human and natural. The receptors vary in distance from the edge of the proposed M28 Road Project:-

- A total of 186 properties are located within 50 metres of the edge of the proposed M28 route corridor including residential developments, schools, places of worship, commercial operations, etc. The most sensitive receptors include residential dwellings where people are present for significant periods and thereby continuously exposed to any road traffic emissions.
- In addition to the residential and human receptors, the Cork Harbour SPA, Lough Beg and Monkstown Creek pNHA are sensitive ecological receptors that are located close to the route corridor of the proposed M28 road project towards the start and end points.

Along some sections of the existing N28 (e.g. the section from Carr's Hill to the Rochestown Road Junction) the road verges consist of mature and semi mature trees and wooded area (i.e. Bloomfield Wood and Donnybrook Wood. Trees may act as a natural barrier for some pollutants such as dusts during the construction stage but trees offer no natural mitigation for gaseous pollutants such as NO_x. It is noted that the proposed removal of some of these trees may reduce the barrier potential for construction dusts and increase a risk of dust nuisance on affected properties.

The Service Area (SA) is located north of the existing L2545 road east of the village of Ringaskiddy. The nearest receptor to the site is the National Maritime College of Ireland which bounds the Service Area to the east. South of the service area is the Hammond Lane commercial operation which lies on the opposite side of the L2545. The nearest residential properties to the Service Area include those at Martello Park to the south west of the site and north of the new alignment.

There are a number of potential sources of existing pollution along the existing and proposed M28 route corridors as follows.

Road traffic on the national routes (including the existing N28 and the N40 South Ring Road at the northern boundary of the proposed M28 road project, the regional roads (R611 and R613 to Carrigaline from the N28, and the R610 and R609) and on the local road network will generate levels of gaseous (NO_x, CO, VOCs) and particulate (PM_{10} and $PM_{2.5}$) pollution along the road network. Emissions are higher under congested traffic conditions so areas where there are bottlenecks or slow moving traffic (such as during morning or evening peaks) are at higher risk of elevated levels of traffic derived pollution. Traffic congestion on the existing N28 is currently experienced during peak hours at the Bloomfield Interchange, Carr's Hill, Shannonpark Roundabout and at Shanbally Village (refer to **Section 3.4** of this EIS).

Space heating for residential and commercial premises is likely to generate levels of gaseous (NO_x, SO_2, CO) and particulate (PM_{10} and $PM_{2.5}$) pollution especially in the areas of higher population density such as the areas of Douglas and Rochestown close to Cork City as well as the villages of Ringaskiddy and Shanbally. The extent of the emissions depends on the fuel used with solid fuels (coal, peat, wood) generating higher levels of pollution followed by liquid fuels (oil) and gaseous fuels (such as natural gas) generating the lowest emissions. Under the Air Pollution Act (Marketing, Sale, Distribution and Burning of Specified Fuels) Regulations 2012 (S.I. No. 326 of 2012) the entire study area is covered by the smoky coal ban so emissions from space heating should not pose a high risk of PM_{10}, $PM_{2.5}$ or SO_2 emissions in the area.

Agricultural activities are prevalent in the areas outside of the city and villages and any agricultural activities have the potential to generate dusts and odours depending on the season and activity undertaken.

While Raffeen quarry is not currently operational there is the potential for windblown dust from the surfaces of open faces and stockpiles on the quarry. In the event that the quarry was to become operational as a result of this project or under its current permission, there is a heightened risk of windblown dust from materials handling impacting on properties in the immediate vicinity of the quarry.

The current operations at the Port of Cork have the potential to generate air quality impacts through road traffic (N28 and local roads), land based operations (cranes, trucks, etc.) and the existing shipping volumes (in port emissions and at sea emissions). In addition, existing operations at the site also involve the handling of bulk grains (existing operations involve two cranes and three hoppers) and there is a current risk of fugitive dust release impacting the area. In May 2015, ABP granted planning permission to the Port of Cork for the redevelopment of existing port facilities at Ringaskiddy, Co Cork. The main construction works commenced on this site in late 2016 which may also generate construction dust. The EIS for this scheme concluded that residual impacts from the construction phase are not anticipated as mitigation measures have been identified to control potential dust impacts. The initial construction stages (Phase 1 and Phase 2) of the consented Port of Cork development will be completed prior to the commencement of construction the M28 Road Project. Construction of Phase 3 of the Port of Cork plans will not commence until the M28 Road Project is in operation (refer to **Chapter 18: Interaction and Inter-Relationship of Impacts** for further details on cumulative effects).

At the southern extent of the Study Area and to the immediate north of Ringaskiddy Village is Haulbowline Island and Cork County Council plan to remediate the East Tip of the island which currently comprises of approximately two thirds of slag waste together with varying amounts of refractory wastes, millscale, sludge, flue dust, metal and construction waste. As with Raffeen quarry, this area poses a potential risk to air quality from airborne dust (including hazardous dusts) but this risk should be mitigated through the planned remediation programme which is to be carried out under licence from the EPA (W0289-01). This development has been granted planning permission and is scheduled to commence remediation works in the summer of 2017.

Fill material for the East Tip site will be sourced from the Martello Tower site in Ringaskiddy which was recently granted planning permission (November 2016). Excavation of cover material from the Martello Tower site has the potential for a number of short term negative impacts on air quality during the construction phase (11 months). Construction activities such as excavation, screening, crushing, earth moving and backfilling may generate quantities of dust, particularly in dry weather conditions. Traffic movements onto and off the site during construction may also lead to emissions of dust and fine particulate along the haul route. Construction traffic from this proposed development will have negligible impact on air quality given the low volumes and it is expected that construction activity will be complete prior to commencement of works on the proposed M28 road project.

Also along the existing N28 corridor is the Shannonpark Housing Development which is a development of 297 no. residential units and ancillary facilities which was granted permission in September 2016 but is yet to be constructed. The EIS for this development notes that the greatest potential impact on air quality during the construction phase is from the construction dust emissions and the potential for nuisance dust. Mitigation measures include a dust minimisation plan. Provided these measures are implemented then the impacts during the construction phase will be not be significant.

There are five other EPA licensed facilities located adjacent to the existing N28 and/or the proposed M28 road project as listed in **Table 13.7** and each of these operators has the potential to emit levels of combustion gases or other pollutants but emissions are regulated by the EPA and high levels of abatement are currently in place. The table indicates the name and nature of the five EPA licensed facilities as well as the level of emissions of GHGs (CO_2) and acidifying gases (NO_x) reported by the operators in 2013.

Table 13.7: EPA Licensed Facilities in the Study Area

Licence Register	Licensee	Nature of Operation	2015 NO_x (tonnes)	2015 CO_2 (tonnes)
W0145-02	Enva Ireland Ld.	Hazardous Waste Transfer Station	0	0
P0013-04	Pfizer Ireland Pharmaceuticals	Pharmachem	0.3	11,168
P0865-01	Biomarin	Biopharma	0	0
P0778-01	Janssen Biologics	Biopharma	0.6	0
P0006-03	Novartis Ringaskiddy Limited	Pharmachem	13.38	14,365

There are five Major Accidents (Seveso III) Directive sites within the Ringaskiddy area. These are Novartis Ringaskiddy Ltd, Pfizer Ireland Pharmaceuticals Ringaskiddy API Plant, Hovione Limited, Carbon Chemicals and GlaxoSmithKline, SmithKline Beecham (Cork) Ltd.

In addition to the EPA licensed operations, there is one smaller waste operator, Hammond Lane Metal Company located to the east of Ringaskiddy village close to the terminus of the proposed M28 road project and the site of the Service Area. This operation has the potential to generate dust especially during dry or windy conditions.

In January 2016, Indaver submitted an application to ABP for a 240,000 tonnes per annum waste-to-energy facility at a site located east of the road alignment and south of the Service Area in Ringaskiddy. According to the EIS for this development, the construction of this facility will take circa 31 months to complete. Construction of this project will generate levels of dust and construction traffic (along the L2545 and N28) and will generate levels of construction traffic emissions.

During the operational phase, this facility will generate emissions of combustion gases and particulates including NO_x, SO_x, CO, VOCs, metals, acids and dioxins/furans. The operational emissions will be monitored as required by the EU Industrial Emissions Directive and in compliance with an industrial emission licence which will be regulated by the EPA. The EIS for this development presents an analysis of air dispersion modelling of the emissions which demonstrates that the ambient ground level concentrations will be below the relevant air quality standards for the protection of human health for all parameters under maximum and abnormal operation of the facility. Thus, no adverse impact on public health or the environment, including the Cork Harbour SPA, is envisaged to occur at or beyond the facility boundary.

13.3.2 Baseline Air Quality

The entire Study Area is located within EPA Zone B, the greater Cork area. The results of the baseline air quality monitoring and data from the Zone B EPA National Air Quality Monitoring Programme are presented for each pollutant below.

In addition, an extensive baseline survey was carried out in the region of the proposed Ringaskiddy Indaver: Waste to Energy Facility over the period August 2014 to July 2015 and the results of this study (as referenced in the EIS for that facility) have also been referenced.

The State of Ireland's Environment 2016

In October 2016 the EPA published the "State of Ireland's Environment 2016" which provides the most recent update of the quality of Ireland's environment and identifies the key stresses and pressures for each environmental media.

The report identifies that Ireland's air quality currently is good, relative to other EU Member States and all air quality monitoring stations show that Ireland continues to meet all EU air quality standards. In the past 5 years, Ireland has had no breaches of the EU air quality standards at any of the 31 monitoring stations located around the country in both urban and rural areas. Ireland's good air quality is largely thanks to the prevailing clean Atlantic air and the absence of large cities and heavy industry. The report does note that in urban areas such as Dublin and Cork, levels of nitrogen dioxide are close to the specified EU limit values for air quality as a result of exhaust emissions from vehicles.

The report states that in Ireland the premature deaths attributable to air pollution are estimated at 1,200 people. The most common causes of premature death attributable to poor air quality are strokes and heart disease. In Ireland, the most overtly problematic pollutants causing disease in humans are particulate matter (PM), ground-level ozone (O_3) and nitrogen dioxide (NO_2).

The risk of heart disease, which includes heart attacks, has particularly strong and consistent associations with fine particulate pollutants in air (e.g. $PM_{2.5}$). During 2013, the WHO concluded that outdoor air pollution exposes humans to carcinogens, with the particulate matter component of air pollution closely associated with an increased incidence of cancer, especially lung cancer.

Specifically in relation to road transport the report notes that the new EU emissions standards for vehicles, cleaner technology, and a reduction in the number of vehicles using the roads as a result of the economic downturn led to a decrease in NO_2 in urban centres. However, this is unlikely to continue into the future as the economic recovery will most likely lead to an increase in NO_2 levels.

Since 1970, the EU has been implementing a series of vehicle emission standards aimed at reducing the levels of traffic pollutants at source. All vehicles sold within the EU must comply with these standards and the National Car Test (NCT) includes a monitoring of simulated emissions to test compliance with the standards. **Table 13.8** shows the progression of the Euro 1 to Euro 6 emission standards for passenger cars for petrol and diesel vehicles. As an example, the particulate emission standards from diesel vehicles have reduced from 0.14g/km in 1992 to 0.005g/km in 2014 (a 99% decrease).

Table 13.8: EU Emission Standards for Passenger Cars

Standard	Year	Diesel		Petrol	
		NO_x (g/km)	PM (g/km)	NO_x (g/km)	PM (g/km)
Euro 1†	July 1992	-	0.14	-	-
Euro 2	January 1996	-	0.08	-	-
Euro 3	January 2000	0.50	0.05	0.15	-
Euro 4	January 2005	0.25	0.025	0.08	-
Euro 5	September 2009	0.180	0.005	0.060	0.005
Euro 6	September 2014	0.080	0.005	0.060	0.005

These standards have been devised to provide for ongoing decreases in road traffic emissions across the EU. On balance these standards have achieved reductions in emissions but the EPA report notes the failure of real-world emissions of NO_x in the Euro 5 class vehicles compared to these simulated emission standards. This has resulted in expected NO_x emissions reductions not being achieved.

Baseline Nitrogen Dioxide (NO_2)

Nitrogen dioxide (NO_2) is classed as both a primary and a secondary pollutant. As a primary pollutant NO_2 is emitted from all combustion processes (such as a gas/oil fired boiler or a car or ship engine). As a secondary pollutant NO_2 is derived from atmospheric reactions of pollutants that are themselves, derived mainly from traffic sources. NO_2 has been shown to reduce the pulmonary function of the lungs. Long term exposure to high concentrations of NO_2 can cause a range of effects, primarily in the lungs, but also in the liver and blood. The results of the site specific baseline monitoring undertaken are presented in **Table 13.9**.

Table 13.9: Baseline Nitrogen Dioxide Results

Reference	Description	NO_2 Concentration ($\mu g/m^3$)			
		30/01/15-10/03/15	20/10/16-25/11/16	25/11/16 - 13/01/17	13/01/17-22/02/17
A1	Ringaskiddy on the L2545	12.24	-	-	-
A2	Ringaskiddy (Shamrock Place)	12.13	-	-	-
A3	Warrens Cross Roads	9.51	-	-	-
A4	Shanbally Mews	13.48	-	-	-
A5	Raffeen	8.00	-	-	-
A6	Shannonpark Roundabout	29.45	-	-	-
A7	Ballinrea Road	11.55	-	-	-
A8	N28-R609 Junction	18.75	-	-	-
A9	N28 Entrance to Mount Oval Village Estate	39.16	-	-	-
A10	R610 Rochestown Road	-	25.90	30.15	31.61
A11	Rochestown Rise Estate	-	20.99	19.37	22.12
A12	Maryborough Heights Estate	-	14.64	24.01	25.12
A13	Rowan Hill Estate	-	22.04	18.05	19.19
A14	Rock Road, Carrigaline	-	20.30	16.78	13.70
Annual Limit for the Protection of Human Health (AQ Standards)		**40**			
Annual Guideline for the Protection of Human Health (WHO)		**40**			

The results of the baseline monitoring indicate that levels detected in the southern section of the study area in the vicinity of Shanbally (A4, A5) and Ringaskiddy (A1 to A3) are typically lower that the northern section of the study area with levels in the range 8-14 $\mu g/m^3$. In addition, the offline location in the northern section of the proposed M28 Road Project that is located away from the existing N28 (location A7), shows similar levels.

The monitoring results presented in **Table 13.9** are based on kerbside locations adjacent to the road traffic and do not represent the levels of pollutants at the nearest properties. The UK DMRB (Appendix C, Volume 11) provides a distance curve of traffic pollutant level versus distance from the road centre and indicate that for properties at 20m from the road the levels would be circa 65-70% of the kerbside, for properties at 40m from the road the levels would be circa 40-45% of the kerbside and for properties at 60m from the road the levels would be circa 25-30% of the kerbside. The trend shows a clear reduction in road traffic impact with distance from the road. As such, it is important to note that the levels measured in the baseline are not the levels of exposure of properties in the area but the kerbside data. Levels at properties in the area will decrease in a non-linear fashion from the road.

The locations that are kerbside monitoring locations on the existing N28 (A6 and A9) or regional roads (A10) show significantly higher levels as a result of higher traffic volumes on these roads. In addition, these locations are where traffic congestion is more frequent and hence indicate the highest levels.

All monitoring locations show levels less than the annual limit for the protection of human health (40μg/m^3), however, the location closest to Cork City (A9 at the entrance to Mount Oval Village) is only marginally below the limit. The nearest residential property to this location is in Maryborough Heights and is circa 20m from the monitoring location. Based on DMRB distance curves, the NO_2 concentration at this property would be of the order of 25-27μg/m^3 and well below the limit for the protection of human health. This is supported by the monitoring undertaken at Maryborough Heights (A12) which shows levels of the range 15-25μg/m^3. The other residential monitoring locations (A11 to A14) show similar levels.

The R610 Rochestown Road monitoring location (A10) indicates a higher level similar to the Shannonpark Roundabout (A6), however this location is a kerbside site at the entrance to the Newlyn Vale estate adjacent to the road network and does not represent levels within the residential area.

The analysis outlined above is based on comparison with the statutory limits for the protection of human health as outlined in S.I. 180 of 2011 (**Table 13.2**). The WHO Guidelines (**Table 13.6**) identify levels analogous to the limits so the discussion above is valid for both limits and WHO guidelines.

The EPA uses a series of continuous chemiluminescent analyser to determine nitrogen dioxide (NO_2) concentrations at the monitoring stations around the country. The relevant monitoring station that is considered representative of the study area is the South Link Road in Cork City (Zone B, to represent urban levels). The EPA data for this station is outlined in **Table 13.10**.

Table 13.10: Results of NO_2 Monitoring Carried out by the EPA at South Link Road (Zone B)

Statistic	2014	2015	AQ Limit
Annual Mean (μg/m^3)	27	22	**40**
Max 1-hour (μg/m^3)	148	128	**200**
NO_2 Values >200μg/m^3	0	0	**18**

Air quality data from the South Link Road monitoring station in Cork City indicate that the levels detected are below the relevant air quality limits for each year. The data indicates that a typical background level in the area would be of the order of 22-27μg/m^3 which is typical of a background urban location close to major roads in Ireland. The station also shows full compliance with the annual and 1-hour limits for the protection of human health as specified in S.I. 180 of 2011 (refer **Table 13.2**). The EPA data is largely in line with the levels detected in the baseline study of the northern section of the N28 (A9 to A13) where levels show and average of circa 24μg/m^3. However, the EPA data is based on continuous annual results and provides a more accurate representative indicator of baseline air quality in the region.

In the Ringaskiddy area to the south of the proposed M28 there are two large developments (Port of Cork and Indaver: Waste to Energy Facility) that have undertaken baseline NO_2 measurements in the vicinity using diffusion tubes area with the following results:-

- Annual Average NO_2 at the Indaver Site (2006-2008 and 2014-2015): 10μg/m^3
- Annual Average NO_2 at the Port of Cork Site (2012): 13.83μg/m^3

These levels are consistent with the baseline undertaken in 2015/2016 for the M28 baseline and illustrate that average NO_2 levels in the Ringaskiddy area are of the order of 10-15μg/m^3.

Baseline Nitrogen Oxides (NO_x)

Oxides of nitrogen (NO_x) is the sum of NO_2 and NO and is both a primary and secondary pollutant. NO_x is an atmospheric precursor for acid rain on reaction with water to form nitric acid. NO_x may have a positive or negative impact by acting as a fertiliser or a phytotoxicant. Effects are mainly on growth, photosynthesis and nitrogen assimilation/metabolism. As such, there is an annual limit for the protection of vegetation of 30μg/m^3 (refer to **Table 13.2**). The EPA used a continuous chemiluminescent analyser to determine nitrogen oxides (NO_x) concentrations at South Link Road. The results of the EPA monitoring are outlined in **Table 13.11**.

Table 13.11: Results of NO_x Monitoring Carried Out by the EPA at South Link Road

Statistic	2014	2015	AQ Limit
Annual Mean (μg/m^3)	64	49	**30**

The EPA air quality data from South Link Road indicate that the levels detected are continuously above the annual average limit for the protection of vegetation for each year (30μg/m^3). It should be noted that this limit applies for the protection of vegetation and not human health and the levels need to be viewed in the context of sensitive ecological areas in the area.

Baseline Particulate Matter (PM_{10} and $PM_{2.5}$)

Particulate matter (PM_{10}) may be emitted as a primary pollutant from road vehicle exhausts, which is the main source of pollutant in urban areas. In rural areas, sources will include traffic, agricultural activities and natural processes. Also point sources such as combustion, i.e. domestic fires, industrial boilers etc. are primary sources of PM_{10}. PM_{10} may also be formed as secondary pollutants from the condensation or reaction of chemical vapours in the atmosphere. Health effects associated with PM_{10}, in the long term, include chronic effects such as increased rates of bronchitis and reduced lung function.

Particulate Matter ($PM_{2.5}$) has similar effects on health as PM_{10}, however, $PM_{2.5}$ is a better indicator of anthropogenic (man-made) emissions. Fine particulate matter $PM_{2.5}$ can be responsible for significant negative impacts on human health.

The results of the site specific baseline particulate matter monitoring undertaken are presented in **Table 13.12**. The results illustrate that the period average PM_{10} results are below the limit for the protection of human health and the WHO Guideline. In addition, all daily averages detected are also within both the limits and the WHO Guidelines. The levels show a degree of variation on a daily basis that is likely a direct result of the weather conditions on any given day.

The levels detected A15 along the existing N28 location are similar in scale to those detected by the EPA at the South Link Road but higher than those in Heatherton Park (refer **Table 13.13**). This is as expected given that both A15 and South Link Road are similar monitoring locations in close proximity to the N40 South Ring and national primary routes serving the N40.

Table 13.12: Baseline Particulate Matter (PM_{10}) Results

Date	Particulate Matter (PM_{10}) 24-hour Average ($\mu g/m^3$)
23/03/2017	20.37
24/03/2017	30.37
25/03/2017	27.25
26/03/2017	12.46
27/03/2017	34.79
28/03/2017	30.92
29/03/2017	18.42
30/03/2017	13.37
31/03/2017	22.22
01/04/2017	11.50
02/04/2017	8.87
03/04/2017	16.92
04/04/2017	19.25
05/04/2017	19.71
06/04/2017	16.87
07/04/2017	19.42
08/04/2017	30.21
09/04/2017	27.92
10/04/2017	13.42
11/04/2017	15.62
12/04/2017	12.21
13/04/2017	13.79
14/04/2017	14.29
15/04/2017	13.67
16/04/2017	15.62
17/04/2017	10.21
18/04/2017	16.33
19/04/2017	22.83
20/04/2017	33.04
21/04/2017	19.87
22/04/2017	21.96
23/04/2017	20.00
24/04/2017	21.75
25/04/2017	18.04
26/04/2017	15.37
27/04/2017	15.58
28/04/2017	14.37
29/04/2017	15.83
30/04/2017	23.37
24-hour Limit (S.I. 180 of 2011)	**50**
WHO 24-hour Guideline	**50**
Period Average	19.18
Annual Limit (S.I. 180 of 2011)	**40**
WHO Annual Guideline	**20**

The EPA measured results for PM_{10} and $PM_{2.5}$ at the following monitoring stations which are applicable to this project:-

- South Link Road in Cork City Centre (Zone B); and
- Heatherton Park in Cork City (Zone B).

The results from these monitoring stations are presented in **Table 13.13**.

Table 13.13: Results of PM_{10} and $PM_{2.5}$ monitoring carried out by the EPA

Station	Parameter	Statistic	2014	2015	AQ Limit
South Link Road (Zone B)	Particulate Matter (PM_{10})	Annual Mean ($\mu g/m^3$)	19	17	**40**
		Max 24-hour ($\mu g/m^3$)	66	133	**50**
		24-hour Values >50$\mu g/m^3$	5	3	**35**
	Particulate Matter ($PM_{2.5}$)	Annual Mean ($\mu g/m^3$)	-	-	**25**
Heatherton Park (Zone B)	Particulate Matter (PM_{10})	Annual Mean ($\mu g/m^3$)	16	11	**40**
		Max 24-hour ($\mu g/m^3$)	84	44	**50**
		24-hour Values >50$\mu g/m^3$	1	0	**35**
	Particulate Matter ($PM_{2.5}$)	Annual Mean ($\mu g/m^3$)	8	7	**25**

The results for the two Zone B monitoring locations in Cork City indicate that annual average PM_{10} concentrations are typically in the range of 15-20$\mu g/m^3$ as these sources are closer to the main sources of traffic and space heating. While there are a low number of exceedences of the 24-hour limit for the protection of human health (50$\mu g/m^3$) this number is within the 35 day tolerance in the legislation.

In relation to the WHO Guideline for PM_{10} (**Table 13.6**), the recent annual average levels in the Cork area are below the guideline of 20$\mu g/m^3$. The evidence shows that the 24-hour average levels at both stations in the Cork area are above the WHO guidelines each year on a low number of occasions (up to 5 days per annum). These results indicate that baseline levels of PM in the Cork area are challenged in meeting the levels specified in the WHO Guidelines.

The EIS for the Indaver: Waste to Energy Facility in Ringaskiddy carried out PM_{10} and $PM_{2.5}$ monitoring to determine the baseline at the site with the following results:-

- Annual Average PM_{10} at the Indaver Site (Aug 2014 to July 2015): 20$\mu g/m^3$
- Annual Average $PM_{2.5}$ at the Indaver Site (May – Jun 2008): 7$\mu g/m^3$

These levels are in line with the levels detected by the EPA in Zone B in recent years and these results do not exceed the AQ and WHO limits. While the site at Ringaskiddy is more rural in nature and therefore less exposed to traffic pollutants, there is potential for natural sources such as sea salt aerosol to increase the particulate levels in this area.

Baseline Volatile Organic Compounds (VOCs)

Volatile Organic Compounds (VOCs) consist of any organic substance (solvent) that can exist in the vapour phase at ambient temperatures. There is a wide variety of VOCs available but the principle VOCs relevant to this project are those derived from vehicle emissions, in particular the aromatic hydrocarbons benzene, toluene, ethylbenzene and the xylenes which are collectively known as BTEX. Aromatic hydrocarbons typically consist of one third of the constituent of petrol and provide a good indicator of traffic related emissions. In addition, benzene is a known carcinogen and S.I. 180 of 2011 (**Table 13.2**) shows the statutory limit for the protection of human health. Due to its carcinogenic nature the WHO have not stated a safe level of exposure for benzene. The other aromatic compounds are not classed as carcinogens and do not have limits for the protection of human health.

The results of the site specific baseline monitoring undertaken are presented in **Table 13.14**.

Table 13.14: Baseline Volatile Organic Compounds (VOCs) Results

Reference	Description	Benzene (μg/m³)				Toluene (μg/m³)				Ethylbenzene (μg/m³)				Xylenes (μg/m³)			
		30/01/15 - 10/03/15	20/10/16 - 25/11/16	25/11/16 - 13/01/17	13/01/17 - 22/02/17	30/01/15 - 10/03/15	20/10/16 - 25/11/16	25/11/16 - 13/01/17	13/01/17 - 22/02/17	30/01/15 - 10/03/15	20/10/16 - 25/11/16	25/11/16 - 13/01/17	13/01/17 - 22/02/17	30/01/15 - 10/03/15	20/10/16 - 25/11/16	25/11/16 - 13/01/17	13/01/17 - 22/02/17
A1	Ringaskiddy on the L2545	0.46	-	-	-	1.62	-	-	-	0.33	-	-	-	1.07	-	-	-
A2	Ringaskiddy (Shamrock Place)	0.46	-	-	-	0.66	-	-	-	ND	-	-	-	0.27	-	-	-
A3	Warrens Cross Roads	0.45	-	-	-	0.89	-	-	-	ND	-	-	-	0.26	-	-	-
A4	Shanbally Mews	0.58	-	-	-	0.85	-	-	-	ND	-	-	-	0.49	-	-	-
A5	Raffeen	0.43	-	-	-	0.49	-	-	-	ND	-	-	-	0.23	-	-	-
A6	Shannonpark Roundabout	0.50	-	-	-	0.71	-	-	-	ND	-	-	-	0.34	-	-	-
A7	Ballinrea Road	0.37	-	-	-	0.50	-	-	-	ND	-	-	-	0.41	-	-	-
A8	N28-R609 Junction	0.41	-	-	-	0.45	-	-	-	ND	-	-	-	0.24	-	-	-
A9	N28 Entrance to Mount Oval Village Estate	0.72	-	-	-	1.08	-	-	-	ND	-	-	-	0.85	-	-	-
A10	R610 Rochestown Road	-	0.82	0.84	0.99	-	2.21	1.52	1.94	-	0.54	0.29	0.36	-	1.64	1.11	1.46
A11	Rochestown Rise Estate	-	0.79	ND	0.24	-	1.38	0.16	0.31	-	0.27	ND	ND	-	1.20	ND	ND
A12	Maryborough Heights Estate	-	0.80	0.82	1.04	-	2.54	1.61	2.02	-	0.29	0.97	3.16	-	1.17	1.80	3.89
A13	Rowan Hill Estate	-	0.78	0.60	0.90	-	1.32	0.93	1.63	-	0.25	0.68	5.10	-	1.08	1.07	5.08
A14	Rock Road, Carrigaline	-	0.81	0.71	0.85	-	1.25	1.23	2.12	-	ND	0.29	1.98	-	0.89	1.08	2.79
Annual Limit for the Protection of Human Health AQ		**5**				**-**				-				-			
Weekly Guideline for the Protection of Human Health WHO		**-**				**260**				-				-			

The results of the VOC baseline illustrate that levels detected in the area are low and benzene levels are in compliance with the limit for the protection of human health. There are no limits for the other VOCs detected but toluene levels are well below the WHO guideline for the protection of human health. There is no routine monitoring of VOCs carried out by the EPA in the Zone B area.

Climate

The weather in the study area is influenced by the Atlantic Ocean, resulting in mild, moist weather dominated by maritime air masses. The prevailing wind direction in Ireland is from a quadrant centred on west-southwest. These are relatively warm winds from the Atlantic and frequently bring rain. Easterly winds are weaker and less frequent and tend to bring cooler weather from the northeast in spring and warmer weather from the southeast in summer.

The nearest meteorological station to the area is the Met Éireann Station in Cork Airport which lies approximately 5km west of the proposed alignment. The 30-year averages from the station at Cork Airport are presented in **Table 13.15**.

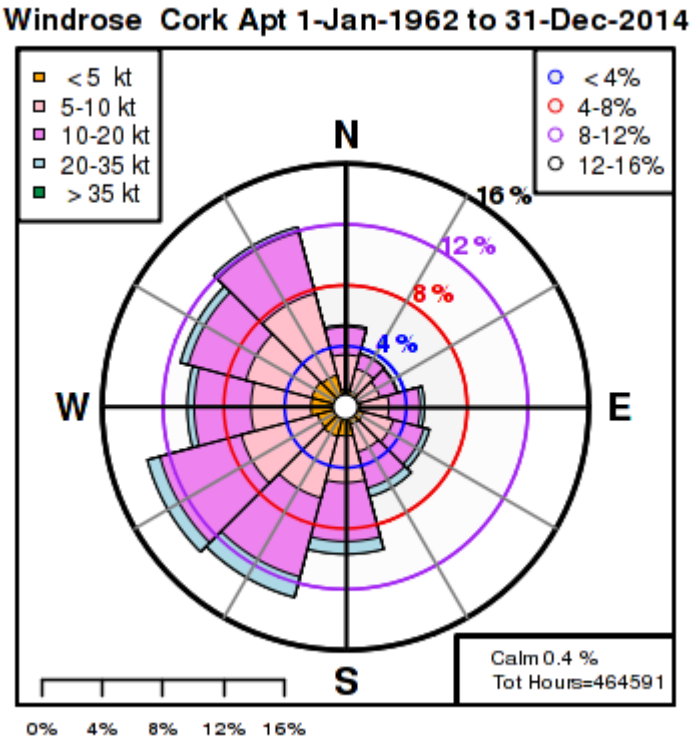
Table 13.15: 30-year Average Meteorological Data from Cork Airport (Annual Values from 1981-2010)

Parameter	30-year Average
Mean Temperature (^{0}C)	12.9
Mean Relative Humidity at 0900UTC (%)	86.7
Mean Daily Sunshine Duration (hours)	3.9
Mean Annual Total Rainfall (mm)	1227.9
Mean Wind Speed (knots)	10.5

The prevailing wind direction for the area is between northwest to southwest as presented in the windrose for Cork Airport Met Station in **Figure 13.2**. Easterly winds tend to be very infrequent. Wind characteristics vary between a moderate breeze to gales (average 10.8 days with gales per annum). Monthly average wind speeds range between 9.03 and 12.1 knots with highest wind speeds occurring during winter months (December and January). Lowest wind speeds were recorded in the June, July and August period.

Poor dispersion can occur under certain weather characteristics known as inversions that form in very light or calm wind and stable atmospheric conditions. The wind rose illustrated in **Figure 13.2** identifies that such wind conditions are very infrequent (0.4%).

Figure 13.2: Windrose for Cork Airport Met Station (source: www.met.ie)



The National Policy Position on Climate Action and Low Carbon Development was published on the 23rd April 2014. The policy sets a fundamental national objective to achieve transition to a competitive, low-carbon, climate-resilient and environmentally sustainable economy by 2050. The policy states that GHG mitigation and adaptation to the impacts of climate change are to be addressed in parallel national strategies – respectively through a series of National Mitigation Plans and a series of National Climate Change Adaptation Frameworks.

The National Policy Position envisages that development of National Mitigation Plans will be guided by a long-term vision of low carbon transition based on the following:-

- An aggregate reduction in carbon dioxide (CO_2) emissions of at least 80% (compared to 1990 levels) by 2050 across the electricity generation, built environment and transport sectors; and
- In parallel, an approach to carbon neutrality in the agriculture and land-use sector, including forestry, which does not compromise capacity for sustainable food production.

With reference to this project, the aggregate reduction emissions of at least 80% from the electricity generation, built environment and transport sector by 2050 is the relevant policy reference.

Further to the National Policy Position, the Climate Action and Low Carbon Development Act 2015 (No. 46 of 2015) was enacted on the 10th of December 2015. The Climate Act sets out the proposed national objective to transition to a low carbon, climate resilient and environmentally sustainable economy by the end of 2050. Section 4 of the Act sets out the provisions which require the preparation of a National Mitigation Plan on climate change. A draft National Mitigation Plan was open to public consultation in March/April 2017 and a final plan will be adopted in June 2017. The plan will be reviewed not less than once in every five year period.

Ireland reported an emission level of 58.3 million tonnes in 2014 which was a drop of 0.3% from the 2013 emissions. When compared to the 1990 baseline, Ireland has increased GHG emissions by 3.7% which is well below the 20% reduction target set for Ireland under the EU 2020 strategy.

Transport is currently the second largest contributor of GHG emissions in Ireland (after agriculture) at 19.5% (which predominately consists of road transport). Between 1990 and 2014, the transport sector showed the greatest overall sectoral increase of 120.9% and increases are linked to economic prosperity with year on year increases observed up to 2007 followed by five years of year on year decrease during the economic downturn. Emissions in the transport sector started to show a year on year increase again in 2014 when compared to the 2013 annual emissions.

The EPA estimate transport emissions to 2020 under two scenarios:-

- "With Measures" - based on the full impact of VRT and motor tax changes, public transport efficiencies and the carbon tax imposed on fuels since 2010. Also assumes improvements to the fuel economy of private cars, supported by EU Regulation which mandates maximum levels of CO_2 for new cars to 120g/km in 2015 and 95g/km in 2020 and 6% of transport energy demand comes from biofuels by 2020 which is supported by the Biofuel Obligation Scheme 2010.
- "With Additional Measures" – assumes that on top of the above, biofuel use is 10% of total transport fuel demand by 2020, the Biofuels Obligation Scheme and the rollout of 50,000 electric vehicles are achieved by 2020.

The latest EPA projections indicate that under the "With Measures" scenario, transport emissions are projected to increase by 16% in the period 2014 to 2020. Under the "With Additional Measures" scenario emissions are projected to increase by 10% in this period. The latter scenario assumes the target of 10% renewable fuel use in transport is reached, 50,000 electric vehicles are deployed and more efficient eco-driving practices are in place. Based on these trends, the transport sector is the one facing the greatest challenge in achieving the emissions reductions set out in the National Policy Position.

13.4 POTENTIAL IMPACTS

13.4.1 Construction Phase

Dust Emissions

In accordance with the NRA Guidelines, where there are operations at a construction site there is a risk that dust may cause an impact at sensitive receptors in close proximity to the source of the dust generated. These distances are presented in **Table 13.16** (source NRA Guidelines, May 2011 Revision).

Table 13.16: Assessment Criteria for the Impact of Dust Emissions from Construction Activities, (with Standard Mitigation in Place)

Source		Potential Distance for Significant Effects (Distance from Source)		
Scale	Description	Soiling	PM_{10}	Vegetation Effects
Major	Large Construction sites, with high use of haul routes.	100m	25m	25m
Moderate	Moderate Construction sites, with moderate use of haul routes.	50m	15m	15m
Minor	Minor Construction sites, with minor use of haul routes.	25m	10m	10m

The main sources of dust emissions from the proposed construction phase will be from the following areas:-

- Road construction activities along the main alignment of the proposed road project.
- Construction activities at the proposed SA.

The number of properties within the dust risk zone for each of the above sources is presented in **Table 13.17**. The data indicates that 249 properties are located within the dust risk zone along the N28/M28 alignments.

The distances presented in **Table 13.17** indicate that there are 186 properties located along the proposed M28 and at the Service Area that may be affected by dust nuisance during the construction phase of the project. A series of dust mitigation measures are presented in **Section 13.5** of this EIS. With these mitigation measures in place these 186 properties are likely to experience a slight adverse impact as a result of dust nuisance of temporary nature.

Table 13.17: Construction Area and Proximity to the Nearest Residential Receptors

Area	Size (Risk Distance)	Receptors Impacted
Main Alignment of the M28 from Bloomfield to Ringaskiddy	Moderate (50 metres)	There are 186 residential/commercial properties within 50 metres of the proposed M28 road project.
Service Area in Ringaskiddy	Major (100 metres)	There are 2 additional commercial receptors north of the SA

Greenhouse Gas Emissions

Emissions with the potential to cause climate change include carbon dioxide (the main GHG), which will arise from site materials as well as vehicles delivering this material to the construction site. These emissions have been quantified using the Environment Agency (EA) *Carbon Calculator for Construction Sites* and the results are presented in **Table 13.18**. The details of the materials have been derived from the data presented in the project description (**Section 3.11.6**).

Table 13.18: Summary of Greenhouse Emissions for Construction Phase

Item	Estimated GHG Emissions (tCO_2eq)
Aggregates	42,665
Concretes	1,061
Plant Emissions	1,450
Material Transport	8,745
Personnel Transport	488
TOTAL	**54,409**

Based on the volumes of material described in the earthworks section of **Chapter 3: Description of the Proposed Road Development**, the total estimated GHG emissions associated with the proposed construction of the M28 road project is calculated at 54,409 tonnes of CO_{2eq}. The works will require 1.05 million cubic meters of additional fill material which results in a very high quarried aggregates total.

13.4.2 Operational Phase

Motorway Impacts - Air Quality Exposure Index

The Air Quality Exposure Index in terms of overall rate of exposure of the population to pollutants from the proposed road project has been calculated in accordance with the NRA Guidelines. The approach looks at the total emissions generated on each link of the existing N28 and proposed M28 road project as calculated using the DMRB Regional Model, coupled with the number of properties located within 50 metres of each road alignment. The data is used to calculate an index of overall change in exposure that may be used to illustrate if the exposure to the general public will increase or decrease with the proposed road project in operation. The index score is a dimensionless figure that is used to illustrate the rate of exposure. A negative score indicates that there would be an overall reduction in exposure to pollution. The exposure index is calculated for both sections (online and offline) of the proposed road project and the results are presented in **Table 13.19**.

Table 13.19: Index of Overall Change in Exposure from the existing N28 to the Proposed M28 Road Project 2020

Section	NO_x Score	PM_{10} Score
Section 1: An online 2km section of motorway from the Bloomfield Interchange to Carr's Hill	-33,692	-1,200
Section 2: An offline 8.9km section of motorway from Carr's Hill to the Barnahely Roundabout and an offline 1.5km single carriageway section from Barnahely Roundabout to the east of Ringaskiddy	-84,048	-2,128
Full M28 Road Project	-117,740	-3,328

The results presented for both NO_x and PM_{10} are negative scores indicating that with the proposed M28 road project in operation there will be a net reduction in the number of properties who will be exposed to air pollution from road traffic. This is as a direct result of the new M28 alignment moving the road alignment and traffic volumes away from densely populated areas along the existing N28 such as the villages of Shanbally and Ringaskiddy. While the N28 moves the alignment closer to other properties (refer to local impact assessment), the net overall impact is a reduction in exposure.

This element is most evident in Section 2 where the new offline section of the M28 moves the alignment away from the properties located along the existing N28 and hence the strong negative score for this section. As Section 1 is largely online, the number of properties is largely unaffected by the location of the proposed M28 and the score here is less negative meaning a slightly lower reduction in exposure. This reduction is largely as a result of the reduction in congestion and the general increase in traffic speed thereby reducing the exposure to pollutants on a regional scale.

The regional assessment concludes that the proposed road project will result in a long term positive impact to regional air quality through the reduction of population exposure to traffic pollution.

Local Impacts of Air Quality (Human Health)

Modelling of local impacts has been undertaken for a series of sections along the proposed M28 Road Project and the existing N28 where there is the potential for sensitive receptors to experience a positive or negative impact as a result of the proposed road project. The sections addressed are those where there are properties potentially impacted by the proposed changes as follows:-

- Section 1: M28 at Cork City South;
- Section 2: M28 at Moneygourney;
- Section 2: M28/N28 at Shannonpark Roundabout;
- Section 2: M28 Junction at Shanbally;
- Section 2: N28 at Lower Shanbally Village;
- Section 2: M28 Junction with the Old Post Office Road, Ringaskiddy; and
- Section 2: N28 at Ringaskiddy Village.

Each of the above sections of the proposed M28 road network have been assessed to determine the potential impact with respect to the NRA impact criteria presented in **Tables 13.3, 13.4 and 13.5**. Background data has been incorporated into the model using the latest EPA dataset and future year backgrounds have been calculated as per Appendix 5 of the NRA Guidelines.

Section 1: M28 at Cork City South

This section of the M28 runs from the Bloomfield Interchange to the Carr's Hill Interchange. This section of the M28 is largely on-line so the changes to the traffic volumes/speeds and the small variations in horizontal alignment may impact on the residential properties in the area. Given the hill on the mainline M28 and the grade separated junction at Carr's Hill, this section of the M28 has been modelled using a refined modelling approach.

There are a number of residential areas in close proximity to the alignment as follows:-

- Kiltegan Park north of the Rochestown Road;
- Delford Drive north of the Rochestown Road;
- St. Patricks Church north of the Rochestown Road;
- Wainsfort north of the Rochestown Road;
- Newlyn Vale north of the Rochestown Road;
- Mount Oval and Rochestown Rise to the south of Rochestown Road;
- Maryborough Heights to the east of Maryborough Hill; and
- Edgewood Close.

The results of the modelling for the nearest receptors are presented in **Table 13.20**. It should be noted that these are the "worst-case" receptors in each residential areas, i.e. the residential property that is closest to the M28 and likely to experience the most significant impact. All other properties located in these areas will experience a lower impact than that presented in this table.

The results indicate that there will be negligible change in ambient air quality concentrations of traffic pollutants in these areas as a result of the proposed M28 road project. This is as a direct result of minor changes in traffic, speed and/or proximity to the proposed road project.

The results indicate that regardless of whether the proposed road project proceeds or not, the predicted levels will remain well below the air quality limits for the protection of human health (**Table 13.2**). The levels are also predicted to remain below the WHO guidelines for the protection of human health (**Table 3.6**) for all parameters.

The residential areas of Kiltegan Park and Delford Drive are predicted to experience an increase in levels of ambient air pollution as a result of the M28. These increases are as a result of the changes in traffic and the increased proximity to the new slip road from the M28 to the N40 South Ring Road. The predicted increases in annual average NO_2 concentrations are "small" in 2020 and 2035 (i.e. a change of less than 2$\mu g/m^3$, refer **Table 13.3**) with the levels remaining well below the limit value. As a consequence, the predicted air quality impacts for the receptors in these areas are classed as "negligible" (refer **Table 13.4**). All other properties in these residential areas will experience a lower impact than the properties included in the table.

For receptors that are close to the existing N28 carriageway between the Rochestown Road Interchange and the Carr's Hill Interchange, there will be slight reduction in levels of ambient air pollution as a result of the proposed road project. While there is a slight increase in traffic volumes the increase in average road speed will lead to a net reduction in emissions and hence the decrease in pollution levels. The predicted decreases in annual average NO_2 concentrations are "small" in 2020 and 2035 with the levels remaining well below the limit value. As a consequence, the predicted air quality impacts for the receptors in these areas are classed as "negligible" (refer **Table 13.4**).

Table 13.20: Local Impact at N28 at Cork City South (Northern Section of the Proposed M28 Road Project)

Property Group	Scenarios	NO_2 (µg/m^3)	PM_{10} (µg/m^3)		$PM_{2.5}$ (µg/m^3)
		Annual Average NO_2	Annual Average PM_{10}	24-hour Average PM_{10}	Annual Average $PM_{2.5}$
Kiltegan Park	2020 Do-Minimum	22.76	17.32	18.31	7.18
	2020 Do-Something	23.03	17.46	18.99	7.25
	2035 Do-Minimum	22.60	17.38	18.51	7.20
	2035 Do-Something	22.77	17.52	19.15	7.27
Delford Drive	2020 Do-Minimum	22.69	17.25	17.96	7.14
	2020 Do-Something	22.88	17.33	18.38	7.19
	2035 Do-Minimum	22.55	17.31	18.13	7.16
	2035 Do-Something	22.66	17.39	18.53	7.21
St. Patricks Church	2020 Do-Minimum	22.84	17.40	18.27	7.23
	2020 Do-Something	22.76	17.35	18.24	7.19
	2035 Do-Minimum	22.68	17.50	18.58	7.26
	2035 Do-Something	22.59	17.42	18.52	7.22
Wainsfort	2020 Do-Minimum	22.84	17.36	18.26	7.21
	2020 Do-Something	22.76	17.31	18.05	7.17
	2035 Do-Minimum	22.67	17.46	18.93	7.24
	2035 Do-Something	22.57	17.37	18.27	7.20
Newlyn Vale	2020 Do-Minimum	23.00	17.42	18.75	7.25
	2020 Do-Something	22.73	17.33	18.02	7.18
	2035 Do-Minimum	22.78	17.58	19.80	7.30
	2035 Do-Something	22.55	17.39	18.22	7.21
Rochestown Rise	2020 Do-Minimum	22.94	17.33	18.22	7.20
	2020 Do-Something	22.53	17.22	17.82	7.12
	2035 Do-Minimum	22.71	17.51	19.15	7.25
	2035 Do-Something	22.39	17.27	17.99	7.14
Mount Oval	2020 Do-Minimum	23.90	17.76	18.97	7.65
	2020 Do-Something	22.66	17.46	18.24	7.25
	2035 Do-Minimum	23.37	18.91	22.01	7.90
	2035 Do-Something	22.49	17.56	18.53	7.30
Maryborough Heights	2020 Do-Minimum	23.30	17.44	18.55	7.31
	2020 Do-Something	22.41	17.22	17.68	7.12
	2035 Do-Minimum	22.94	17.92	20.35	7.43
	2035 Do-Something	22.29	17.27	17.85	7.14
Edgewood Close	2020 Do-Minimum	23.40	17.49	18.95	7.38
	2020 Do-Something	22.52	17.32	18.18	7.18
	2035 Do-Minimum	23.00	18.14	21.42	7.53
	2035 Do-Something	22.39	17.40	18.46	7.21
Statutory Limits		**40**	**40**	**50**	**25**
WHO Guidelines		**40**	**20**	**50**	**10**

Section 2: N28/M28 from Carr's Hill to Shannonpark

This section of the N28/M28 runs from the south of the Carr's Hill Interchange to the Shannonpark Roundabout. There are relatively few sensitive receptors in this section but all are located along the existing N28. The majority are located on the eastern side of the N28 and hence the alignment of the M28 will move the source of traffic further west and away from these receptors. There are a small number of receptors located to the west of the N28 and these will lie between the existing N28 and the proposed M28 mainline. The residential receptor predicted to experience the greatest impact of the M28 lies to the west of the N28 close to the Cork County Council Reservoir.

The results of the modelling for this receptor are presented in **Table 13.21** and indicate that the levels of road traffic pollution for the property will decrease with the M28 in operation both in 2020 and 2035. This decrease is as a direct result of reduction in traffic on the road closest to the property (the existing N28) offsetting the potential increases from the introduction of the M28 to the south. The predicted decreases in annual average NO_2 concentrations are "small" in 2020 and "medium" in 2035 (refer **Table 13.3**) with the levels remaining well below the limit value. In summary, the predicted air quality impacts for the receptors in this area are classed as "negligible" (refer **Table 13.4**). This finding is valid for all other properties located in this section of the proposed M28 road project.

Table 13.21: Local Impact at N28/M28 from Carr's Hill to Shannonpark

Scenarios	Nitrogen Dioxide ($\mu g/m^3$)	Particulates (PM_{10}) ($\mu g/m^3$)		Particulates ($PM_{2.5}$) ($\mu g/m^3$)
	Annual Average NO_2	Annual Average PM_{10}	Days > 50$\mu g/m^3$	Annual Average $PM_{2.5}$
2020 Do-Minimum	22.80	18.73	0.24	7.44
2020 Do-Something	21.89	18.54	0.20	7.32
2035 Do-Minimum	25.23	19.76	0.62	8.06
2035 Do-Something	22.79	18.75	0.24	7.45
Statutory Limits	**40**	**40**	**35**	**25**
WHO Guidelines	**40**	**20**	**-**	**10**

Note: $PM_{2.5}$ estimated based on 60% of PM_{10} annual average.

Section 2: N28 at Shannonpark Roundabout

This section of the network covers the area around the existing N28 Shannonpark Roundabout which will remain operational under the proposed road project with the proposed M28 mainline alignment to the south west of the roundabout. There are a number of sensitive receptors located in the area including the following:-

- There are three residential properties located to the east of the roundabout close to the existing N28 towards Ringaskiddy;
- There are ten residential properties to the north of the roundabout close to the existing N28 towards Cork; and
- There are five residential properties located to the south of the roundabout located off the local road to the west of the R611 to Carrigaline.

The receptor in this area which will experience the greatest negative impact is the residential dwelling to the south west of the existing roundabout located off the local road to the west of the R611 to Carrigaline. The proposed M28 will run to the south of this receptor which will be subject to sources of road traffic pollution to the north and south.

The results of the modelling are presented in **Table 13.22** and indicate that the levels under all scenarios will be below the air quality limits and the WHO Guidelines but the levels of road traffic pollution for the property closest to these roads will increase with the M28 in operation as a result of the introduction of a new source to the south of the property. The predicted increases in annual average NO_2 concentrations are "small" in 2020 and 2035 (refer **Table 13.3**) with the levels remaining well below the limit value. In summary, the predicted air quality impacts for the receptors in this area are classed as "negligible" (refer **Table 13.4**). Other receptors in the area and those located to the north and east of the roundabout will experience a reduced impact and are also classed as "negligible".

Table 13.22: Local Impact at Shannonpark Roundabout

Scenarios	Nitrogen Dioxide ($\mu g/m^3$)	Particulates (PM_{10}) ($\mu g/m^3$)		Particulates ($PM_{2.5}$) ($\mu g/m^3$)
	Annual Average NO_2	Annual Average PM_{10}	Days > 50$\mu g/m^3$	Annual Average $PM_{2.5}$
2020 Do-Minimum	19.43	17.43	0.00	7.66
2020 Do-Something	20.17	17.86	0.00	7.91
2035 Do-Minimum	20.15	17.62	0.00	7.77
2035 Do-Something	20.94	18.00	0.00	8.00
Statutory Limits	**40**	**40**	**35**	**25**
WHO Guidelines	**40**	**20**	**-**	**10**

Note: $PM_{2.5}$ estimated based on 60% of PM_{10} annual average

Section 2: M28 Junction at Shanbally

This section of the network covers the area around the proposed M28 junction at Shanbally. There are a number of sensitive receptors located in the area (for example, Shanbally Mews and Coolmore Close to the south and Marian Terrace to the north). These properties currently experience background level of air quality as they are located away from major sources of air pollution. The inclusion of the new junction and link roads will introduce a source of air pollution into this area not currently present.

The results of the modelling are presented in **Table 13.23** and indicate that the levels of road traffic pollution for the property closest to this junction will remain below the AQ limits and WHO guidelines for all scenarios. As expected, the predicted levels will increase with the M28 in operation as a new source of pollution is located in the area. The predicted increases in annual average NO_2 concentrations are "small" in 2020 and 2035 (refer **Table 13.3**) with the levels remaining well below the limit value. In summary, the predicted air quality impacts for the receptors close to the proposed M28 Shanbally Junction are classed as "negligible" (refer **Table 13.4**).

Table 13.23: Local Impact at M28 Junction at Shanbally

Scenarios	Nitrogen Dioxide ($\mu g/m^3$)	Particulates (PM_{10}) ($\mu g/m^3$)		Particulates ($PM_{2.5}$) ($\mu g/m^3$)
	Annual Average NO_2	Annual Average PM_{10}	Days > 50$\mu g/m^3$	Annual Average $PM_{2.5}$
2020 Do-Minimum	18.00	17.00	0.00	7.40
2020 Do-Something	19.59	17.48	0.00	7.69
2035 Do-Minimum	18.00	17.00	0.00	7.40
2035 Do-Something	19.79	17.46	0.00	7.68
Statutory Limits	**40**	**40**	**35**	**25**
WHO Guidelines	**40**	**20**	**-**	**10**

Note: $PM_{2.5}$ estimated based on 60% of PM_{10} annual average

Section 2: N28 at Shanbally Village

This section of the network covers the properties along the existing N28 in Shanbally Village. While the existing N28 will remain operational, the traffic volumes will be significantly reduced with the diversion of traffic onto the proposed M28. The results of the modelling are presented in **Table 13.24** and indicate that the levels of road traffic pollution in the village will remain within the statutory limits and the WHO guidelines regardless of whether the proposed road project proceeds.

The levels in the village will decrease with the M28 in operation as a direct result of the decrease in traffic volumes on the existing N28. The predicted decreases in annual average NO_2 concentrations in the village are "medium" in 2020 and "large" in 2035 (refer **Table 13.3**) with the levels remaining well below the limit value. In summary, the predicted air quality impacts for the receptors in Shanbally Village are classed as "negligible" to "slight beneficial" in the long term (refer **Table 13.4**).

Table 13.24: Local Impact at Shanbally Village

Scenarios	Nitrogen Dioxide ($\mu g/m^3$)	Particulates (PM_{10}) ($\mu g/m^3$)		Particulates ($PM_{2.5}$) ($\mu g/m^3$)
	Annual Average NO_2	Annual Average PM_{10}	Days > 50$\mu g/m^3$	Annual Average $PM_{2.5}$
2020 Do-Minimum	22.44	18.46	0.18	8.276
2020 Do-Something	19.33	17.37	0.00	7.622
2035 Do-Minimum	25.46	19.52	0.51	8.912
2035 Do-Something	20.06	17.54	0.00	7.724
Statutory Limits	**40**	**40**	**35**	**25**
WHO Guidelines	**40**	**20**	**-**	**10**

Note: $PM_{2.5}$ estimated based on 60% of PM_{10} annual average

Section 2: Junction with the Old Post Office Road, Ringaskiddy

This section of the network covers the proposed junction between the proposed M28 and the Old Post Office Road to the south of Ringaskiddy Village. There are a number of sensitive receptors located in the area (for example, St. Carthage Place as well as a number of individual properties) that are currently only exposed to traffic from the Old Post Office Road. These receptors are likely to experience an increase in exposure from the alignment of the M28 to the south and north of these properties.

The results of the modelling are presented in **Table 13.25** and indicate that the levels of road traffic pollution for the property closest to this junction will increase with the proposed M28 in operation. The predicted increases in annual average NO_2 concentrations are "small" in 2020 and "medium" in 2035 (refer **Table 13.3**) with the levels remaining well below the limit value. In summary, the predicted air quality impacts for the receptors at the Old Post Office Road are classed as "negligible" (refer **Table 13.4**).

Table 13.25: Local Impact at N28 at the Old Post Office Road, Ringaskiddy

Scenarios	Nitrogen Dioxide ($\mu g/m^3$)	Particulates (PM_{10}) ($\mu g/m^3$)		Particulates ($PM_{2.5}$) ($\mu g/m^3$)
	Annual Average NO_2	Annual Average PM_{10}	Days > 50$\mu g/m^3$	Annual Average $PM_{2.5}$
2020 Do-Minimum	18.00	17.00	0.00	7.40
2020 Do-Something	19.90	17.55	0.00	7.73
2035 Do-Minimum	18.00	17.00	0.00	7.40
2035 Do-Something	21.56	17.91	0.00	7.95
Statutory Limits	**40**	**40**	**35**	**25**
WHO Guidelines	**40**	**20**	**-**	**10**

Note: $PM_{2.5}$ estimated based on 60% of PM_{10} annual average

Section 2: N28 at Ringaskiddy Village

This section of the network covers the properties along the existing N28 in Ringaskiddy Village. While the existing N28 will remain operational the traffic volumes will be significantly reduced with the diversion of traffic onto the M28. The results of the modelling are presented in **Table 13.26** and indicate that the levels of road traffic pollution in the village will decrease with the M28 in operation. The predicted decreases in annual average NO_2 concentrations in the village are "small" in 2020 and in 2035 (refer **Table 13.3**) with the levels remaining well below the limit value. In summary, the predicted air quality impacts for the receptors in Ringaskiddy Village are classed as "negligible" (refer **Table 13.4**).

Table 13.26: Local Impact at N28 at Ringaskiddy Village

Scenarios	Nitrogen Dioxide ($\mu g/m^3$)	Particulates (PM_{10}) ($\mu g/m^3$)		Particulates ($PM_{2.5}$) ($\mu g/m^3$)
	Annual Average NO_2	Annual Average PM_{10}	Days > 50$\mu g/m^3$	Annual Average $PM_{2.5}$
2020 Do-Minimum	19.47	17.64	0.00	7.78
2020 Do-Something	18.17	17.05	0.00	7.43
2035 Do-Minimum	19.94	17.85	0.00	7.91
2035 Do-Something	18.22	17.07	0.00	7.44
Statutory Limits	**40**	**40**	**35**	**25**
WHO Guidelines	**40**	**20**	**-**	**10**

Note: $PM_{2.5}$ estimated based on 60% of PM_{10} annual average

Impact on Sensitive Ecosystem

The principal pollutants of concern which originate from road developments are the nitrogen oxides (NO_x), in terms of impact on sensitive ecosystems. Nitrogen oxides (NO_x) may have a positive or negative impact by acting as a fertiliser or a phytotoxicant. Effects are mainly on vegetation growth, photosynthesis, and nitrogen assimilation/metabolism.

The alignments of the existing N28 and the proposed M28 road project are close to the Cork Harbour SPA in a number of locations as follows:-

- Bloomfield Interchange (adjacent to SPA);
- Monkstown Creek (circa 200 metres); and
- Ringaskiddy Village and Lough Beg (circa 300 metres).

The results of the local monitoring undertaken in the Cork area indicates that levels of NO_x of the order of 43$\mu g/m^3$ which is above the annual NO_x limit for the protection of vegetation of 30$\mu g/m^3$ (**Table 13.2**). Given the ecological sensitivity of the area, a nitrogen deposition assessment has been carried out as per the NRA Guidelines.

Using the results of the dispersion modelling and the procedures outlined in the NRA Guidelines, an assessment of nitrogen deposition on these sensitive ecosystems has been undertaken. **Table 13.27** presents the results in terms of nitrogen deposition on the wetland at Cork Harbour SPA as a result of traffic associated with the proposed road project in 2020.

Table 13.27: Predictions of Nitrogen Deposition at Sensitive Ecosystems in 2020

Ecosystem	2020 Do-Minimum NO_2 Concentration ($\mu g/m^3$)	2020 Do-Something NO_2 Concentration ($\mu g/m^3$)	Nitrogen Deposition with Proposed M28 kg(N)/ha/year
Cork Harbour SPA	17.73	17.46	1.75
UNECE Critical Load (kg(N)/ha/year) – Moist to Wet Dune Slacks			10-25
UNECE Critical Load (kg(N)/ha/year) – Pioneer and low-mid salt marshes			30-40

The predicted nitrogen deposition levels onto the Cork Harbour SPA site as a result of the proposed M28 road project indicate levels of approximately 1.75 kg(N)/ha/year and shows a slight decrease from the predicted deposition levels from the existing N28 alignment. The slight reduction is as a result of the main traffic being moved further south and away from the SPA.

The deposition with the M28 in operation (1.75 kg(N)/ha/year) is compared to the UNECE critical loads for nitrogen as presented in the NRA Guidelines. The UNECE critical load for nitrogen in moist to wet dune slacks is 10-25 kg(N)/ha/year. These results indicate that the levels of nitrogen deposition are less than 20% of the critical load as set by UNECE with the proposed road project in operation.

In addition, it should be noted that the future 'Do-Minimum' scenario in 2020 indicates that a higher level of nitrogen deposition will occur on this ecological site if the proposed M28 road project was not in operation. This low level of nitrogen deposition also applies to the other sensitive habitats that are adjacent to the route but are not in the Natura 2000 network.

Other than nitrogen oxides (NO_x), the other potential impact on sensitive ecosystems will be the potential impact of construction dusts during the construction phase. Dusts can be deposited on the leaves of plants reducing the photosynthetic potential. DMRB guidance states that dust or particles falling onto plants can physically smother the leaves affecting photosynthesis, respiration and transpiration. The literature suggests that the most sensitive species appear to be affected by dust deposition at levels above 1000 mg/m^2/day. As such, once dust deposition rates are maintained within the standard guideline for human nuisance (350mg/m^2/day) the impact of construction dust on sensitive ecosystems is considered negligible.

Further details of the predicted impacts to sensitive ecosystems are presented in **Chapter 12: Terrestrial Ecology** of the EIS.

Impacts at the National/International Level

In accordance with the UK DMRB, the regional impact of the proposed M28 road project has been assessed in terms of the total mass of CO_2 and NO_x emitted and the results are presented in **Table 13.28**.

Table 13.28: Total Emissions from the Existing and Proposed Networks

Scenario	Carbon Dioxide (CO_2) (tonnes)	Oxides of Nitrogen (NO_x) (tonnes)
2020 Existing Network	19,624	44.508
2020 Proposed Network	23,650	53.057

The results of the assessment indicate that the total GHG emissions as CO_2 from the existing N28 road network will increase with the proposed M28 road project in operation. This approximate 20% increase equates to 4,026 tonnes of carbon dioxide per annum in 2020 compared to the do-nothing scenario.

Similarly, the annual emissions of oxides of nitrogen (as NO_x) from the N28 road network will increase with the proposed M28 road project in operation. This approximate 19% increase equates to 9 tonnes of NO_x per annum in 2020 compared to the do-nothing scenario.

These impacts are considered as slight adverse in the long term. These increases are largely as a direct result of the increased number of vehicle kilometres travelled in the area on the combined existing N28 and the proposed M28 road project.

Direct Impacts from the proposed Service Area (SA)

The proposed SA in Ringaskiddy will include a potential source of air emissions when operational from fugitive vapours from the storage and sale of fuel. The storage of fuel is governed by the Dangerous Substances (Retail and Private Petroleum Stores) Regulations, S.I. 311 of 1979, as amended, and are made under the Dangerous Substances Act, No. 10 of 1972. The Act requires that all fuel storage facilities must be licensed and must meet minimum standards for the design and construction of both storage and dispensing infrastructure. In addition, these operations are regulated by the European Union (Stage II Petrol Vapour Recovery during Refuelling of Motor Vehicles at Service Stations) Regulations 2011, which will require the SA to be equipped with Stage II Petrol Vapour Recovery (PVRII) systems to recover Volatile Organic Compounds (VOC) during refuelling of vehicles. As such, the potential for fugitive emissions of fuels from the storage tanks and forecourts is limited and it is not considered that there will be any significant effects on air quality from this source.

Climate Change Adaption

Chapter 9: Hydrology and Drainage of this EIS provides details of the flood risk associated with the study area and the proposed road project. Guidance for the application of climate change in terms of sea level rise is provided in 'Assessment of Future Scenarios for Flood Risk Management' (OPW, 2009) which has been employed in the assessment.

One flood event was identified in the immediate vicinity of the proposed road project associated with Glounatouig Stream at Raffeen Bridge in November 2002. In addition, a flood event was identified in the immediate vicinity of the proposed SA associated with tidal flooding at the car park at end of local road (L2545) in February 2014.

The flood risk assessment considered a mid-range future scenario of 500mm rise in sea levels and a 1000mm increase in sea levels for the high end future scenario. Climate change is also likely to increase the risk from fluvial and surface water.

The project flood risk assessment has indicated that these risks are already low and it is not considered that climate change will significantly increase the risk of flooding. Increased runoff into drainage systems could significantly increase the risk of flooding from drainage systems, however the drainage design for the proposed M28 road project will include an allowance for climate change. It is therefore considered that impacts of climate change on the proposed M28 drainage will be suitably managed without specific mitigation measures being required and no additional climate change adaptation measures are proposed.

13.5 MITIGATION MEASURES

13.5.1 Construction Phase

Construction Dust

At the construction phase, the potential for dust emissions must be assessed qualitatively by the main Contractor through a Dust Risk Assessment prepared in accordance with the NRA Air Quality Guidelines and the NRA *Guidelines for the Creation and Maintenance of an Environmental Operating Plan* (NRA, 2007). This assessment must be based on the details of construction works and methodologies to be utilised by the main Contractor and proximities of works to residential and ecological receptors.

A construction compound has been selected so that it is located as far as practicable from sensitive receptors such as residential dwellings, etc. and at a sufficient distance from ecological receptors. A Dust Risk Assessment and a Dust Minimisation Plan will be prepared by the contractor in advance to the commencement of works. The Dust Minimisation Plan will be based upon the industry guidelines in the Building Research Establishment document entitled '*Control of Dust from Construction and Demolition Activities' (BRE 2003)*, as referenced in the NRA Guidelines. In order to ensure that any dust nuisance is minimised, a series of mitigation measures have been listed below. These measures are provided as an example and a full list of dust mitigation measures are provided in the NRA *Guidelines for the Creation and Maintenance of an Environmental Operating Plan* (NRA, 2007).

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 receptors locations and whether the wind can carry the dust to these locations. The implementation of a Dust Minimisation Plan during the construction phase of the project will include standard measures such as:-

- Site roads shall be regularly cleaned and maintained as appropriate. Hard surface roads shall be swept to remove mud and aggregate materials from their surface while any un-surfaced roads shall be restricted to essential site traffic only.
- Any site roads with the potential to give rise to dust will be regularly watered, as appropriate, during dry and/or windy conditions (also applies to vehicles delivering material with dust potential).
- All vehicles exiting the site shall make use of a wheel wash facility prior to entering onto public roads, to ensure mud and other wastes are not tracked onto public roads. Wheel washes should be self-contained systems that do not require discharge of the wastewater to water bodies.
- Public roads outside the site shall be regularly inspected for cleanliness, and cleaned as necessary. The Contractor will be required to submit for approval, from the Local Authority, his methodology for monitoring dust emissions both on and beyond the site boundary.
- Material handling systems and site stockpiling of materials shall be designed and laid out to minimise exposure to wind.
- Water misting or sprays shall be used as required if particularly dusty activities are necessary during dry or windy periods.

In addition to the standard methods outlined above the following additional measures will be applied to sensitive areas such as the area adjacent to Raffeen Quarry (in the event that material is extracted for the purposes of this project) to prevent the potential for dust impacts on sensitive receptors in close proximity:-

- Site traffic in these areas will be restricted to 20km/hr to minimise dust re-suspension.
- All material handling will be carried out to minimise drop heights from plant to plant or from plant to stockpile.
- Water bowsers will be used across the areas as required on roads, stockpiles and material handling systems.

The Contractor will be required to maintain monthly dust levels below the guideline of 350mg/m^2/day as an annual average at sensitive receptors.

With the implementation of the mitigation measures as set out in this chapter and adherence to good working practices by the Contractor, the levels of dust generated are unlikely to cause an environmental nuisance. The Contractor will be required to maintain monthly dust levels below the guideline of 350mg/m^2/day as an annual average at sensitive receptors. Where dust levels are found to be above this threshold, the mitigation measures in the area must be reviewed as part of the Dust Minimisation Plan.

Construction Greenhouse Gas Emissions

Mitigation measures to minimise CO_2 emissions from transport during the construction phase that must be implemented include the following:-

- Local sourcing of construction materials such as the recycling of material won on excavations for reuse on site and the use of material from Raffeen Quarry for aggregates. This measure has been implemented in the design to significantly reduce the transportation distances and resultant emissions for the haulage of this material.
- Implementation of the Traffic Management Plan. This will outline measures to minimise congestion and queuing, reduce distances of deliveries and eliminate unnecessary loads.
- Reducing the idle times by providing an efficient material handling plan that minimises the waiting time for loads and unloads. Reducing idle times could save up to 10% of total emissions during construction phase.
- Turning off engines when not in use for more than five minutes. This restriction will be enforced strictly unless the idle function is necessary for security or functionality reasons.
- Regular maintenance of plant and equipment. Technical inspection of vehicles will be undertaken to ensure they will perform the most efficiently.

Materials with a reduced environmental impact may also be incorporated into the construction design through re-use of materials or incorporation of recycled materials in place of conventional building materials. The following materials should be considered for the construction phase:-

- Ground Granulated Blast Furnace Slag (GGBS) & Pulverised Fuel Ash - Used as replacements for Portland cements to increase sustainability and carbon footprint of civil and structural works.

- Steel - The recovery rates associated with using recycled steel are high and research exists which shows that 99% of structural steel arising from demolition sites is recycled or re-used. The carbon emissions emitted during the production of virgin steel can be higher than some other structural materials on a tonne by tonne basis, and recycled steel should be used where possible.

As part of the Environmental Operating Plan/ Construction Environmental Management Plan, the Contractor will be required to implement an Energy Management System for the duration of the works. This Energy Management system will include such measures as:-

- The use of thermostatic controls on all space heating systems in site buildings to maintain optimum comfort at minimum energy use.
- The use of sensors on light fittings in all site buildings and low energy lighting systems.
- The use of adequately insulated temporary building structures for the construction compound fitted with suitable vents.
- The use of low energy equipment and "power saving" functions on all PCs and monitors in the site offices.
- The use of low flow showers and tap fittings.
- The use of solar/thermal power to heat water for the on-site welfare facilities and contamination unit (sinks and showers).

13.5.2 Operational Phase

Road Traffic

The collection of EU Directives, known as the Auto Oil Programme, have outlined improved emission criteria which manufacturers are required to achieve from vehicles produced in the past and in future years. This is a trend which has been in operation for many years and is destined to continue in future years for both cars and heavy duty vehicles. The introduction of the National Car Test (NCT) has also helped to reduce transport emissions by ensuring that all vehicles on Irish roads over 4 years old undergo an emissions test.

As outlined in the prediction model findings, if this project becomes operational, compliance with all the relevant limit values will be achieved at the nearest sensitive residential and ecological receptors. Therefore no route specific mitigation measures have been identified as a result of this assessment for the operational phase of the proposed road project.

13.6 RESIDUAL IMPACTS

13.6.1 Construction Phase

Dust Emissions

Once dusts are effectively managed, the potential impact of construction dust on affected properties is a 'short-term, slight adverse' for 186 properties.

Greenhouse Gas Emissions

The construction of the proposed M28 road project, including materials employed (aggregates, asphalt, etc.), material/personnel transport, mobile plant, etc. is predicted to be 54,409 tonnes of CO_{2eq} and this will be a permanent slight adverse impact.

13.6.2 Operational Phase

Index of Exposure

The operation of the proposed M28 road project will divert the main traffic volumes off the existing N28 leading to a net reduction in the exposure of the general public to road traffic emissions. As such, the road project will result in an overall "positive long term impact" in the area. In other words, at a regional scale the road project will ultimately move the source of pollution further away from properties thereby reducing the exposure of the general public to road traffic emissions. At a local level (as outlined in the following section) some receptors will experience a deterioration in air quality while others will experience an improvement in air quality but the net result is an overall positive impact.

Local Emissions (Human Health)

At the level of changes presented for the proposed M28 alignment coupled with the proposed changes in traffic, the predicted air quality impact on local human and ecological receptors is classed as 'negligible'. A number of properties in Section 1 (north of Carr's Hill) and along the offline section of the M28 south of Carr's Hill will experience small changes in levels of traffic derived pollution, albeit at levels well below the limits for the protection of human health. As a consequence, these properties are classed as experiencing a "negligible" air quality impact as a result of the proposed M28 Road Project.

Conversely, there are a number of properties located along the existing N28 south of Carr's Hill and in the villages of Shanbally and Ringaskiddy that will experience small to moderate decreases in levels of traffic derived pollution, also at levels well below the limits for the protection of human health. As above, these properties are classed as experiencing a "negligible" air quality impact as a result of the proposed M28 road project.

A Human Health Study (including air quality) on the proposed development is provided in **Appendix 1C.**

Impacts at the National/International Level

At the national level, the proposed M28 road project and traffic will result in change of 4,026 tonnes of CO_{2eq} and 9 tonnes NO_x per annum over the existing scheme in 2020. This is regarded as a 'long-term, slight adverse' impact.

13.7 MONITORING

13.7.1 Construction Phase

Dust Monitoring

The Contractor will be required to prepare a Dust Minimisation Plan and part of the project Construction Environmental Management Plan. The Dust Minimisation Plan will include details of a monitoring regime using standard Bergerhoff gauges (to VDI standard) at a series of locations that are identified based on potential risk of dust nuisance (including the quarry) and agreed with the local authority. The Contractor will be required to maintain monthly dust levels below the guideline of 350mg/m^2/day as an annual average at sensitive receptors. Where dust levels are found to be above this threshold, the mitigation measures in the area must be reviewed as part of the Dust Minimisation Plan.

13.7.2 Operation Phase

There is no proposed monitoring during the operation phase of the development.

14. NOISE AND VIBRATION

14.1 INTRODUCTION

This chapter of the EIS assesses the predicted impacts of the proposed M28 Road Project in terms of its impact from noise on the surrounding environment and the potential for generation of vibration.

14.1.1 Noise Assessment Criteria

Noise is regarded as a form of manmade pollution and under the *Environmental Protection Agency Act*, (1992) the definition of 'environmental pollution' includes 'noise… which is a nuisance or would endanger human health or damage property or harm the environment'.

Sound levels are expressed in decibels (dB) on a logarithmic scale. In terms of sound pressure levels, audible sound ranges from 0 dB (i.e. the threshold of hearing) to the threshold of pain at 120dB. A doubling/halving of pressure equates to a 3 dB increase/decrease in decibel level. Typically, under normal circumstances, a 3 dB change in environmental noise level is the smallest noticeable to the human ear. A 10 dB increase/decrease in sound level normally equates to a subjective doubling/ halving of noise.

The frequency of sound is the rate at which a sound wave oscillates, and is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example, hearing sensitivity decreases markedly as frequency falls below 250 Hz. A mechanism known as "A-weighting" has been adopted in order to account for this non-linearity of the human ear. Sound levels expressed using "A-weighting" are typically denoted dB(A). An indication of the level of common sounds on the dB(A) scale is presented in **Figure 14.1.**

The parameter most commonly used for the assessment of noise impact is L_{Aeq}, which is defined as being the A-weighted equivalent continuous steady sound level during the sample period and effectively represents an average value. In other words the L_{Aeq} is a good measure of the average ambient noise level. The L_{A10} index is considered a good indication of road traffic noise, while the L_{A90} index is considered a good indication of the background noise level. A glossary of noise level indices terms is given below:-

$L_{Aeq,T}$ The continuous equivalent A-weighted sound pressure level. This is an "average" of the sound pressure level over a period of time (T).

$L_{Amax,T}$ is the maximum A-weighted sound level measured during a period of time (T).

$L_{Amin,T}$ is the minimum A-weighted sound level measured during a period of time (T).

$L_{A90,T}$ The A-weighted noise level exceeded for 90% of the measurement over a period of time (T). This is normally used to indicate background noise.

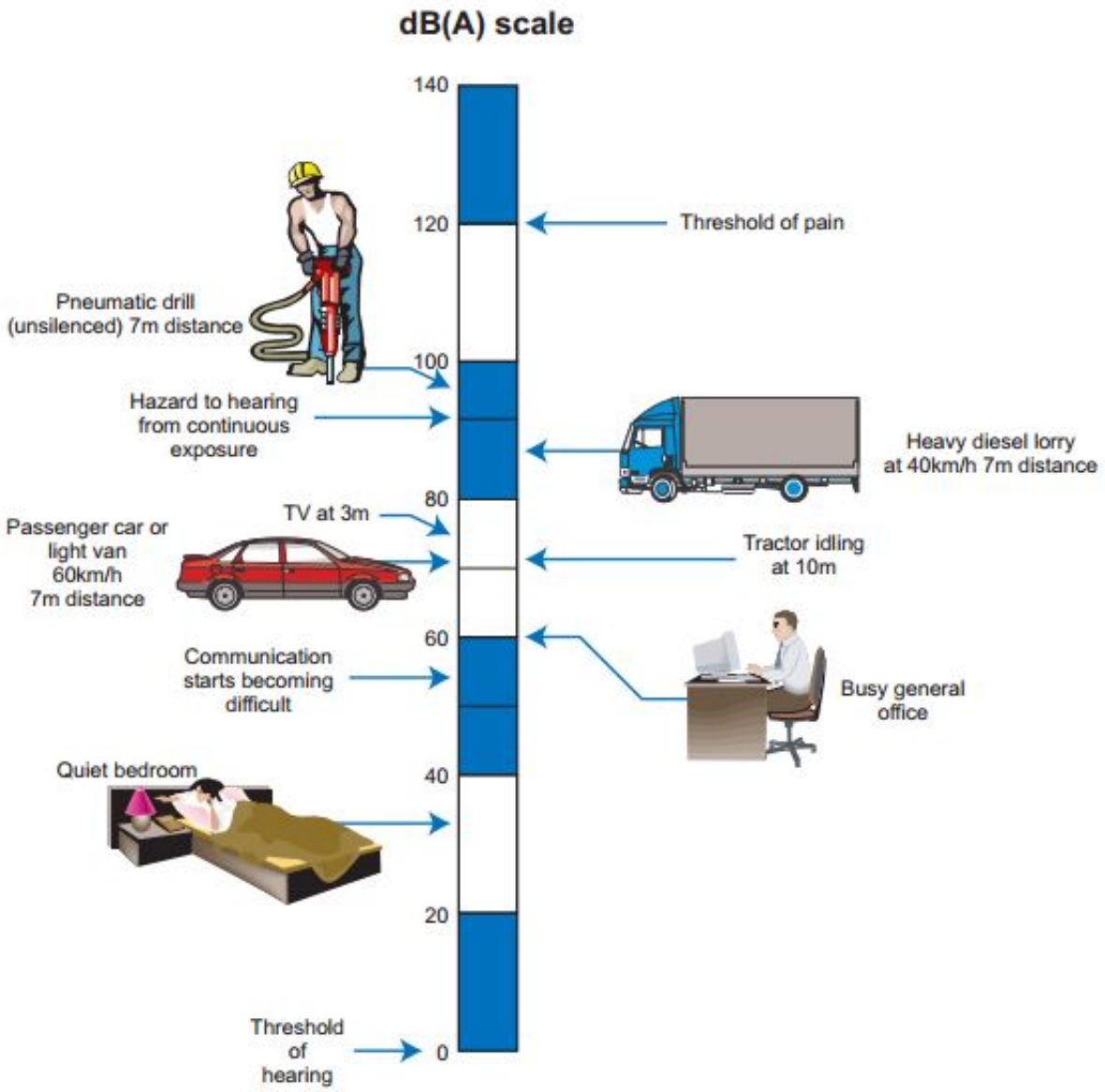
$L_{A10,T}$ The noise level exceeded for 10% of the measurement over a period of time (T). This is normally used as a measure of road traffic noise.

L_A Denotes, measurements were made using the A-weighting network. The A-weighting represents the response of human ear to sound.

Road traffic noise is considered in Directive 2002/49/EC of the European Parliament and of the Council of 25th June 2002 (transposed in Ireland by the Environmental Noise Regulations S.I. 140 of 2006) relating to the assessment and management of environmental noise. The Regulations require Local Authorities to prepare Noise Action Plans for their area. These Regulations use the L_{den} and L_{night} noise indicators for road traffic noise in Ireland. L_{den} and L_{night} are based on L_{Aeq} with adjustments for the evening and night periods.

Figure 14.1: The Level of Typical Common Sounds on the dB(A) Scale

(Based on Guidance taken from: Design Manual for Roads and Bridges, Volume 11 Consolidation Edition, 1993)



14.2 METHODOLOGY

14.2.1 Design Criteria

The NRA (now TII)'s *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*, as revised by the National Roads Authority in October 2004, are based on the Authority's phased approach to road scheme planning and development.

The current design goal is that all new national road schemes should be designed, where feasible, to meet a day-evening-night sound level of 60 dB L_{den} (free-field residential façade criterion), to be met both in the year of opening and in the design year.

The Guidelines acknowledge that it may not always be sustainable to provide adequate mitigation in order to achieve the design goal.

The assessment has been carried out having regard to the following guidelines:-

- Design Manual for Roads and Bridges Volume II Environmental Assessment, Section 2 Environmental Impact Assessment;
- Guidelines for the Treatment of Noise and Vibration in National Road Schemes Revision 1 (2004) – National Roads Authority;
- Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (2014) – National Roads Authority;
- Cork Agglomeration Noise Action Plan (2013-2018);
- Major Roads Cork County Noise Action Plan (2013-2018);
- BS 5228-1:2009+A1:2014 Noise and Vibration Control on Construction and Open Sites: Part 1 Noise;
- BS 5228-1:2009+A1:2014 Noise and Vibration Control on Construction and Open Sites: Part 2 Vibration;
- BS6472-1:2008 Guide to evaluation of human exposure to vibration in buildings. Vibration sources other than blasting;
- BS6472-2:2008 Guide to evaluation of human exposure to vibration in buildings. Blast-induces vibration;
- BS7385-2 1993: Evaluation and measurement for vibration in buildings. Guide to damage levels from ground borne vibration;
- ISO1996-1_2016 Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedure;
- UK's Department of Transport (Welsh Office) *"Calculation of Road Traffic Noise' Document"*, 1988;
- Guidelines on the information to be contained in Environmental Impact Statements, EPA (2002);
- Advice Notes on Current Practice in the Preparation of Environmental Impact Statements, EPA (2003);
- Revised Guidelines on Information to be Contained in Environmental Impact Statements, EPA (Draft September 2015);

- Advice Notes from Preparing Environmental Impact Statements, EPA (Draft September 2015).
- EPA Guidance Note for Noise Action Planning For the first round of the Environmental Noise Regulations 2006 (July 2009); and
- Environmental Protection Agency Office of Environmental Enforcement (OEE), Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) January 2016.

14.2.2 Construction Noise Criteria

With regard to the construction stage the NRA Guidance document '*Guidelines for the treatment of Noise and Vibration on National Road Schemes'* has published Irish guidance relating to the permissible noise level that may be generated during construction (see **Table 14.1**). These limits have been considered to represent a reasonable compromise between the practical limitations in a construction project, and the need to ensure an acceptable ambient noise level for nearby residents.

Table 14.1: Recommended Maximum Permissible Noise Levels at the Façade of Dwellings During Construction (Normal Construction Activities)

Days and Times	$L_{Aeq\ (1hr)}$ dB(A)	$L_{A\ (max)\ slow}$ dB(A)
Monday to Friday 07:00 to 19:00 hours	70	80
Monday to Friday 19:00 to 22:00 hours	60	65
Saturday 08:00 to 16:30 hours	65	75
Sundays and Bank Holidays 08:00 to 16:30 hours	60	65

(Source: NRA Guidelines for the Treatment of Noise and Vibration on National Road Schemes, 2004)

The TII Guidelines do not provide guidance for night time working. Weekend and night time working will be necessary for critical works involving road closures i.e. for the bridge works at Maryborough Hill. In addition to this, it is likely there will be need for other works to be carried out at night time and weekends.

Construction activity on Monday to Friday evenings, on Sundays and on Bank Holidays, and work outside the times indicated above, will require the explicit permission of the relevant local authority in accordance with the limits set out in **Table 14.2** below. Any explicit permission for night or weekend working will give consideration to the potential disruptive effects there may be on nearby residences and restrictions on noise and other adverse environmental emissions may be conditioned to any approval granted.

Annex E of BS 5228-1:2009 + A1:2014 "Code of practice for noise and vibration control on construction and open sites – Part 1" presents various methods of determining the significance of noise effects due to construction works. In this assessment, the ABC method detailed in Annex E.3.2 has been used.

The time periods have been adjusted to correspond with the TII periods outlined in **Table 14.1**, i.e., night time has been brought forward to commence at 22:00 and extend to 08:00 on weekends and bank holidays. Using the ABC method, the measured ambient noise level is rounded to the nearest 5 dB for the appropriate period (night, evening/ weekends or day). This is then compared with the estimated construction noise level. If the construction noise level exceeds the appropriate category

value, then there is potential for a significant effect to occur. The example threshold for significant effects at dwellings is shown below in **Table 14.2.**

Table 14.2: Recommended Maximum Permissible Noise Levels at the Façade of Dwellings During Construction (Exceptional Circumstances)

Threshold value period (L_{Aeq})	Threshold value (dB)		
	Category A	Category B	Category C
Night time (22:00-07:00 weekdays) and (22:00-08:00 weekends and bank holidays)	45	50	55
Evenings (19:00-22:00 weekdays) and Weekends (13:00-22:00 Saturdays) and (08:00-19:00 Sundays)	55	60	65
Daytime (07:00-19:00 weekdays) and Saturdays (08:00-16:30)	65	70	75

(Based on: BS 5228 -1:2009 + A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise time periods modified as outlined in the text)

The values in Category A, B and C are the threshold values to be used to determine the potential for significance at a noise sensitive receptor, based on ambient noise levels rounded to the nearest 5 dB. A receptor is categorised by comparing its rounded ambient noise level with the values assigned to Category A for the relevant time period, and is then categorised depending on whether the rounded ambient noise levels are less than, equal to, or higher than the values in Category A column, respectively. For example, if the rounded daytime ambient noise level is below 65 dB(A), then it is a Category A receptor and the threshold for potential significance is 65 dB(A). If the rounded daytime ambient noise level is equal to 65 dB(A), then the receptor is assigned to Category B and the threshold level is 70 dB(A).

Some blasting activity will be required during the earthworks phase for rock removal. Air overpressure from any required blasting shall not exceed 125 dB(linear) max peak, with a 95% confidence limit when measured at the nearest noise sensitive location. No individual air overpressure value shall exceed the limit value by more than 5 dB(Linear).

14.2.3 Operational Noise Criteria

14.2.3.1 General Considerations

Humans are considered in this assessment to be most sensitive to noise as species such as birds are acknowledged to have less sensitivity to noise. The following classifications can be regarded as conservative in their case. The significance of the changes in noise levels have been evaluated based on the assessment of changes in noise levels in terms of perceived change and loudness by humans and is shown in **Table 14.3**. The prediction of the perceived human impact of change in traffic noise level may result in a noise sensitive receiver being classified as potentially suffering from a 'neutral', 'imperceptible', 'slight', 'moderate', 'significant', 'very significant', or 'profound' subjective change in noise level. The thresholds outlined in the table are based on scientifically accepted norms, as published in Bies & Hansen Engineering Noise Control – Theory and Practice (2009) and Environmental Protection Agency Office of Environmental Enforcement (OEE), Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) January 2016.

Table 14.3: Significance of Changes in Noise Levels in Terms of Perceived Change in Loudness

Change in Noise Level	Impact Significance	Subjective Reaction
0	Neutral	Neutral
<1 dB	Imperceptible	Imperceptible
<3 dB	Not Significant	Rarely perceptible
<5 dB	Slight (Positive or Negative)	Just perceptible
5 to 10 dB	Moderate (Positive or Negative)	Clearly Perceptible
>10 dB	Significant (Positive or Negative)	>2 times change in loudness
>15 dB	Very Significant (Positive or Negative)	~3 times change in loudness
>20 dB	Profound (Negative only)	Much louder

14.2.3.2 TII Guidelines

The TII Guidelines acknowledge that it may be appropriate to adopt different design goals for diverse situations, e.g. design goals for existing situations may be different from new situations. They also acknowledge that it may not always be sustainable to provide adequate mitigation in order to achieve the design goal.

Traffic noise levels at the northern end of the proposed M28 Road Project are currently in excess of 70 dB L_{den} and are forecast to increase in the Do Minimum scenario. Scope to reduce noise levels using barriers and low noise surfaces is limited, and a reduction of over 10 dBA to achieve the TII Design Goal is not practicable.

Engineering solutions would require excessively high barriers which have structural, visual and safety issues making their implementation unsustainable. Possible design options including 4m and higher barriers and the use of high median barriers between carriageways were examined and found to have no significant acoustic benefits. Mitigation measures proposed in this EIS include 3m high barriers and low noise surfaces where their use will be effective.

The design goal specified in the NRA Guidance is an L_{den} value of 60 dB. This design goal applies to new road schemes only, which in the case of this proposed M28 Road Project is the section from Carr's Hill Interchange (Ch. 2200.0) south. The northern section (Ch. 0.0 to 2200.0) is on an existing alignment and online improvement and subject to criteria set out in **Section 14.2.3.3**. The on-line and off-line sections of the proposed M28 Road Project are illustrated on **Figure 14.2** contained in **Volume 5**.

The NRA Guidance also states that mitigation is required for new road schemes where the following three conditions arise at a noise sensitive location (NSL):-

a) *The combined expected maximum traffic noise level, i.e. the relevant noise level, from the proposed road scheme together with other traffic in the vicinity is greater than the design goal;*
b) *The relevant noise level is at least 1 dB more than the expected traffic noise level without the proposed scheme in place; and*
c) *The contribution to the increase in the relevant noise level from the proposed road scheme is at least 1 dB.*

14.2.3.3 Noise Plans

Noise Action Plans for the Cork area; *Cork Agglomeration Noise Action Plan* (2013-2018) and the *Major Roads Cork County Noise Action Plan* (2013-2018), have been prepared by Cork City and Cork County Councils. The Noise Action Plans identified and prioritised cluster areas which require further assessment and may require mitigation measures to be put in place. The Action Plans aim to minimise the population exposed to values of greater than 70 dB L_{den} through mitigation measures such as noise barriers, low noise surfacing etc. subject to budgets and available resources.

Existing noise levels at the northern end of the proposed road project have been measured consistently in excess of 70 dB(A).The proposed onset levels for assessment of noise mitigation for major roads in the Cork County area are as follows:-

- 70 dB L_{den}; and
- 57 dB, L_{night}

Five high priority areas as identified in the Noise Action Plans fall within the vicinity of the proposed M28 Road Project. They are identified as; N40-8 along the N40 at Kilteegan Park; N28-1 in the northern area of the N28 in the area of Newlyn Vale; N28-2 in the northern area of the N28 near Mount Oval; N28-3 south of Carr's Hill; and N28-4 at Hilltown.

The noise criteria assessment for the proposed road project has been divided between the northern (existing on-line improvement) and southern (new road) sections of the project. The criteria for the northern end of the road project, which represents an upgrade to the existing road alignment, are the onset levels for mitigation in the Cork Noise Action Plans (70 dB $L_{den)}$. The criterion for the southern part of the road project, which consists of new road, is the TII/NRA design goal (60 dB L_{den}).

The on-line and off-line sections of the proposed M28 Road Project are illustrated on **Figure 14.2** contained in **Volume 5**.

14.2.4 Vibration Assessment Criteria

In respect of vibration, 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 ground of energy waves. These waves arise as a function of the size, shape and speed of the vehicle.

In the case of nominally continuous sources of vibration, such as traffic, vibration is perceptible at a peak particle velocity of 0.5mm/s or greater. The operational stages of the proposed road project will be assessed against this vibration level. Nelson et al. (1987) state that typical levels of traffic induced vibration velocity, 3.65m from the edge of a road, range from 0.06mm/s to 0.25mm/s in the frequency range of 20-30 Hz. The level of vibration arising through this pathway for modern road schemes at nearby residences is generally imperceptible.

There are various vibration guidelines to protect individuals and properties during operational and construction stages of a development. Common practice in Ireland has been to use guidance from these internationally recognised standards, which address vibration standards in two criteria, those

dealing with human comfort and those dealing with cosmetic or structural damage to buildings. The generally accepted criteria for vibration levels are:-

- Vibration levels that would be likely to lead to structural damage (BS7385-2 1993: Evaluation and measurement for vibration in buildings. Guide to damage levels from ground borne vibration); and
- Vibration that would be likely to lead to complaints (BS6472-1:2008 Guide to Evaluation of Human Exposure to Vibration in Building. Vibration sources other than blasting and BS 6472-2:2008 Guide to evaluation of human exposure to vibration in buildings. Blast-induced vibration).

During the construction stage of the proposed M28 Road Project, vibration levels are likely to be higher and associated with single events or events of short duration. For example, blasting or rock-breaking, which can be sources of vibration during construction are typically not significant at vibration levels up to 2.5mm/s for temporary nature/short works. Blast-induced vibration due to its infrequent nature is typically tolerated at much higher thresholds.

The NRA limits for protection of properties against cosmetic damage, which are given as a function of vibration frequency and are outlined in **Table 14.4**. These guidelines are in line with international best practice. The lowest international guideline for the protection of buildings with "particular sensitivity to vibration" and "of great intrinsic value" are set out in Deutsches Institut für Normung, "*Structural Vibration, Part 3: Effects of Vibration on Structures*," DIN 4150-3 (Berlin: German Institute for Standardization, 1999): 1-11. The guideline set in this standard is 3mm/s at frequencies lower than 10 Hz and rising for higher frequencies.

Table 14.4: Allowable Vibration during Road Construction in Order to Minimise the Risk to Building Damage

Allowable Vibration Velocity (Peak Particle Velocity) at the Closest Part of any Sensitive Property to the Source of Vibration, at a Frequency of:		
Less than 10 Hz	10 to 50 Hz	50 to 100 Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

(Source Reference: NRA *Guidelines for the Treatment of Noise and Vibration on National Road Schemes*)

14.3 NOISE MODELS FOR CONSTRUCTION AND OPERATION PHASES

Cadna noise modelling software was used to predict the impact of the proposed M28 Road Project on noise sensitive receptors. The Cadna software provides a three dimensional model for sound propagation and attenuation using a selection of appropriate calculation methods. Cadna has been validated in accordance with the German Standard: DIN 45687 "*Acoustics - Software products for the calculation of the sound propagation outdoors - Quality requirements and test conditions*" (German title: "Akustik - Software-Erzeugnisse zur Berechnung der Geräuschimmission im Freien - Qualitätsanforderungen und Prüfbestimmungen", issue date: 2006-05).

A construction stage model was generated using *BS* 5228-1:2009+A1:2014 "*Code of Practice for Noise and Vibration Control on construction and open sites – Part 1: Noise"* in order to predict likely construction noise levels during the construction stage of the proposed road project. This takes account of noise emissions from construction plant and machinery likely to be used during construction. The cumulative impact of traffic on the existing N28, other roads in the study area and the operation of the John A. Woods quarry at Raffeen were also taken in to account as part of the assessment.

Cadna noise modelling software was used to predict the impact of operational phase on the noise sensitive receptors. The software was used based on CRTN ''*Calculation of Road Traffic Noise*''. CRTN dates from 1988 and updated advice on using CRTN recommended in the NRA *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes* (March 2014) have been included in the methodology.

In the model a three dimensional base map of the proposed road project including a 300m buffer zone is imported. The position of various buildings, receptor locations and distances are then inserted on the topography. Roads are imported in to the model and the traffic count data for each section is inserted. Distance losses, ground attenuation, and barrier/berm effects are applied as a result of the ground contour data inserted and the resulting noise levels are computed at the sensitive receptor locations. The noise model has the ability to show how the noise radiates from the sources and is affected by intervening structures and terrain.

The Cadna software includes detailed calculations for reflections from structures and allows for mitigation measures such as barriers and different road surfaces to be put in place within the model to assess their effectiveness in reducing the sound levels arising from the proposed M28 Road Project. 'Standard' road surface material is normal hot-rolled asphalt (HRA) with a surface layer depth of 50mm. Low noise road surface design is based on stone mastic asphalt with a surface layer depth of 30-50mm.

All calculations were based on the predicted traffic flows set out in **Chapter 5: Traffic and Transportation** and associated variables were inserted such as the speed of the various roads and the percentage of HGVs. All traffic flows were developed using project specific data in order to calculate L_{den} in accordance with Method A outlined in the TII Guidelines.

Noise models were generated for the following scenarios:-

- Existing Baseline Scenario;
- Construction Phase;
- Opening Year 2020 'Do-Minimum' scenario;
- Design Year 2035 'Do-Minimum' Scenario;
- Design Year 2035 'Do-Something' Scenario; and
- Design Year 2035 'Do-Something' with mitigation.

14.3.1 Noise Model Verification

The NRA Guidelines state that:-

> ''*whilst there is no need for further validation of the established CRTN prediction methodology, the Authority considers that the noise models themselves should be validated in order to ensure that the roads, topography and other crucial features have been correctly represented and incorporated into the model. This could be done in a number of ways, for example, the survey results could be compared with the predicted results obtained using traffic data that are representative of the conditions during the period when the survey was conducted. The exact method of validation is left to the discretion of the Acoustic Engineer*''

It is reasonable to consider that where the modelled noise levels are within +/- 2 dB of the measured noise levels for flat terrain and urban areas up to a distance of 2km, the model can be considered to be validated. Where the modelled and measured noise levels are within +/- 5 dB for hilly terrain the model can be considered to be validated. The complex terrain in which this project is located places the acceptable tolerance in the +/- 5 dB range.

This difference between the modelled and measured noise levels can be accounted for due to the fact that the noise levels in the model arise as a result of traffic noise only, whereas the monitored noise levels take in to account other noise sources in the surrounding area and are limited to the traffic volumes during the noise survey period. It must be borne in mind that the predicted levels are annual average levels. In general comparisons are made with short term measurements. Short term measurements can vary significantly.

The models used in this study were verified by ensuring the vertical alignment was transferred directly from the planning drawings; road sections were assigned correct road surface types and traffic flows and speeds were coordinated with the traffic section. The topography, buildings and receiver heights were checked for consistency.

The noise model for the baseline scenario was generated using baseline traffic count data and baseline noise levels were predicted at a number of receiver locations within the vicinity of the proposed works. The model was validated through two baseline noise measurement surveys carried out in February/March 2015 and in October 2016. The baseline surveys consisted of both 24 hour and short term measurements. A series of locations where the baseline noise model could be compared with measurements were identified. The noise levels measured at these locations were within an acceptable range of the predicted levels calculated in the Cadna model. Therefore the noise model can be considered to be validated. **Table 14.5** compared the measured values to those predicted in the Cadna model.

Table 14.5: Measured vs Modelled Noise Levels

Sample Location	Measured Ambient Noise Level L_{den} dB(A)	Predicted Noise Level L_{den} dB(A)
N1-1	70	70
N1-3	57	57
N1-4	67	63
N1-5	61	60
N1-6	83	78
N2-1	65	65
N2-6	68	64
N3-1	66	69
N3-3	68	66
N3-4	69	72
N3-6	71	68
N4-1	59	64
N4-2	63	64
N4-3	62	57
N4-4	65	61
N4-5	62	61
N4-7	70	66
N4-8	54	52
N4-9	80	75

14.4 RECEIVING ENVIRONMENT

14.4.1 Existing Sources and Receptors

A noise sensitive location (NSL) is defined in the EPA *Guidance Note for Noise: Licence Applications, Surveys and Assessments in relation to Scheduled Activities* (EPA NG4, January 2016) as " – any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels..

The route corridor runs between the Bloomfield Interchange of the N40 South Ring Road in the south of Cork City to the east of the village of Ringaskiddy on the Ringaskiddy Peninsula in County Cork. The upgrade is on-line through a densely populated area between Bloomfield and Carr's Hill. South of Carr's Hill the route runs on the eastern side of the existing N28 through open country to Shannonpark where it veers to an easterly direction, staying south of the existing road at Shanbally and Barnahely and joining the existing N28/L2545 east of Ringaskiddy.

There are various NSLs located along the proposed route including human and natural habitats. They vary in density and distance from the centreline of the proposed road project.

A total of 2983 properties were considered in the model, of which 225 are located within 50m of the existing N28 and proposed M28 Road Project including residential developments, schools, places of worship, commercial operations, etc. The most sensitive NSLs for the purpose of this document are residential dwellings where people are present for day, evening and night periods and thereby continuously exposed to road traffic noise. Residences, schools and places of worship are regarded as more sensitive than sporting grounds or commercial operations.

Other non-domestic NSLs considered in this document include schools, crèches/playschools, a health centre, residential care centre, B&Bs and a hotel. Amenity NSLs considered include a playground, football pitches, allotments, churches, graveyards and two golf courses. In addition to the residential and human NSLs, the Cork Harbour SPA, Lough Beg and Monkstown Creek pNHA are sensitive ecological NSLs that are located close to the route corridor of the proposed M28 Road Project at the northern and southern ends of the project. The noise levels at ecological NSLs are addressed in **Chapter 12: Terrestrial Ecology**.

Along some sections of the existing N28 (e.g. the section from Carr's Hill to the Rochestown Road Junction) the road verges consist of mature and semi mature trees and wooded area (i.e. Bloomfield Wood and Donnybrook Wood). Trees and shrubs may act as a visual screen but in accordance with the TII Publications and CRTN are not considered to provide any noise reduction in the modelling.

It is proposed that a Service Area will be located in the port area and will fulfil the needs of HGV traffic in the area. The nearest receptor to the site is the National Maritime College of Ireland which bounds the Service Area to the east. South of the Service Area is the Hammond Lane commercial operation which lies south of the L2545. The nearest residential properties to the service area include those at Martello Park to the south west of the site and north of the new alignment.

There are a number of existing noise sources along the existing and proposed road as follows;

- Road traffic on the national routes (including the existing N28 and the N40 at the northern boundary of the road project), the regional roads (R611 and R613 to Carrigaline from the N28, and the R610 and R609) and on the local road network generate significant noise levels along the road network;
- The quarry at Raffeen which has planning permission for blasting, rock processing and material storage. It is anticipated that the quarry will be in operation during the construction stage of the proposed road either for the purposes of supplying material for the road or other needs under its current planning condition (Reg. Ref. 06/10037 and PL. 04.225610). Condition 21 of the existing planning permission for this quarry limits noise emissions and Condition 24 controls blasting;
- The Port of Cork at Ringaskiddy operates on a 24-hour basis and includes shipping and shore based operations along with associated traffic. The traffic levels arising from port operations are included in **Chapter 5: Traffic and Transportation**;
- The noise arising from traffic using the port includes vehicles using the Ringaskiddy area for service calls and overnight parking of refrigerated trailers; and
- Wind turbines operate at three facilities in the wider Ringaskiddy area.

There are no facilities operating vibration sensitive equipment within 300m of the proposed road. The ruin at Castle Warren is a protected structure located approximately 50m from the proposed M28 Road Project. This structure was inspected in March 2017 and found to be in a stable condition with some vulnerability to vibration during the construction phase . In order to ensure this structure is protected during the construction phase specific vibration monitoring measures will be adopted.

14.4.2 Baseline Noise Survey

The existing ambient noise levels in the proposed M28 Road Project area were measured at a number of noise sensitive and receiver locations.

The baseline survey was carried out in accordance with the requirements of the NRA guidelines. Three 24 hour monitoring stations were set up in March 2015 (N1, N2 and N3). Six short-term measurement locations were also identified surrounding each of the 24 hour stations resulting in a total of 18 short-term monitoring locations. Measurements were taken at the short-term monitoring locations for a period of 15 minutes with three monitoring locations being sampled within a 1 hour period in accordance with the NRA guidelines. A description of the noise monitoring locations is presented in **Table 14.6** and their locations are shown on **Figure 14.3** contained in **Volume 5.**

Additional monitoring was also undertaken in October 2016 to revalidate the baseline measurements and collect data in the vicinity of Raffeen Quarry, as well as the proposed Service Area and provide a baseline model of the proposed M28 Road Project in its entirety. Nine locations were monitored and as with the previous short-term measurements monitoring was carried out for a period of 15 minutes with three monitoring locations being sampled within a 1 hour period.

The measurements were taken using a Type 1 Brüel and Kjaer Integrating Averaging Sound Level Meter with real time analysis. All measurements were carried out in accordance with the NRA Guidelines. Short-term measurements were made by placing the microphone at a height of 1.5m above ground level and positioned in the ‘free field’ at least 3m away from any reflecting surfaces. The 24 hour measurements were taken ‘free field’ at a height of 4m above ground level. Before and after the survey the measurement apparatus was checked and calibrated using a Brüel and Kjaer Type 4231 Sound Level Calibrator (94 dB at 1 kHz). Weather conditions during the surveys were in line with the conditions described within ISO 1996.

The noise measurements were noted onto survey record sheets immediately following each measurement and also stored in the instrument’s internal memory for subsequent analysis, notes were taken in relation to the primary contributors to noise build-up at each location. A summary of the short time baseline noise monitoring results is presented in **Table 14.6.**

Table 14.6: Description of Noise Monitoring Locations and Noise Sources

Monitoring Location	Location of the Meter	Primary Noise Source	Secondary Noise Source
N1	This 24hr meter was mounted on a 4M pole and tripod on made ground / hardstanding within Raffeen Quarry, approximately 50m south of the N28. A low level wall was located approximately 2m to the east which formerly formed part of the quarry stockpiling activities.	Traffic from the N28	Some bird song from the quarry
N 1-1	The meter was located on a footpath to the west of the R610 and south of its junction with the L2470.	Traffic from the N28	Local traffic at junction of R610/L2470. Ground was wet for third recording.
N 1-2	The meter was located on a gravelled lay-by on the Ballinrea Rd, approx. 200m west of the Shannonpark Roundabout.	Local traffic dominant on L2473	Traffic from the N28, birdsong in the lull.
N 1-3	The meter was located at a gravel stockpiling area on the L6472 immediately east of Raffeen Quarry, approx. 60m north of an electricity pylon.	Traffic from the N28	Aeolian noise from overhead wires, aircraft and local traffic on L6472
N 1-4	Monitoring was undertaken at the entrance to Fernhill Golf And Country Club on the L2490, approximately 50m north of the ESB substation. The meter was located on a rough tarmacadam surface.	Local traffic on the L2490	N28 is audible, local traffic turning into Fernhill Golf and Country Club, electrical hum from substation
N 1-5	Monitoring took place on the Hilltown local road which connects the L2470 and L6469. The meter was located on the roadside at a field boundary. Linear residential properties were located to the north and south of N1-5 which is approx. 140m east of the N28.	Traffic from the N28	Local traffic on the Hilltown Road, dog barking and birdsong
N 1-6	The meter was located on the verge / rough grassland area immediately adjacent to the N28 at the entrance to an agricultural property. This entrance is located approximately 440m north west of the junction of the N28 with the L6477.	Traffic from the N28, very heavy for third recording	Agricultural property moving e.g. gates, cattle lowing, aircraft, wet ground for third recording
N2	This 24hr meter was attached to a 4m pole on a tripod and secured in the south western most corner of the National Vehicle Distribution property in Ringaskiddy village. The meter was located approximately 5m north of the L2545 and 40m east of the N28 where it enters the Port of Cork.	Traffic from the N28	Local traffic on the L2545, port-related traffic and vehicular movements within the National Vehicle Distribution
N 2-1	Monitoring was undertaken on the footpath outside Barnahely graveyard at the junction of the R613 and the private access road leading to Janssen Biologics.	Traffic on the R613 including trucks accelerating up a hill	Traffic on the N28, aircraft

Monitoring Location	Location of the Meter	Primary Noise Source	Secondary Noise Source
N 2-2	The meter was located on the roadside outside a residential property on the Ringaskiddy – Loughbeg road approx. 150m south of the junction with Ashgrove Terrace.	Local traffic on the L6518	Traffic collecting children from school, human voices, crows, chainsaw
N 2-3	Monitoring was undertaken on the footpath to the east of the junction of the N28 and the R613 approx. 50m south of the Port of Cork entrance.	Traffic from the N28	Trucks entering and exiting the Port of Cork facility onto the N28, Port related activities
N 2-4	The meter was located on a lay-by area outside the church walls immediately south of the junction of Church Rd (R613) and Rock Rd (L2490). This junction is located to the East of Carrigaline urban area.	Traffic on R613	Traffic from junction of R613 and L2490, birdsong
N 2-5	The meter was located outside residential properties at the east of the entrance to Coolmore estate at the junction of the R613 and the L2492.	Traffic on R613	Traffic from junction of R613 and L2492, crows from nearby rookery, human voices, lawnmower
N 2-6	Monitoring was undertaken on the L2492 outside a derelict property approximately 100m south of Shanbally School and immediately north of a private laneway servicing a number of properties to the west of the L2492.	Local traffic and electrical hum from nearby transformer	N28, birdsong, human voices
N3	This 24hr meter was attached to a 4m pole and secured to a tripod with the gardens of a the parochial house which is located approximately 40m east of St. Patricks Church on the Rochestown Road. The meter was also approx. 85m east of the Rochestown / Douglas slip off ramp from the Bloomfield Interchange.	Traffic from the N28 / Bloomfield Interchange	Local traffic attending services in St. Patrick's Church and human voices.
N 3-1	Monitoring was undertaken on a grassed area on the Garryduff Rd outside a residential property at the junction of a minor local road which services 10 properties and loops back to the Garryduff Road again approx. 95m to the south.	Local traffic on Garryduff Road	Birdsong, buses accelerating uphill
N 3-2	The meter was located at a secondary vehicular access point to Douglas Golf Club on Maryborough Hill approx. 190m north east of the Maryborough overpass to the N28.	Traffic on Maryborough Hill	Grass cutting at the Douglas Golf Club, tree cutting / shredding
N 3-3	The meter was located in Moneygourney on a gravelled lay –by on the L6477, located approximately 360m south west of Garryduff playing pitches.	Traffic on the L6477	N28 audible, lambs bleating, some aircraft.

Monitoring Location	Location of the Meter	Primary Noise Source	Secondary Noise Source
N 3-4	Monitoring was undertaken in Wainsfort housing estate on the Rochestown Road, to the west of the Bloomfield interchange. The meter was located to the North of No. 11 Wainsfort.	Traffic from the N28 / Bloomfield Interchange	Dog barking, construction activity – perhaps an electric saw
N 3-5	The meter was located on the L2464 Douglas – Carrigaline Rd at an agricultural entrance opposite the junction of the L2464 with the Board of Works road which is located approx. 700m south west of the N28.	Traffic on the Ballinrea Road	Birdsong
N 3-6	Monitoring was undertaken on the R609 30m to the west of the N28 overpass at an agricultural access point north of the interchange.	Traffic from the N28 overhead	Local traffic on R609
N4	The 24hr meter attached to a 4m pole and secured to a lighting standard within the grounds of a Cork County Council area office to the south of the Rochestown Road roundabout and east of the N28.	Traffic from the N28 to the west.	Local traffic and voices from Cork County Council office and Mount Oval residences.
N 4-1	Monitoring was undertaken adjacent to the church grounds on an access road to serving a number of properties between the church and Bloomfield Interchange.	Traffic from the N28 to the north and west.	Local traffic in the churchyard, birdsong and occasional church bells.
N 4-2	The meter was set up in a cul-de-sac / turning and parking area located within Rochestown Rise housing estate, immediately west of the N28.	Traffic from the N28 to the east.	Local traffic in Rochestown Rise, birdsong and a water main / drain underground.
N 4-3	The meter was on a tripod at the edge of grassed public open space within Lisadell housing estate, between the internal roadway and the treeline forming a boundary with the N28.	Traffic from the N28 to the east and south.	Local traffic, occasional voices and construction noises such as hammering together scaffolding.
N 4-4	Monitoring was undertaken at The Fairways housing estate in an area of public open space adjacent to the internal road network and boundary with Lisadell housing estate.	Traffic from Maryborough Hill.	N28 to the south and east, lawnmower, voices.
N 4-5	The meter was recording sound at The Downs area of Broadale, at an area of open space overlooking the N28 to the west.	Traffic from the N28.	Local traffic on the internal estate road network, rubbish truck, occasional voices.
N 4-6	Noise monitoring was carried out in the Edgeworth area of Maryborough Ridge housing estate, at an area of open space to the north east of apartment blocks.	Local traffic within the Maryborough Ridge internal road network.	Voices, dogs barking, crows.
N 4-7	Monitoring was undertaken at the west of the junction between the L2545 and the eastern extent of Martello Park.	Traffic on the L2545	Voices, some construction work, truck idling in the National Vehicle Distribution Centre.

Monitoring Location	Location of the Meter	Primary Noise Source	Secondary Noise Source
N 4-8	The meter was set up on the northern access road to Coolmore Close to the north of house No. 1.	Traffic on the L2492 Shanbally Mews / Marian Terrace road.	Crows, some construction noise and voices.
N 4-9	The meter was recording noise on the hardshoulder of the N28 to the east of a number of residences east of Shannonpark Roundabout.	Traffic from the N28 and Shannonpark Roundabout.	Voices at residences to the west, birdsong and ducks at a farm to the north.

14.4.3 Cork County Council Noise Monitoring

Cork County Council operates a permanent noise monitoring station at a facility in Mount Oval. This monitoring station has operated since 2014 and the latest year for which a full dataset is available is 2016.

The data from this station was downloaded and an annual L_{den} for 2016 was calculated for this location, the result of the calculation is compared with the modelling result for the baseline year in **Table 14.7**:-

Table 14.7: Measured v's Modelled Noise Level at Cork County Council Station

	Measured Ambient Noise Level	Predicted Modelled Noise Level
L_{den} dB(A)	69.2	68.6
L_{night} dB(A)	57.0	58.1

The modelled level is comparable to the calculated L_{den} level albeit slightly lower. This is normal for a traffic noise model as the model only includes traffic noise from the road, whereas the measured noise level includes noise from all sources. The night time predicted noise level is marginally higher than the measured value but within acceptable modelling tolerance.

The measured noise level indicates that noise levels at the northern end of the proposed road project are at or above the thresholds in the Noise Action Plans. Some properties are closer to the road than the measured location and others more exposed to road traffic noise, resulting in the need for mitigation measures to be introduced as part of the proposed M28 Road Project.

14.4.3.1 Baseline Noise Survey Results

The results of the short-term baseline measurement survey are shown in **Table 14.8.**

Table 14.8: Short-Term Baseline Measurement Results

Location	Measurement Date & Time	L_{A90}	L_{A10}	L_{Aeq}	Notes
N1-1	26/02/2015 14:01-14:17	54.4	69.9	66.3	Traffic from N28 and local traffic dominant source of noise. Measurement paused due to hail shower.
N1-1	26/02/2015 15:06-15:21	53.9	69.6	65.7	Traffic from N28 and local traffic dominant source of noise.
N1-1	26/02/2015 16:09-16:24	61.1	71.6	68.5	Traffic from N28 and local traffic dominant source of noise.
Derived Measurements					
Average L_{10}			70.4		
$L_{A10, 18\ hour*}$			69.4		
L_{den**}				69.5	
Location	**Measurement Date &Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N1-2	26/02/2015 14:23-14:38	50.0	72.1	67.3	Local traffic dominant source of noise. Traffic from N28 audible. Birdsong.
N1-2	26/02/2015 15:26-15:41	47.2	68.8	65.0	Trucks passing intermittently.
N1-2	26/02/2015 16:32-16:47	48.5	71.3	66.6	Birdsong. Intermittent local traffic. Aircraft movement overhead.
Derived Measurements					
Average L_{10}			70.7		
$L_{A10, 18\ hour*}$			69.7		
L_{den**}				69.8	
Location	**Measurement Date &Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N1-3	26/02/2015 14:46-15:01	48.1	55.1	52.7	Local traffic dominant source of noise. Traffic from N28 audible. Aircraft movement overhead. Birdsong.
N1-3	26/02/2015 15:47-16:02	47.2	55.6	54.0	Local traffic dominant source of noise. Traffic from N28 audible.
N1-3	26/02/2015 16:52-17:07	49.0	55.0	55.2	Local traffic dominant source of noise. Traffic from N28 audible.
Derived Measurements					
Average L_{10}			55.2		
$L_{A10, 18\ hour*}$			54.2		
L_{den**}				56.5	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N1-4	27/06/2015 10:00-10:15	43.3	67.4	64.4	Intermittent local traffic. Birdsong and distant traffic dominant source of noise.

N1-4	27/06/2015 11:06-11:21	41.3	67.4	64.4	Electrical hum from substation.
N1-4	27/06/2015 12:05-12:20	44.6	66.5	64.1	Aircraft movement overhead. Car horn. Dog barking. Noise from golf club audible. Wind through foliage.
Derived Measurements					
Average L_{10}			67.1		
$L_{A10, 18\ hour*}$			66.7		
L_{den**}				66.7	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N1-5	27/06/2015 10:22-10:37	51.1	58.3	56.4	Dog barking. Birdsong. Intermittent local traffic. Traffic on N28 audible.
N1-5	27/06/2015 11:27-11:42	52.9	58.8	57.0	Dog barking. Helicopter flying overhead.
N1-5	27/06/2015 12:26-12:41	56.7	62.4	60.8	Dog barking.
Derived Measurements					
Average L_{10}			59.8		
$L_{A10, 18\ hour*}$			58.8		
L_{den**}				60.5	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N1-6	27/06/2015 10:47-11:02	61.7	85.2	80.7	N28 dominant source of noise. Agricultural noise. Low flying aircraft movement overhead.
N1-6	27/06/2015 11:47-12:02	61.5	85.4	80.7	N28 dominant source of noise.
N1-6	27/06/2015 12:46-13:01	70.6	86.6	82.4	N28 dominant source of noise. Ground wet during measurement.
Derived Measurements					
Average L_{10}			85.7		
$L_{A10, 18\ hour*}$			84.7		
L_{den**}				82.7	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N2-1	10/03/2015 14:11-14:26	38.5	64.0	60.4	Local traffic. Truck passing. Aircraft movement overhead.
N2-1	10/03/2015 15:19-15:34	39.6	66.5	63.1	Local traffic dominant source of noise. N28 audible. Aircraft movements overhead.
N2-1	10/03/2015 16:17-16:32	44.2	65.7	60.7	Car engine running close to measurement location. Wind glider overhead.
Derived Measurements					
Average L_{10}			65.4		

$L_{A10, 18\ hour*}$			64.4		
L_{den**}				65.7	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N2-2	10/03/2015 14:42-14:57	41.7	56.9	54.7	Local traffic. N28 audible. Aircraft movement overhead. Noise from chainsaw and people at one point during the measurement.
N2-2	10/03/2015 15:39-15:54	37.1	47.3	50.8	Traffic from N28 dominant source of noise.
N2-2	10/03/2015 16:37-16:52	38.7	46.0	44.4	Dog barking.
Derived Measurements					
Average L_{10}			40.1		
$L_{A10, 18\ hour*}$			49.1		
L_{den**}				52.1	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N2-3	10/03/2015 15:01-15:16	54.2	76.1	71.9	Traffic noise from N28 dominant. Truck movements in and out of the adjacent facility.
N2-3	10/03/2015 15:59-16:14	56.8	78.1	73.6	Traffic noise from N28 dominant.
N2-3	10/03/2015 16:56-17:11	61.2	79.5	74.9	Traffic noise dominant. Road very busy.
Derived Measurements					
Average L_{10}			77.9		
$L_{A10, 18\ hour*}$			76.9		
L_{den**}				76.0	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N2-4	11/03/2015 13:46-14:01	47.5	73.6	69.5	Local traffic at junction. Birdsong.
N2-4	11/03/2015 14:53-15:08	51.2	72.8	68.3	Low flying aircraft movement overhead.
N2-4	11/03/2015 15:56-16:11	45.6	71.4	67.6	Car engine running nearby for period of measurement.
Derived Measurements					
Average L_{10}			72.6		
$L_{A10, 18\ hour*}$			71.6		
L_{den**}				71.4	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N2-5	11/03/2015 14:07-14:22	47.4	70.1	67.5	Traffic noise dominant. Bird noise from nearby rookery.

N2-5	11/03/2015 15:14-15:29	49.6	70.4	67.6	Lawn mower and music audible from across the road. Bus passing. Voices nearby.
N2-5	11/03/2015 16:18-16:33	54.7	76.1	71.8	Dog barking. Voices nearby. Road traffic noise. Road very busy.
Derived Measurements					
Average L_{10}			72.2		
$L_{A10, 18\ hour*}$			71.2		
L_{den**}				71.1	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N2-6	11/03/2015 14:29-14:44	42.9	68.5	64.3	Hum from transformer. Birdsong. School bell. N28 traffic noise audible. Local traffic noise.
N2-6	11/03/2015 15:33-15:48	42.5	67.6	64.3	Talking near microphone.
N2-6	11/03/2015 16:39-16:54	44.0	71.0	66.9	Cars queuing at roundabout. Birdsong. Aircraft movement overhead. Conservation.
Derived Measurements					
Average L_{10}			69.0		
$L_{A10, 18\ hour*}$			68.0		
L_{den**}				68.4	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N3-1	14/04/2015 09:45-10:00	38.9	65.6	63.8	Birdsong. Local traffic. Conversation.
N3-1	14/04/2015 10:55-11:10	38.0	66.2	62.1	Local traffic.
N3-1	14/04/2015 11:54-12:09	42.7	68.1	64.2	Local traffic.
Derived Measurements					
Average L_{10}			66.6		
$L_{A10, 18\ hour*}$			65.6		
L_{den**}				66.3	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N3-2	14/04/2015 10:07-10:22	50.4	77.1	72.4	N28 audible. Local traffic. Birdsong.
N3-2	14/04/2015 11:15-11:30	55.1	79.2	74.4	Grass cutting at golf course. Frequent local traffic.
N3-2	14/04/2015 12:13-12:28	53.5	78.7	73.9	Tree cutting/branch shredding.
Derived Measurements					
Average L_{10}			78.3		
$L_{A10, 18\ hour*}$			77.3		

L_{den}**				76.4	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N3-3	14/04/2015 10:34-10:49	36.4	69.4	68.1	Local traffic. Lambs bleating. Birdsong. Aircraft movement overhead.
N3-3	14/04/2015 11:34-11:49	36.1	69.6	67.2	Local traffic. Very quiet during periods of low traffic noise.
N3-3	14/04/2015 12:32-12:47	40.8	68.1	66.5	Wind through foliage.
Derived Measurements					
Average L_{10}			69.0		
$L_{A10, 18\ hour}$*			68.0		
L_{den}**				68.4	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N3-4	15/04/2015 13:46-14:01	64.2	70.3	69.1	N28 dominant source of noise. Dog barking.
N3-4	15/04/2015 14:56-15:11	63.0	69.2	67.5	Dog barking.
N3-4	15/04/2016 16:07-16:22	64.3	69.0	67.8	Dog barking. Construction noise – electric saw.
Derived Measurements					
Average L_{10}			69.5		
$L_{A10, 18\ hour}$*			68.5		
L_{den}**				68.8	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N3-5	15/04/2015 14:13-14:28	38.4	74.1	70.3	Intermittent local traffic. Birdsong.
N3-5	15/04/2015 15:23-15:38	42.0	73.8	69.3	Intermittent local traffic. Birdsong.
N3-5	15/04/2015 16:35-16:50	46.4	76.1	71.5	Intermittent local traffic. Birdsong.
Derived Measurements					
Average L_{10}			74.7		
$L_{A10, 18\ hour}$*			73.7		
L_{den}**				73.2	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N3-6	15/04/2015 14:34-14:49	49.5	73.5	71.7	Traffic from N28 overpass audible. Local traffic. Birdsong.
N3-6	15/04/2015 15:44-15:59	52.9	70.0	70.3	Traffic from N28 overpass audible. Local traffic. Birdsong.
N3-6	15/04/2015 16:56-17:12	56.0	73.7	72.2	Traffic from N28 overpass audible. Local traffic. Birdsong.

Derived Measurements					
Average L_{10}			72.4		
$L_{A10, 18\ hour*}$			71.4		
L_{den**}				71.3	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N4-1	09:00-09:15	52.8	57.4	55.6	Local traffic dominant. Birdsong. M28 visible and audible.
N4-1	10:09-10:24	51.8	57.6	56.2	Church bells at one occasion. Car pulling in near measurement position. Car horn.
N4-1	11:13-11:28	51.6	58.2	55.7	Plane flying overhead. Car passing on laneway.
Derived Measurements					
Average L_{10}			57.7		
$L_{A10, 18\ hour*}$			56.7		
L_{den**}				58.7	
Location	**Measurement Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N4-2	09:19-09:34	57.0	63.2	61.1	Local traffic dominant. Birdsong. M28 visible and audible. Watermain/drain audible.
N4-2	10:28-10:43	55.9	63.0	60.2	Conversation near microphone for a few minutes.
N4-2	11:32-11:47	55.7	62.8	60.1	
Derived Measurements					
Average L_{10}			63.0		
$L_{A10, 18\ hour*}$			62.0		
L_{den**}				63.2	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N4-3	09:45-10:00	54.6	62.0	59.6	Local traffic dominant. Birdsong. M28 visible and audible. Occasional cars passing measurement position.
N4-3	10:50-11:05	54.3	61.1	59.9	Occasional vans and cars passing.
N4-3	11:56-12:11	55.6	61.4	59.4	Hammering audible from nearby construction work. Car starting near measurement position on two occasions.
Derived Measurements					
Average L_{10}			61.5		
$L_{A10, 18\ hour*}$			60.5		
L_{den**}				61.9	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N4-4	14:44-14:59	52.5	59.8	57.3	Traffic on N28 audible. Traffic from Maryborough Hill also audible. Low flying plane overhead.

N4-4	15:44-15:59	51.0	58.7	56.2	Voices near microphone. Car door.
N4-4	16:42-16:57	55.6	75.4	71.2	Motorbike passing. Lawnmower audible.
Derived Measurements					
Average L_{10}			64.6		
$L_{A10, 18\ hour*}$			63.6		
L_{den**}				64.6	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N4-5	15:05-15:20	56.1	61.9	60.4	Traffic from N28 and Maryborough Hill dominant source of noise. Birdsong. Waste truck also noted on two occasions during the measurement.
N4-5	16:03-16:18	56.8	61.2	59.5	Voices nearby. Birds in nearby trees. Plane flying overhead.
N4-5	17:05-17:20	55.5	62.2	59.8	
Derived Measurements					
Average L_{10}			61.8		
$L_{A10, 18\ hour*}$			60.8		
L_{den**}				62.1	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N4-6	15:26-15:41	40.8	54.9	53.5	Birds overhead. N28 audible. Occasional noise from vehicles including waste truck.
N4-6	16:22-16:37	41.9	53.9	53.4	Dog barking. High pitch noise from car.
N4-6	17:24-17:39	42.0	58.5	54.9	
Derived Measurements					
Average L_{10}			55.8		
$L_{A10, 18\ hour*}$			54.8		
L_{den**}				57.0	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N4-7	09:12-09:27	51.7	71.5	67.4	Local traffic dominant. Engine running from nearby vehicle distribution centre. Birdsong. Voices from nearby residence. Bus and truck passing.
N4-7	10:25-10:40	42.6	70.4	68.0	Truck and empty trailer passing. Angle grinder audible.
N4-7	11:31-11:46	37.7	71.9	68.6	
Derived Measurements					
Average L_{10}			71.3		
$L_{A10, 18\ hour*}$			70.3		
L_{den**}				70.3	

Location	Measurement Date & Time	L_{A90}	L_{A10}	L_{Aeq}	Notes
N4-8	09:36-09:51	42.9	51.4	50.1	Quiet area. Occasional vehicles entering estate. Birdsong. N28 audible in the distance. Activity within estate.
N4-8	10:45-11:00	37.7	51.4	49.6	Generator running at grotto to the east of measurement position audible.
N4-8	11:52-12:07	38.4	54.6	51.3	Church bells at Shanbally noted at one period. Frequent passing of cars and trucks overhead to the north-east of Shannonpark roundabout. Voices nearby microphone at the end of the measurement.
Derived Measurements					
Average L_{10}			52.5		
$L_{A10, 18\ hour}$*			51.5		
L_{den}**				54.1	
Location	**Measurement Date & Time**	**L_{A90}**	**L_{A10}**	**L_{Aeq}**	**Notes**
N4-9	09:59-10:14	60.7	81.0	77.1	Traffic noise from N28 and Shannonpark dominant. Voices from construction work at nearby house audible.
N4-9	11:06-11:21	64.7	82.8	78.7	Chainsaw to the north of N28 audible.
N4-9	12:12-12:27	66.5	83.4	79.5	
Derived Measurements					
Average L_{10}			82.4		
$L_{A10, 18\ hour}$*			81.4		
L_{den}**				79.9	

*The $L_{A10, 18\ hour}$ level was derived from the short-term calculation $L_{A10, 18\ hour}$ = (Average measured L_{10} values)/3 – 1 given in the NRA document ''*Guidelines for the treatment of Noise and Vibration in National Road Schemes*''.

**The L_{den} level was derived from the Method B calculation given in the NRA document ''*Guidelines for the treatment of Noise and Vibration in National Road Schemes*'' L_{den} = 0.86 x $L_{A10, 18\ hour}$ + 9.86.

The results of the baseline 24 hour noise surveys carried out at each 24 hour monitoring location are shown in **Table 14.9** to **Table 14.11**.

Table 14.9: Location N1 24 Hour Baseline Noise Survey Results

Hour End	$L_{A90, 1\ Hour}$	$L_{A10, 1\ Hour}$	$L_{Aeq, 1\ Hour}$
14:30	56.9	66.5	63.7
15:30	56.6	66.9	63.9
16:30	60.0	67.0	64.5
17:30	60.1	66.7	64.3
18:30	59.5	66.6	64.1
19:30	58.9	66.2	63.7
20:30	52.7	64.7	61.5
21:30	47.1	61.9	58.2
22:30	43.2	60.6	56.0
23:30	40.9	59.0	54.4
00:30	40.0	58.3	53.3
01:30	38.6	56.2	51.9
02:30	37.6	51.0	49.6
03:30	37.3	50.9	48.7
04:30	37.4	49.3	47.9
05:30	38.3	52.5	49.3
06:30	42.2	62.6	57.7
07:30	58.6	67.7	65.3
08:30	61.8	67.3	65.3
09:30	57.9	66.9	64.4
10:30	53.8	64.4	61.1
11:30	52.7	63.9	60..5
12:30	56.0	64.1	61.3
13:30	57.7	64.4	62.0
Derived Measurements			
L_{den}*			63

*The L_{den} value was derived from the Method B calculation given in the NRA document ''*Guidelines for the treatment of Noise and Vibration in National Road Schemes*'' $L_{den} = 10 \times \log_{10}(\frac{1}{24})(12\times10^{L_{day}/10} + 4\times10^{(5+L_{evening})/10} + 8\times10^{(10+L_{night})/10})$ dB(A).

Table 14.10: Location N2 24 Hour Baseline Noise Survey Results

Hour End	$L_{A90, 1\ Hour}$	$L_{A10, 1\ Hour}$	$L_{Aeq, 1\ Hour}$
14:47	48.8	70.3	67.5
15:47	48.7	67.4	63.6
16:47	51.7	70.4	66.0
17:47	52.7	69.3	66.0
18:47	51.1	69.0	65.0
19:47	46.8	63.9	60.8
20:47	41.1	60.1	59.0
21:47	40.6	61.1	60.4
22:47	39.8	52.3	54.1
23:47	39.9	47.4	53.0
00:47	40.7	48.6	50.8
01:47	42.5	50.4	50.8
02:47	44.5	51.1	50.0
03:47	46.3	55.2	52.1
04:47	50.8	59.5	57.4
05:47	49.8	58.3	58.9
06:47	51.4	62.6	60.3
07:47	61.4	72.8	70.3
08:47	63.6	74.6	70.8
09:47	60.5	74.6	70.6
10:47	52.0	70.4	67.0
11:47	49.0	67.4	63.1
12:47	50.4	69.2	64.1
13:47	50.2	69.7	65.0
Derived Measurements			
L_{den}*			66

*The L_{den} value was derived from the Method B calculation given in the NRA document ''*Guidelines for the treatment of Noise and Vibration in National Road Schemes*'' $L_{den} = 10x10\log_{10}(\frac{1}{24})(12x10^{L_{day}/10} + 4x10^{(5+L_{evening})/10} + 8x10^{(10+L_{night})/10})$ dB(A).

Table 14.11: Location N3 24 Hour Baseline Noise Survey Results

Hour End	$L_{A90, 1\ Hour}$	$L_{A10, 1\ Hour}$	$L_{Aeq, 1\ Hour}$
14:25	56.3	61.2	60.0
15:25	57.0	61.7	59.8
16:25	58.0	62.5	60.6
17:25	59.3	63.1	61.5
18:25	59.8	63.5	61.9
19:25	58.4	62.9	61.1
20:25	54.7	59.9	57.9
21:25	52.3	58.3	55.9
22:25	50.9	57.7	55.2
23:25	48.0	56.5	53.6
00:25	44.9	55.2	52.0
01:25	38.6	52.1	48.3
02:25	33.9	50.1	45.9
03:25	34.0	49.7	45.7
04:25	35.7	50.8	47.1
05:25	41.6	53.9	50.4
06:25	51.1	59.0	56.0
07:25	58.8	63.2	61.4
08:25	59.7	63.3	61.8
09:25	59.3	63.1	61.7
10:25	56.1	61.1	59.2
11:25	55.3	60.2	58.2
12:25	54.8	59.8	57.9
13:25	56.1	61.6	59.8
Derived Measurements			
L_{den}*			61

*The L_{den} value was derived from the Method B calculation given in the NRA document ''*Guidelines for the treatment of Noise and Vibration in National Road Schemes*'' $L_{den} = 10x10\log_{10}(\frac{1}{24})(12x10^{L_{day}/10} + 4x10^{(5+L_{evening})/10} + 8x10^{(10+L_{night})/10})$ dB(A).

14.5 POTENTIAL IMPACTS

The potential noise and vibration impacts of the proposed road project have been evaluated for both the construction and operational stages.

14.5.1 Construction Stage

The construction stage is a significant task and is expected to take 30-36 months to complete. Details of the construction programme are set out in **Chapter 3: Description of the Proposed Road Development** and comprises:-

- Pre Main Construction works comprising fencing, tree and hedgerow clearance, site investigation and utility diversions. These works will generally be localised in extent and temporary in duration;
- Main construction works will comprise the construction of 3 interchanges, 10 significant structures approximately 13km of mainline and single carriageways with significant local road upgrades and tie-ins;
- The construction of the Service Area in Ringaskiddy; and
- Approximately 1,150,000m^3 of reusable material will be excavated along the mainline with the majority located between Ch. 4,670m and Ch. 6,000m. This rock will be extracted using drilling and blasting.

The main works to be carried out at the northern will require short-term traffic management measures which include local diversions. The principal works requiring traffic management measures include:-

- Widening of the westbound M28 to N40 South Ring Road merge;
- On-line widening between Bloomfield and Rochestown Road, including the construction of large retaining walls and a new overbridge over Rochestown Road;
- Proposed works on Rochestown Road;
- On-line widening between Rochestown Road and Maryborough Hill, including the construction of large retaining walls;
- Proposed new bridge replacement at Maryborough Hill;
- On-line widening between Maryborough Hill and Carr's Hill, including the construction of large retaining walls;
- Widening of Carr's Hill Underbridge; and
- Construction of a Service Area at Ringaskiddy.

The traffic management measures are outlined in Drawings TM001 to TM010 and described in **Chapter 5: Traffic and Transportation.**

14.5.1.1 Quarrying During Construction

The construction phase of this road project will require considerable 'cut and fill' operations where material is beneficially reused inside the site boundary. This reuse of material will reduce the

quantum of material having to be hauled to the site from external sources, considerably reducing the overall environmental impact of the proposed M28 Road Project. No useful material will be hauled off the site.

In order to reuse material extracted from 'cut' operations it needs to be processed on site for use as aggregate in the construction of the road. This will involve the use of crushing and screening plants at certain locations along the route. These locations include the Carr's Hill junction, the mainline north of Shannonpark and south of Ringaskiddy. Other locations may need some material processing for limited periods.

The quarry at Raffeen has a 30 year planning permission (as of the 16th July 2008 under Reg. Ref. 06/10037 and PL. 04.225610) and it is proposed to utilise this resource for the construction of the proposed M28 Road Project to minimise the impact of hauling material on to the site from external sources.

Potential noise and vibration impacts from the cut and fill operations are included in the construction stage noise model.

14.5.1.2 Construction Stage Noise Impacts

The construction stage of a project on this scale will result in 'slight' to 'profound' negative impacts due to increases in noise levels. In the majority of cases the impact will be just perceptible or 'slight', but localised impacts, while of brief or temporary duration, could be profound. Mitigation measures will be required during construction to minimise noise and vibration impacts.

The works required for the construction of the proposed road project will include ground works for the excavation of cut and fill sections, road paving and the installation of services. The full extent of the proposed works is detailed in **Chapter 3: Description of the Proposed Road Development**. The construction stage will involve blasting and the use of a variety of equipment including excavators, rock breakers, generators, concrete mixers, lifting equipment, compressors, pumps, lighting, and dumper trucks. There will be vehicular movements to and from the site. All of these construction activities will generate noise and vibration.

In order to minimise the impact on nearby sensitive locations, it is common practice to limit the times of day during which it is permissible to carry out construction work that could create high levels of noise. It is proposed that normal working hours will be 07:00 and 19:00 Monday to Friday and 08:00 to 16:30 on Saturday. 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 Local Authority.

Higher noise levels are generally accepted during the construction stage of this type of project than the operational stage, as these works are short-term in nature. The northern end of the project area is a sensitive residential area where significant civil engineering construction is required to be implemented. Off-peak and night working will be considered for works in critical locations. Any approval for night working will give consideration to the potential disruptive effects there may be on nearby residences and significant restrictions on noise and other adverse environmental emissions will be conditioned to any approval granted.

For the purpose of this requirement, night is defined as 22.00 to 07.00 hours.

This EIS sets out the control measures to be adopted for the proposed M28 Road Project. As part of the implementation of noise mitigation detailed noise control measures, for tasks arising during construction, detailed method statements for specific work elements will be developed. The Contractor will be obliged to comply with the noise limits set out in this chapter and apply Best Practicable Means, including the recommendations of BS 5228 *Code of practice for noise and vibration control on construction and open sites*, together with the specific requirements of any EIA Approval and the Construction Environmental Management Plan (CEMP) in the method statements. Any proposal for night time working will include a specific requirement for stakeholder engagement, including the Local Authority and the residential community.

Example of works that may be required outside the normal working hours include diversion of utilities, demolition and reconstruction of the bridge at Maryborough or working on existing roads outside of peak traffic periods to avoid or minimise traffic congestion.

Based on the likely construction methods required to complete the works, an indication of worst case noise levels at the nearest NSLs from the use of a range of equipment was calculated using data from *BS 5228-1:2009+A1 - Code of practice for noise and vibration control on construction and open sites – Part 1: Noise* and the Cadna noise modelling software. Indicative construction activities and locations have been modelled and are shown in **Figure 14.4** contained in **Volume 5**. While these locations are indicative all works will be subject to noise control measures outlined in any EIA Approval.

BS 5228-1:2009+A1:2014 sets out a method of calculating the propagation of sound towards a receiver from the use of certain construction plant and machinery on a construction site. The standard describes single octave sound power level data for a range of standardised plant and machinery as would be expected to be the norm on construction sites.

Sound propagation calculations for a range of plant and machinery have been presented and are shown in **Table 14.12**.

Table 14.12: Sound Pressure Levels of Typical Machinery Used During Construction Stage

Item & BS5228-1:2009+A1:2014 Reference	Predicted Noise Levels at 10m
Pneumatic breaker (Ref D.2.11)	87
Backhoe Mounted Hydraulic Breaker (Ref C.5.1)	88
Concrete Mixer Truck (Ref D.6.35)	72
Wheeled Mobile Telescopic Crane (Ref C.4.38)	78
Vibratory Roller (Ref C.5.26)	77
Dumper (Ref C.4.9)	77
Articulated Dump Truck (Ref C.2.33)	81
Water Pump (Ref C.2.46)	66
Tracked semi-mobile crusher (Ref C.9.14)	90
Screen stockpile (Ref C.10.14)	81
Tracked Excavator (Ref C.2.14)	79
Bored piling/pile cast in place	87

Cars and vans travelling to and from the site compounds during the construction stage would be expected to peak during the morning (arrival of Contractors at the site) and evening (departure of Contractors from the site), and would not be a continuous source of noise emissions from the site during a typical working day. The delivery of construction materials by HGVs to the site has been included in the traffic figures.

Blasting works may be required to be carried out at a number of locations along the proposed road project, principally at the cut sections on the mainline north of Shannonpark and south of Ringaskiddy (as described in **Chapter 3: Description of the Proposed Road Development**). These blasting events will increase the noise levels within the vicinity of the blast. Noise from blasting will however be momentary in nature.

The potential noise impacts during the construction stage have been modelled at four specimen locations along the proposed M28 route using the Cadna software. These locations are shown on contained in **Volume 5**, which also shows the location of indicative crushing and screening operations modelled. The relevant noise sources listed in **Table 14.12** were included in the model at each location and all machinery modelled to operate simultaneously throughout the entirety of the day-time period. This represents a worst case condition. The reality will entail machinery being operated at different periods and at different locations throughout the proposed road project. **Figure 14.5** (refer to **Volume 5** of the EIS) shows the noise contour map results at each of the modelled locations. The results of the noise contours indicate that, under worst case conditions, noise levels may be above the limits set in **Table 14.1** or **Table 14.2**. In particular Edgewood, Maryborough Hill, Noise Action Plan Area N28-1, The Close and The View all indicated levels which, if uncontrolled, have the potential to exceed these noise limits. Mitigation in the form of construction phase acoustic screens is proposed for these areas in **Section 14.6.1.**

In the event that the Contractor's method statement for any proposed works indicates that the levels set out in **Table 14.1 or Table 14.2** may be exceeded, permission for the works must be sought from the Planning Authority in advance of any works taking place. The application for such works will require a detailed noise control plan and follow up report to be prepared. This plan will include (i) a justification for the works, (ii) an assessment indicating what alternatives have been considered, (iii) a statement of the noise control measures from B.S. 5228 to be adopted and how Best Practicable Means will be used to control noise, (iv) an activity specific noise monitoring programme including contact details for persons with the authority to cease working if required by the Planning Authority. Each follow up report will include details of any complaints received and the action taken to address such complaints. The proposed mitigation measures for the construction period are detailed in **Section 14.6.1**.

In the event that material is used from the quarry for the purposes of the road noise levels from the quarry operation at Raffeen have been considered as part of the construction phase model. The predominant noise sources from the quarry will be from the various items of plant and machinery involved in the quarrying activities, as well as from blast events. It is likely that noise from blast events will be audible at some sensitive receptors. The nearest sensitive receptor is approximately 100m from the quarry. Noise from a quarry blast however will be intermittent and occur on average 4 times per month as set out under the existing planning permission – see Condition 24 of the permission. The quarry will not be operational on Sundays or Bank Holidays.

14.5.1.3 Construction Stage Vibration Impacts

The main sources of vibration during the construction works will arise as a result of blasting during the excavation works and to a lesser extent vehicles travelling on, to and from the construction sites. As discussed in **Section 14.2.4** the main issues of concern with regards to vibration are human sensitivity and potential structural damage to nearby buildings. Any works likely to cause vibration will be subject to vibration control measures set out in this document and in compliance with the limits set out in the NRA Guidelines.

The majority of dwellings within the vicinity of the proposed works will comply with modern building regulations standards and therefore will be tolerable to the vibration limits given in the NRA guidance (see **Table 14.4**). The NRA guidance limits also include a considerable factor of safety and therefore any older buildings or buildings that deviate from building regulations standards should still be tolerable to these vibration limits.

The Castle Warren site is considered to be sensitive to vibration during the construction phase. The nearest blasting activity will be over 1 kilometre from Castle Warren. The primary risk to the structure will arise from construction traffic during placement and compaction of materials during the construction of the elevated section of the road 50m from the structure. The largest dynamic compaction rollers have the capability of generating vibration levels of up to 3mm/s at a distance of 50m.

Vibration levels during construction will be maintained below the threshold of risk to the structure and a combination of structural and vibration monitoring will be carried out during the construction phase to protect the structure.

14.5.2 Operational Phase

14.5.2.1 Noise Impacts

The TII Guidelines require predictions to be reported for the Opening Year (2020), and for a Design Year (2035), 15 years after opening. Noise levels in the Design Year differ from those in the Opening Year by the same amount at all locations. This means that there will be no property that meets the requirements for mitigation in the Design Year that does not also meet them in the Opening Year.

TII Guidelines state it is only necessary to table the predictions for the Design Year and to report the (constant) difference between the Design and the Opening Year levels. This will reduce the volume of data presented in the noise report. It also avoids the need to consider mitigation for two different years, as any mitigation which is adequate for the Design Year will also meet the requirements of the Opening Year.

The main source of noise during the operational phase will arise from traffic on the proposed M28 Road Project. The traffic volumes and speeds are as set out in **Chapter 5: Traffic and Transportation**. For the purpose of noise modelling the 'high-growth' scenario has been chosen. The predicted impacts of the operational stage of the development on selected NSLs have been modelled for the design year. A 'Do-Minimum' (proposed road project is not carried out) and a 'Do-Something' (proposed road project is carried out without any mitigation) scenario has been modelled based on predicted traffic flows. The location of the NSLs is shown on **Figure 14.6** contained in **Volume 5**.

The predicted noise level at specific NSLs for the design year 2035 'Do-Minimum' and 'Do-Something' scenario are given in **Table 14.13**. The Operational Noise Criteria set out in **Section 14.2.2** have been applied and the reasoning whether mitigation is required or not is also set out. The requirements of the Cork Noise Action Plans are referred to below under the Design Criteria Column of **Table 14.13** as Cork NAP. Where a number of properties in the same area have been examined, e.g., Belgard Downs, a range of values is presented.

The existing noise levels on the northern end (on-line section) of the proposed M28 Road Project are significantly higher than the TII Design Goal it is therefore not practicable to reduce these levels to achieve the TII Design Goal in a sustainable manner at all locations.

For this assessment the requirement for mitigation is triggered for the northern on-line section of the proposed road project where the onset levels for assessment of noise mitigation in the Cork Noise Action Plan are met. Where practicable on the northern section, mitigation will also be provided to reduce noise to the TII Design Goal. For the southern section, mitigation is provided where all three conditions requiring mitigation as set out in the NRA guidelines are met (refer to **Section 14.2.3.2**).

Table 14.13: Predicted Noise Levels Design Year 2035 'Do-Minimum' v's 'Do-Something'

Noise Sensitive Location	Baseline L_{den} dB(A)	'Do-Minimum' L_{den} dB(A)	'Do-Something' L_{den} dB(A)	'Do-Something' L_{Night} dB(A)	Design Criteria	Mitigation Required (Yes/No)
All Saints Cemetery	55	56	58	48	South – NRA Conditions	No
Belgard Downs	63-69	63-69	63-69	53-59	North - NRA Conditions & Cork NAP	Yes
Bloomfield	42	44	63-64	50-51	South – NRA Conditions	Yes
Broadale Complex	59	75	69	62	North - NRA Conditions & Cork NAP	Yes
Carrigaline B&B	67	71	65	58	South – NRA Conditions	No
Carrigaline Road	59-67	60-68	63-69	53-60	North - NRA Conditions & Cork NAP	Yes
Carrigaline Rugby Club	56	55	57	47	South – NRA Conditions	No
Carr's Hill	67-73	67-72	66-69	55-61	South – NRA Conditions	No
Chestnut Lodge B&B	59	62	66	56	South – NRA Conditions	Yes
Church (Ringaskiddy)	63	64	62	55	South – NRA Conditions	No
Clarkes Hill	59-63	59-68	58-64	49-57	North - NRA Conditions & Cork NAP	No

Noise Sensitive Location	Baseline L_{den} dB(A)	'Do-Minimum' L_{den} dB(A)	'Do-Something' L_{den} dB(A)	'Do-Something' L_{Night} dB(A)	Design Criteria	Mitigation Required (Yes/No)
Coolmore Close	48-54	53-59	63-65	52-55	South – NRA Conditions	Yes
Delfern Groove	60-64	62-66	66-70	55-59	North - NRA Conditions & Cork NAP	Yes
Edgewood	60-61	63-64	63-66	53-56	North - NRA Conditions & Cork NAP	Yes
Ferryview Student Accommodation	39	42	54	40	South – NRA Conditions	No
Footprints Montessori and Daycare	67	69	67	58	South – NRA Conditions	No
Health Centre (Shanbally)	50	54	61	52	South – NRA Conditions	Yes
Hibernian AFC	46	50	65	54	South – NRA Conditions	Yes
Kilteggan Park (N40 - 8)	66-73	66-73	66-73	56-64	North - NRA Conditions & Cork NAP	Yes
Lissadell	60	62	65	55	North - NRA Conditions & Cork NAP	Yes
Manor Avenue	58	60	65	54	North - NRA Conditions & Cork NAP	Yes
Marian Terrace	42-61	47-65	58-65	46-54	South – NRA Conditions	Yes
Martello Park	49-59	50-61	57-60	43-48	South – NRA Conditions	No
Maryborough Heights	65-68	66-70	69-71	59-61	North - NRA Conditions & Cork NAP	Yes
Maryborough Hill	60-70	62-71	63-69	53-59	North - NRA Conditions & Cork NAP	Yes
Maryborough Hotel	58	59	59	49	North - NRA Conditions & Cork NAP	No
Maryborough Nursing Home	58	59	59	49	North - NRA Conditions & Cork NAP	No
Mount Oval Village	50	53	53	44	North - NRA Conditions & Cork NAP	No
National Maritime College	44-47	47-48	49-56	38-42	South – NRA Conditions	No

Noise Sensitive Location	Baseline L_{den} dB(A)	'Do-Minimum' L_{den} dB(A)	'Do-Something' L_{den} dB(A)	'Do-Something' L_{Night} dB(A)	Design Criteria	Mitigation Required (Yes/No)
Noise Action Plan N28-1	66-72	66-73	66-71	56-62	North - NRA Conditions & Cork NAP	Yes
Noise Action Plan N28-2	67-75	69-76	68-74	58-66	North - NRA Conditions & Cork NAP	Yes
Noise Action Plan N28-3	59-72	59-71	65-69	55-61	South – NRA Conditions	Yes
Noise Action Plan N28 4	59-63	60-64	57-61	47-51	South – NRA Conditions	No
Old Post Office Road	51-53	51-53	64-65	50-51	South – NRA Conditions	Yes
Playground	65	65	63	55	South – NRA Conditions	No
Raffeen	51-66	51-67	59-65	47-55	South – NRA Conditions	Yes
Raffeen Lodge B&B	66	67	65	55	South – NRA Conditions	No
Ringaskiddy	53	54	63	48	South – NRA Conditions	Yes
Ringaskiddy Community Centre	57	56	54	43	South – NRA Conditions	No
Ringaskiddy Lower Harbour National School	55	58	62	55	South – NRA Conditions	Yes
Rochestown Park Hotel	70	70	70	60	North - NRA Conditions & Cork NAP	Yes
Rochestown Rd	65-70	66-71	65-70	56-63	North - NRA Conditions & Cork NAP	Yes
Rochestown Rise	61-68	63-69	65-69	55-61	North - NRA Conditions & Cork NAP	Yes
Rochestown Rise B&B	61	63	67	56	North - NRA Conditions & Cork NAP	Yes
Rowan Hill	61-63	62-65	64-67	53-57	North - NRA Conditions & Cork NAP	Yes
Rowan Hill (8m)	65	66	70	60	North - NRA Conditions & Cork NAP	Yes
Shamrock Place	46-53	48-62	60-65	47-55	South – NRA Conditions	Yes

Noise Sensitive Location	Baseline L_{den} dB(A)	'Do-Minimum' L_{den} dB(A)	'Do-Something' L_{den} dB(A)	'Do-Something' L_{Night} dB(A)	Design Criteria	Mitigation Required (Yes/No)
Shamrocks GAA Club	47	50	60	48	South – NRA Conditions	No
Shanbally	46-50	50-53	58-60	47-48	South – NRA Conditions	No
Shanbally Catholic Church	52	57	55	44	South – NRA Conditions	No
Shanbally Mews	53-65	57-69	62-68	53-60	South – NRA Conditions	Yes
Shanbally National School	48	53	56	44	South – NRA Conditions	No
Shannonpark	45-61	46-64	53-68	42-58	South – NRA Conditions	Yes
Shannonpark House B&B	65	64	65	56	South – NRA Conditions	No
SP Housing Development	46-69	48-69	55-70	43-62	South – NRA Conditions	Yes
St Carthege Place	41	44	61	47	South – NRA Conditions	Yes
St. Patrick's Church (RC)	63	65	63	56	North - NRA Conditions & Cork NAP	No
Suite Cottages	48	49	54	43	South – NRA Conditions	No
The Close	56-62	57-63	61-68	51-57	North - NRA Conditions & Cork NAP	Yes
The Downs	61	63	65	55	North - NRA Conditions & Cork NAP	Yes
The Fairways	70	71	68	57	North - NRA Conditions & Cork NAP	Yes
The Ferryboat Inn and Accommodation	67	68	65	58	South – NRA Conditions	No
The Oaks	51-52	53	53-56	43-46	North - NRA Conditions & Cork NAP	No
The View	65-71	68-72	68-74	60-64	North - NRA Conditions & Cork NAP	Yes
Warren's Court	43	46	59	46	South – NRA Conditions	No
Wishing Well Centre	48	49	54	43	South – NRA Conditions	No

The proposed Service Area in Ringaskiddy has been modelled on the basis that 10% of the traffic going to the port at Ringaskiddy will stop at the service station. This figure was obtained based on the assumption made in the *Cork Port Heavy Goods Vehicle Rest Area Study* carried out by AECOM. The Service Area comprises 45 HGV spaces and includes a 500m^2 facility building with a forecourt. Six fuel pump stations will be constructed at the Service Area. For the truck parking spaces a worst case scenario was taken with the trucks being modelled as all containing refrigeration units, and all parking spaces being occupied at the one time. The other parking spaces were modelled using the Cadna parking lot source option and is based on the German Standard RLS-90.

As part of the planning permission for the house under construction just east of Raffeen Quarry a planning condition for that site requires that a 2.4m high barrier be constructed on the site. A 2.4m high barrier has been modelled along the south and western boundary of this site in to the Do-Something noise model.

Noise contour maps generated for the 'Do-Minimum' L_{den} and the 'Do-Minimum' L_{night} are shown on Figure 14.7 and **Figure 14.8 contained in** Volume 5**.**

14.5.2.2 Vibration Impacts

The NRA Document ''*Guidelines for the Treatment of Noise and Vibration on National Road Schemes''* states that ''*ground vibrations produced by road traffic is unlikely to cause perceptible structural vibration in properties located near to well-maintained and smooth road surfaces. This aspect does not require further consideration unless there are unusual circumstances under which higher than normal traffic vibration levels may be expected''.* It is not expected that there will be an unusual level of vibration from the proposed M28 Road Project and therefore it is not expected that any vibrational impacts will arise during the operational phase of the project.

The Castle Warren site is a kilometre from the nearest blasting and 50m from the nearest construction activity required for the project. These separation zones ensure that the potential vibration levels are below the most conservative international vibration level guidelines at Castle Warren. In order to protect this site, emphasis will focus on prevention of vibration at source and monitoring and reporting of vibration levels during the construction phase.

14.6 MITIGATION MEASURES

14.6.1 Construction Phase

14.6.1.1 Construction Phase Noise & Vibration Mitigation Measures

The following mitigation measures will be implemented during the construction works:-

- Temporary acoustic barriers will be installed at the locations adjacent to the Maryborough overpass shown in Drawing TM0010 (barriers 3m high).
- The Contractor will be required to install additional screening at the piling machine at Maryborough Hill that will be capable of providing a reduction of 10dB(A) at the nearby noise sensitive locations.

- The existing wall and fence (2m high) shown on Drawing No. TM0001 will be maintained to provide an acoustic screen for the construction phase, prior to the installation of AB01 and RW01 barriers.
- Acoustic noise barriers AB01 to AB04, RW01 to RW05, AB06 to AB08, AB10 to 14 and AB26, AB27 and AB28 will be constructed as early as possible during the construction phase. The Contractor will be required to set out an acoustic barrier construction schedule to maximise acoustic screening for the construction phase.
- Construction will be phased to minimise the duration of activities in each area.
- All Contractors will employ the Best Practicable Means to minimise noise emissions and will be obliged to comply with the general recommendations of BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*. And BS 5228-2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part2: Vibration* (together referred to as B.S. 5228).
  - "Best Practicable Means" include:-
    - Limiting the hours during which site activities likely to create high levels of vibration are permitted; any work outside normal working hours shall only take place with the written permission of the local authority; and
    - Establishing channels of communication between the Contractor/developer, Local Authority and residents.
- Where works need to be completed outside normal working hours or the Contractor's method statement for any proposed works indicates that the levels set out in **Table 14.1** may be exceeded, permission for these works must be sought from the Planning Authority in advance of any works taking place. The application for such works will require a detailed noise control plan and follow up report to be prepared. This plan will include (i) a justification for the works being carried out in the manner proposed, (ii) an assessment indicating what alternatives have been considered, (iii) a statement of the noise control measures from B.S. 5228 to be adopted and how Best Practicable Means will be used to control noise, (iv) an activity specific noise monitoring programme including contact details for persons with the authority to cease working if required by the Planning Authority. Each follow up report will include details of any complaints received and the action taken to address such complaints.
- A noise and vibration monitoring programme will be implemented for the duration of the construction phase. Monitoring will assess compliance of the construction works with the noise limits set out in **Table 14.1** and **Table 14.2**.
- A vibration monitoring programme will be implemented around the Castle Warren site. In the event that vibration levels approach 3mm/s at frequencies below 10 Hz additional vibration control measures will be implemented to protect the structure.
- Full details of the Contractor's provision for noise and vibration monitoring and procedures in relation to public notice will be made available to the Planning Authority.
- Blasting will only be permitted between 0900 and 1800 hrs Monday to Friday inclusive. Blasting will not be permitted on Weekends or Bank Holidays.
- In the advance of any blasting operation the Contractor will inform occupants of all dwellings within 500m of the blast that blasting will take place and the duration of blasting operations.
- Air overpressure from any blast will not exceed 125 dB (linear) max peak, with a 95% confidence limit when measured at the nearest air overpressure sensitive location. No individual air overpressure value shall exceed the limit value by more than 5 dB (Lin).
- As part of the implementation of mitigation, the CEMP will include the following measures:-
  - Channels of communication between the Contractor/developer, the council and residents will be established;

- Records of any noise complaints relating to the construction operations will be and investigated as soon as possible and reported to the Local Authority'
- Plant such as pumps and generators used on or near sensitive locations will be contained within an acoustic enclosure and comply with the noise levels in **Table 14.1** and **Table 14.2**;
- Plant and machinery used on-site will comply with the EC (Construction Plant and Equipment) Permissible, Noise Levels Regulations, 1988 (S.I. No. 320 of 1988);
- All noise producing equipment will comply with S.I. No 632 of 2001 European Communities (Noise Emission by Equipment for Use Outdoors) Regulations 2001; and
- Measures outlined in "*Environmental Good Practice Site Guide*" 2005 compiled by CIRIA and the UK Environmental Agency and the "London Good Practice Guide: Noise & Vibration Control for Demolition and Construction" 2016 These guidelines provide useful and practical information regarding the control of noise emissions at construction sites.

14.6.2 Operational Phase

It is proposed to use a low noise surface along the entire mainline of proposed M28 Road Project. A low road noise surface provides a minimum reduction in noise levels of 2.5 dB(A) and will provide mitigation for all properties situated in the vicinity of the road project. A low road noise surface is proposed for the R611 Cork Road from the proposed new roundabout at Shannonpark to the roundabout at Heron's Wood. It is also proposed to install a low road noise surface along a portion of a side road named Ballinrea Road at Shannonpark off the R611. **Table 14.14** outlines the extent of low noise surfacing proposed.

Table 14.14: Proposed Mitigation Measures (Road surfacing)

Location	Type of Mitigation	Length (m)
All surfaces inside LMA boundary including East and west of M28 mainline on Maryborough Hill	Low Noise Road Surface	Full Length of proposed road (approx. 13km)
Existing N28 at Priority area N28-3	Low Noise Road Surface	1436
East and west of M28 mainline on Rochestown Road	Low Noise Road Surface	629
Shannonpark Road*	Low Noise Road Surface	524
Ringaskiddy Harbour National School	Low Noise Road Surface	813

Using a low noise surface in the model resulted in a number of NSLs requiring further mitigation, in accordance with the guidelines listed in **Section 14.2.3**. It is proposed to install noise reducing measures (walls/acoustic barriers) at the remaining locations requiring mitigation. The height and length of the barrier proposed is detailed in **Table 14.15**. The table refers to 'Noise Barriers', this may take the form of walls, earthen berms and other landscaping features providing the required acoustic screening and meeting all other technical specifications. The locations of noise reducing measures are shown on **Figure 14.9** contained in **Volume 5**.

Table 14.15: Proposed Mitigation Structures

Barrier Reference	Type of Mitigation	Height (m)	Length (m)
AB01	Noise Barrier	3.0	1242
AB02	Noise Barrier	3.0	149
AB03	Noise Barrier	3.0	71
AB04	Noise Barrier	2.0	108
AB05	Noise Barrier	3.0	625
AB06	Noise Barrier	3.0	216
AB07	Noise Barrier	3.0	137
AB08	Noise Barrier	3.0	150
AB09	Noise Barrier	3.0	205
AB10	Noise Barrier	3.0	52
AB11	Noise Barrier	2.0	61
AB12	Noise Barrier	2.5	395
AB13	Noise Barrier	3.0	82
AB14	Noise Barrier	3.0	1049
AB15	Noise Barrier	2.0	514
AB16	Noise Barrier	2.0	421
AB17	Noise Barrier	3.0	272
AB18	Noise Barrier	3.0	278
AB19	Noise Barrier	2.5	242
AB20	Noise Barrier	2.0	287
AB21	Noise Barrier	2.0	142
AB22	Noise Barrier	2.0	120
AB23	Noise Barrier	2.0	301
AB24	Noise Barrier	2.0	507
AB25	Noise Barrier	2.0	182
AB26	Noise Barrier	3.0	559
AB27	Noise Barrier	3.0	220
AB28	Noise Barrier	2.0	165
RW-01	Wall	3.0	253
RW-02	Wall	3.0	246
RW-03	Wall	1.2	255
RW-04	Wall	1.2	302
RW-05	Wall	1.2	171
RW-08	Wall	3.0	101
RW-09	Wall	3.0	39
Existing Wall to be Extended	Wall	3.0	119
Wall/Acoustic Barrier	Wall	2.0	53

Acoustic mitigation measures will be installed in accordance with the relevant standards and where proprietary barriers are used they will be required to have a design life of 30 years with no gaps or leaks in the structure. The visual impact of the acoustic mitigation measures is addressed in **Chapter 16: Landscape and Visual**.

Table 14.6 shows the results at the NSLs following mitigation. The significance of the impact in accordance with **Table 14.2** is also included.

Table 14.16: Results at Noise Sensitive Locations with Mitigation

Noise Sensitive Location	'Do-Minimum' L_{den} dB(A)	'Do-Something with Mitigation' L_{den} dB(A)	'Do-Something with Mitigation' L_{Night} dB(A)	Design Criteria	Impact Significance
All Saints Cemetery	56	56	46	South – NRA Conditions	Imperceptible
Belgard Downs	63-69	58-61	49-51	North - NRA Conditions & Cork NAP	Slight Positive – Moderate Positive
Bloomfield	44	52-55	39-42	South – NRA Conditions	Moderate Negative – Significant Negative
Broadale Complex	75	69	62	North - NRA Conditions & Cork NAP	Moderate Positive
Carrigaline B&B	71	65	58	South – NRA Conditions	Moderate Positive
Carrigaline Road	60-68	60-62	50-53	North - NRA Conditions & Cork NAP	Imperceptible – Moderate Positive
Carrigaline Rugby Club	55	54	44	South – NRA Conditions	Not Significant
Carr's Hill	67-72	60-65	50-58	South – NRA Conditions	Moderate Positive
Chestnut Lodge B&B	62	61	51	South – NRA Conditions	Imperceptible
Church (Ringaskiddy)	64	62	55	South – NRA Conditions	Not Significant
Clarkes Hill	59-68	58-64	48-57	North - NRA Conditions & Cork NAP	Not Significant - Slight Positive
Coolmore Close	53-59	58-60	49-52	South – NRA Conditions	Imperceptible – Moderate Negative
Delfern Groove	62-66	61-66	51-56	North - NRA Conditions & Cork NAP	Imperceptible
Edgewood	63-64	61-63	51-53	North - NRA Conditions & Cork NAP	Not Significant

Noise Sensitive Location	'Do-Minimum' L_{den} dB(A)	'Do-Something with Mitigation' L_{den} dB(A)	'Do-Something with Mitigation' L_{Night} dB(A)	Design Criteria	Impact Significance
Ferryview Student Accommodation	42	50	37	South – NRA Conditions	Moderate Negative
Footprints Montessori and Daycare	69	66	58	South – NRA Conditions	Not Significant
Health Centre (Shanbally)	54	56	47	South – NRA Conditions	Not Significant
Hibernian AFC	50	61	50	South – NRA Conditions	Not Significant
Kilteggan Park (N40 - 8)	66-73	61-68	51-59	North - NRA Conditions & Cork NAP	Moderate - Positive
Lissadell	62	63	52	North - NRA Conditions & Cork NAP	Imperceptible
Manor Avenue	60	58	48	North - NRA Conditions & Cork NAP	Not Significant
Marian Terrace	47-65	55-61	44-51	South – NRA Conditions	Not Significant – Significant Negative
Martello Park	50-61	54-57	40-46	South – NRA Conditions	Slight Positive – Slight Negative
Maryborough Heights	66-70	65-67	55-56	North - NRA Conditions & Cork NAP	Imperceptible - Moderate Positive
Maryborough Hill	62-71	60-65	50-57	North - NRA Conditions & Cork NAP	Not Significant – Moderate Positive
Maryborough Hotel	59	58	48	North - NRA Conditions & Cork NAP	Imperceptible
Maryborough Nursing Home	59	59	49	North - NRA Conditions & Cork NAP	Imperceptible
Mount Oval Village	53	53	43	North - NRA Conditions & Cork NAP	Imperceptible
National Maritime College	47-48	49-55	38-42	South – NRA Conditions	Imperceptible – Moderate Negative
Noise Action Plan N28-1	66-73	60-65	50-57	North - NRA Conditions & Cork NAP	Moderate Positive

Noise Sensitive Location	'Do-Minimum' L_{den} dB(A)	'Do-Something with Mitigation' L_{den} dB(A)	'Do-Something with Mitigation' L_{Night} dB(A)	Design Criteria	Impact Significance
Noise Action Plan N28-2	69-76	65-69	55-62	North - NRA Conditions & Cork NAP	Slight Positive – Moderate Positive
Noise Action Plan N28-3	59-71	59-66	49-59	South – NRA Conditions	Imperceptible – Moderate Positive
Noise Action Plan N28 4	60-6	56-60	46-50	South – NRA Conditions	Slight Positive
Old Post Office Road	51-53	52-58	39-45	South – NRA Conditions	Imperceptible – Slight Negative
Playground	65	63	55	South – NRA Conditions	Not Significant
Raffeen	51-67	56-65	44-55	South – NRA Conditions	Slight Positive – Slight Negative
Raffeen Lodge B&B	67	65	55	South – NRA Conditions	Not Significant
Ringaskiddy	54	57	43	South – NRA Conditions	Not Significant
Ringaskiddy Community Centre	56	53	42	South – NRA Conditions	Not Significant
Ringaskiddy Lower Harbour National School	58	60	54	South – NRA Conditions	Not Significant
Rochestown Park Hotel	70	62	52	North - NRA Conditions & Cork NAP	Moderate Positive
Rochestown Rd	66-71	62-69	51-62	North - NRA Conditions & Cork NAP	Not Significant – Moderate Positive
Rochestown Rise	63-69	58-67	48-59	North - NRA Conditions & Cork NAP	Not Significant – Moderate Positive
Rochestown Rise B&B	63	59	49	North - NRA Conditions & Cork NAP	Slight Positive
Rowan Hill	62-65	60-65	50-55	North - NRA Conditions & Cork NAP	Imperceptible – Not Significant
Rowan Hill (8m)	66	68	57	North - NRA Conditions & Cork NAP	Not Significant
Shamrock Place	48-62	59-60	45-53	South – NRA Conditions	Not Significant – Significant Negative

Noise Sensitive Location	'Do-Minimum' L_{den} dB(A)	'Do-Something with Mitigation' L_{den} dB(A)	'Do-Something with Mitigation' L_{Night} dB(A)	Design Criteria	Impact Significance
Shamrocks GAA Club	50	58	46	South – NRA Conditions	Moderate Negative
Shanbally	50-53	56-58	44-46	South – NRA Conditions	Not Significant – Moderate Negative
Shanbally Catholic Church	57	54	43	South – NRA Conditions	Slight Positive
Shanbally Mews	57-69	57-67	47-60	South – NRA Conditions	Imperceptible – Moderate Positive
Shanbally National School	53	54	43	South – NRA Conditions	Imperceptible
Shannonpark	46-64	51-65	40-56	South – NRA Conditions	Imperceptible – Slight Negative
Shannonpark House B&B	64	63	53	South – NRA Conditions	Not Significant
SP Housing Development	48-69	51-68	40-61	South – NRA Conditions	Slight Negative – Moderate Positive
St Carthege Place	44	56	43	South – NRA Conditions	Significant Negative
St. Patrick's Church (RC)	65	61	54	North - NRA Conditions & Cork NAP	Slight Positive
Suite Cottages	49	52	41	South – NRA Conditions	Not Significant
The Close	57-63	56-61	45-50	North - NRA Conditions & Cork NAP	Not Significant
The Downs	63	63	53	North - NRA Conditions & Cork NAP	Imperceptible
The Fairways	71	61	50	North - NRA Conditions & Cork NAP	Moderate Positive
The Ferryboat Inn and Accommodation	68	65	58	South – NRA Conditions	Not Significant
The Oaks	53	52-54	42-43	North - NRA Conditions & Cork NAP	Imperceptible – Not Significant
The View	68-72	66-68	58-60	North - NRA Conditions & Cork NAP	Imperceptible – Slight Positive
Warren's Court	46	56	43	South – NRA Conditions	Moderate Negative
Wishing Well Centre	49	52	41	South – NRA Conditions	Not Significant

Noise contour maps generated for the 'Do-Minimum' L_{den} and the 'Do-Minimum' L_{night} are shown on **Figure 14.10** and **Figure 14.11** contained in **Volume 5**.

14.7 RESIDUAL IMPACTS

The vast majority of NSLs will either have reduced noise levels or be in line with either the TII design goal (southern section) or the Cork Noise Plans (northern section) requirements for mitigation during the operational phase. However, a limited number of properties will experience a residual noise impact as a result of the proposed project.

A total of approximately 2983 residential properties were considered during the noise modelling carried out as part of this EIS. A summary of the Do Minimum and the Do Something (with the proposed mitigation measures is outlined in **Tables 14.17** and **14.18** below.

Table 14.17: Design Year L_{den} Levels

Noise Level Range dB(A)	Do Minimum	Do Something
<55	1196	1374
55-60	835	916
60-65	721	542
65-70	207	143
70-75	23	7

The number of properties in the study area predicted to experience L_{den} levels in excess of 70 dB(A) reduces from 23 to 7. These 7 properties are located more than 300m from the M28 mainline and the noise level at those locations is not attributable to M28 traffic. All properties which are and would exceed the Cork Noise Plan threshold of 70 dB(A) have noise levels reduced to below 70 dB(A) in the Do Something scenario.

The overall number of properties predicted to experience noise levels between 60 and 70 dB(A) reduces from 928 to 685. This results in an additional 243 properties which would have exceeded the TII design goal in the Do Minimum scenario now below the 60 dB(A) threshold. The number of properties predicted to experience noise levels below 60 dB(A) will also experience noise reductions if the proposed road project goes ahead. A small number of properties at the southern section will experience moderate or significant negative impacts but from an overall perspective noise levels will reduce as a result of the proposed road project.

Table 14.18: Design Year L_{night} Levels

Noise Level Range - dB(A)	Do Minimum	Do Something
<45	1197	1382
45-50	770	837
50-55	593	478
55-60	353	251
60-65	69	34

Similarly over 300 properties will experience a reduction in predicted noise levels at night.

The residual impact at the High Priority Areas identified in the Cork County *Noise Action Plan* and the *Cork Agglomeration Area Noise Action Plan* are summarised in **Table 14.19.** At the northern end of the proposed M28 Road Project the residual noise level will remain above the TII Design Goal but meet the Cork County Noise Plan 70 dB L_{den}.

Table 14.19: Residual Impacts at Noise Action Plan Priority Areas

Location	Residual Impact
N40-1	Residual noise levels are above the TII design goal of 60 dB $L_{den.}$ However noise levels are decreasing from the 'Do-minimum' scenario and meet the Cork County Noise Plan 70 dB L_{den}.
N28-1	Residual noise levels are above the TII design goal of 60 dB $L_{den.}$ However noise levels are decreasing from the 'Do-minimum' scenario and meet the Cork County Noise Plan 70 dB L_{den}.
N28-2	Residual noise levels are above the TII design goal of 60 dB $L_{den.}$ However noise levels are not increasing from the 'Do-minimum' scenario by more than 1 dB(A) and meet the Cork County Noise Plan 70 dB L_{den}.
N28-3	Residual noise levels are above the TII design goal of 60 dB $L_{den.}$ However noise levels are decreasing from the 'Do-minimum' scenario and meet the Cork County Noise Plan 70 dB L_{den}.
N28-4	Residual noise levels are below the TII design goal of 60 dB $L_{den.}$

In summary a small number of properties will experience a residual increase in noise levels. The impact as a result of the increase in noise levels will range from 'Not-Significant' to 'Major'. 243 properties will experience a reduction in noise levels ranging from 'Not-Significant' to 'Major'. The overall result will be a net decrease in the impact of road traffic noise on properties after the construction of the proposed M28 Road Project.

15. CULTURAL HERITAGE

15.1 INTRODUCTION

This chapter considers and assesses the potential impact of the proposed M28 Road Project as described in **Chapter 3: Description of Proposed Road Development** on the receiving archaeological, architectural and cultural heritage environment and to propose mitigation measures to ameliorate any potential negative impacts on historical landscapes, monuments, finds or features of archaeological, architectural heritage or cultural heritage significance.

Sites and features identified during the course of this assessment have been given a unique reference number. The sites are designated as AH (Archaeological Heritage), BH (Architecture - Built Heritage) or CH (Cultural Heritage) and then numbered sequentially (e.g. AH1, AH2, BH1, BH2, CH1 CH2, etc.). These sites are detailed in the inventories for Archaeology, Architecture - Built Heritage and Cultural Heritage Sites contained in **Appendices 15A-15C** respectively and are shown on the accompanying mapping (**Figures 15.1a-h** in **Volume 5**). Plates and all other figures are contained in **Appendix 15I.**

Cultural heritage is a broad term that includes a wide range of tangible and intangible cultural considerations. It encompasses aspects of archaeology and architecture and is expressed in the physical landscape as well as in non-physical ways. Cultural heritage can relate to settlements, former designed landscapes, building and structures, as well as folklore, townland and place names, historical events and traditions. Tangible cultural heritage assets within the study area are represented by townland boundaries and a mid-20th century grotto. Potential buried foundations associated with features / structures shown the 1st edition Ordnance Survey six-inch mapping (1841-2) are also included in this evaluation where they fall within the CPO of the proposed road project, as these may often be of interest and valued from an archaeological perspective.

Detailed drawings containing the proposed CPO line are provided in **Volume 5** of this EIS (Ref. GA Series).

15.2 METHODOLOGY

15.2.1 Study Area

The area examined for the study includes the full extent of the proposed M28 Road Project, including the proposed Service Area at Ringaskiddy (Cf. **Chapter 3: Description of Proposed Road Development** for full description).

Initially a 500m wide corridor (250m on either side of the centreline) was assessed in order to identify the known and recorded archaeological, architectural and cultural heritage assets and thus to provide an understanding of the archaeological and historic development of the wider landscape (which is described in the archaeological and historical background for the receiving environment). This was later redefined in width once the final route design had been decided so that a detailed and focussed assessment could take place of the likely impacts on archaeological, architectural and cultural heritage arising from the construction and operation of the new road project. This refined corridor for the purpose of the impact assessment is 50m on either side of the centreline of the

proposed road project, in accordance with the 2006 NRA Guidelines. Professional judgement has been used to determine where the assessment corridor should be extended to take into account archaeological sites/monuments or structures, demesnes and the settings of architectural heritage that lie beyond the proposed impact assessment corridor. As required and where appropriate, the relationship of structures, sites, monuments and complexes that fall outside this corridor were considered and evaluated.

The significance and type of impacts experienced by architectural sites, archaeological monuments and complexes and other cultural heritage features located within the assessment corridor were then evaluated for the construction and operation phases of the project.

15.2.2 Evaluation Process

The assessment is based on a desk study of published and unpublished documentary and cartographic sources, supported by a field survey.

15.2.2.1 Desk Study

The appraisal availed of the following sources:-

- The National Monuments, Preservation Orders, Register of Historic Monuments list for County Cork was sourced directly from the Department for Arts, Heritage, Regional, Rural and Gaeltacht Affairs (DAHRRGA);
- Record of Monuments and Places (RMP) and Sites and Monuments Record (SMR). The SMR, as revised in the light of fieldwork, formed the basis for the establishment of the statutory Record of Monuments and Places in 1994 (RMP; pursuant to Section 12 of the National Monuments (Amendment) Act, 1994). The RMP records known upstanding archaeological monuments, their original location (in cases of destroyed monuments) and the position of possible sites identified as cropmarks on vertical aerial photographs. The information held in the RMP files is read in conjunction with published constraint maps. Archaeological sites identified since 1994 have been added to the non-statutory SMR database of the Archaeological Survey of Ireland (National Monuments Service, DAHRRGA), which is available online at www.archaeology.ie and includes both RMP and SMR sites. Those sites designated as SMR sites have not yet been added to the statutory record, but are scheduled for inclusion in the next revision of the RMP;
- Record of Protected Structures (RPS) and Architectural Conservation Areas (ACAs);
- The topographical files of the National Museum of Ireland;
- Cartographical sources: OSi Historic Mapping Archive, including early editions of the Ordnance Survey, historical mapping (such as Down Survey 1656 Map) and Griffith's Valuation, 1853;
- Excavations Bulletins and Excavations Database (1970-2015);
- Cork County Development Plan (CDP) 2014–2020;
- The National Monuments Service online Survey Database (www.archaeology.ie)
- National Inventory of Architectural Heritage (NIAH), Building Survey and Garden Survey;
- Archaeological Inventories of County Cork, Vol. II – East and South Cork (1994) and Vol. V (2009);
- Aerial imagery (Google Earth 2001–2013, Bing 2013; OSi 1995, 2000, 2006);
- Ordnance Survey of Ireland LiDAR data (ranging from 1–2m resolution) (Hanley 2017); and
- Other documentary sources (as listed in the references, Section 15.9).

The desk study was also informed by data contained in previous cultural heritage reports:-

- Architectural Assessment of sub-route options for the N28 in the vicinity of Castle Warren, Barnahely (John Cronin & Associates, 2004);
- Archaeology, Architectural and Cultural Heritage, N28 Bloomfield to Ringaskiddy Road Improvement Scheme, Unpublished Report by CRDS Ltd;
- Archaeological Assessment of the N28 at Barnahely, Geophysical Survey Report, Licence No. 04R065 (ArchaeoPhysica Ltd, 2004);
- A report on the Archaeological Testing carried out at Castle Warren, Barnahely, Licence No. 04E0774 (Hanley, 2005);
- Environmental Impact Statement, JAW Raffeen Quarry (Tobin & Co. Ltd, August 2006);
- N28 Geophysical Survey, Shannonpark & Hilltown townlands (ArchaeoPhysica Ltd 2005 & 2008);
- Archaeological, Architectural and Cultural Heritage Assessment of Route Options for the N28 Bloomfield to Ringaskiddy Road Improvement Scheme (Courtney Deery Heritage Consultancy, 2014);
- Geophysical Survey Report, Barnahely, Ringaskiddy, Co. Cork. Licence No. 15R017 (Leigh 2015); and
- A report on archaeological testing of enclosures (RMP CO087-155) at Barnahely townland, Licence Ref. 15E0049 (Hanley 2015).

The desk study also incorporates the results of LiDAR analysis carried out by Ken Hanley, TII Project Archaeologist. A list of legislation, standards and guidelines that were consulted to inform the assessment are contained in **Appendix 15F** along with excerpts from the relevant legislation.

15.2.2.2 Field Survey

A field survey was carried out from the 23rd to 26th February 2015. Weather conditions were variable, with heavy snow showers and rain at the beginning of the week, becoming generally dry and favourable thereafter. The purpose of the field survey was to identify potential archaeological sites/areas/features and structures/features of architectural, industrial and cultural heritage merit that may be subject to direct or indirect impacts as a result of the proposed road project. Site work was carried out on a field by field basis and all lands that are traversed were visited in the field. Field work was also assisted by a review of detailed aerial photography and of historic map sources. All anomalies detected by using these techniques were visited in the field and assessed. The type of terrain and ground visibility was noted.

A historic landscape approach was used in order to characterise the receiving cultural heritage environment and to this end, an account of the field work is detailed in **Section 15.3.4** under the following headings: physical environment, cultural landscape and archaeological potential. Each section of the proposed M28 Road Project is discussed sequentially and identified by townland in the field survey reports. Geo-referenced photographs were taken along the route and are held as KMZ files in the project archive; relevant images are included as plates to accompany the field survey reports.

15.2.2.3 Assessing Significance Criteria

Cultural heritage sites/landscapes are considered to be a non-renewable resource and cultural heritage material assets are generally considered to be location sensitive. In this context, any change to their environment, such as construction activity and ground disturbance works, could adversely affect these sites. The likely significance of all impacts is determined in consideration of the magnitude of the impact and the baseline rating upon which the impact has an effect (i.e. the sensitivity or value of the cultural heritage asset). Having assessed the magnitude of impact with respect to the sensitivity/value of the asset, the overall significance of the impact is then classified as imperceptible, slight, moderate, significant, or profound. A glossary of impact assessment terms, including the criteria for the assessment of impact significance, is contained in **Appendix 15G**.

Archaeological and Cultural Heritage

In accordance with the NRA '*Guidelines for the Assessment of Archaeological Heritage Impact of National Road Schemes*' (2006) the significance (i.e. value) criteria used to evaluate an archaeological site, monument or complex are as follows: existing status (level of protection), condition or preservation, documentation or historical significance, group value, rarity, visibility in the landscape, fragility or vulnerability, and amenity value. The archaeological and cultural heritage environment is assigned a baseline rating, taking into account the importance, value and/or sensitivity of the receiving environment (Cf. **Table 15.7, Appendix 15G**).

Architectural Heritage

Architectural heritage sites include structures listed in the Record of Protected Structures (RPS), which have statutory protection. Architectural heritage sites also include structures listed in the National Inventory of Architectural Heritage (NIAH) Building Survey, demesne landscapes and historic gardens listed in the NIAH Garden Survey, and undesignated, newly identified sites such as examples of vernacular architecture (e.g. a dry-stone wall or upstanding structure depicted on the first edition OS six-inch map). In this assessment each building or structure that is considered is assigned a rating in accordance with the NIAH system, or is stated to be not of special architectural interest (Cf. **Appendix 15G**).

15.2.2.4 Assessment of Impacts

Potential impacts on the cultural heritage environment can be described in three categories: direct physical impacts; indirect physical impacts; and impacts on setting.

Direct Physical Impacts

Direct physical impacts describe those development activities that directly cause damage to the fabric of a heritage asset. Typically, these activities are related to construction works; e.g. they could include excavation of foundations, earthmoving/site preparation creation of access roads and the excavation of service trenches. Further direct physical impacts are unlikely to be experienced during the operational life of the proposed road project.

Indirect Physical Impacts

Indirect physical impacts describe those processes, triggered by development activity, that lead to the degradation of heritage assets.

Impacts on Setting

Impacts on setting of heritage assets describes how the presence of a development changes the surroundings of a heritage asset (archaeological, architectural or cultural heritage sites) in such a way that it affects (positively or negatively) the heritage significance of that asset. Visual impacts are most commonly encountered but other environmental factors such as noise, light or air quality can be relevant in some cases. Impacts may be encountered at all stages in the life cycle of a development from construction to decommissioning but they are only likely to be considered significant during the prolonged operational life of the development.

15.3 RECEIVING ENVIRONMENT

15.3.1 Archaeological and Historical Background

Introduction

The landscape through which the proposed road project travels is largely one of undulating arable and pasture land, with many of the fields still given over to farming. Although undulating, the eastern half of the proposed road project (roughly from Ringaskiddy to Shannonpark) is lower-lying than the northern half; several of the natural rises have been exploited in the past, such as the locations of the Martello Tower in Ringaskiddy and the tower house (Barnahely Castle) in Barnahely. North of the Shannonpark roundabout, the steep hills in Hilltown, Ballinrea and Moneygourney (Carr's Hill) offer spectacular views of the surrounding landscape, the River Lee and Cork Harbour. The Glounatouig Stream flows in a deep, steep-sided valley on the eastern boundary between Ballinrea and Hilltown townlands, with the present N28 running alongside it. An east-west ridge of higher ground (50m OD) runs through the eastern half of the proposed road project, to the east of Shannonpark roundabout. The land slopes from this ridge down to the valleys of the Glounatouig Stream to the north and the Owenboy River to the south, with a number of ringforts and enclosures recorded along this contour.

Despite the large tracts of agricultural land, this is also an industrialised landscape, with wind turbines, factories, business or industrial parks and large pylons dominating the skyline, especially at the eastern end of the proposed road project in the Ringaskiddy / Loughbeg / Barnahely area. Further north, the proposed M28 runs parallel with and very close to the existing, N28 National Road, before reaching the urban and suburban development encroaching from Rochestown and Douglas. Settlement is mostly dispersed, with the exception of the village of Ringaskiddy to the east and the small village of Shanbally at the proposed Shanbally Interchange.

Prehistoric Period

The coastline of the Ringaskiddy peninsula, at the eastern end of the proposed road project, has long attracted human settlement and may have been exploited from as early as the Mesolithic period (8000–4000 BC). Its distinctive promontories are separated by shallow creeks which are attractive waters for fishing and for the anchorage of small boats. A shell midden was uncovered during archaeological monitoring to the south of Castle Warren in Barnahely townland, c. 45m south of the proposed M28 Road Project (CO087-120; AH27). Shell middens are the remains of shellfish that were collected as a food source along the foreshore that have been discarded by humans, they are composed of marine faunal shell remains, predominantly edible molluscs. Shell middens can be dated from the Later Mesolithic period (c. 7000-4000 BC) to up to the 16th and 17th century.

The presence of the midden at Barnahely may indicate that the estuarine waters once reached further inland than they do at present. Sea-level changes are attested in this area, with palaeo-environmental studies carried out (mainly by the Dept. of Geography, UCC) within the harbour indicating significant sea-level change since the prehistoric period (The Discovery Programme, Cf. www.risknat.org, Summary Sheet No. P20). A number of other shell middens are recorded along the coastline in this area, with two in Ringaskiddy townland at the eastern end of the Ringaskiddy peninsula (CO087-054 & -161) and three further south in Curraghbinny townland, strung out along the shore line at Lough Beg (CO087-055) and on the northern shore of Curraghbinny Hill (CO087-056, CO087-057). These sites further attest to the early coastal activity in this area.

By c. 4000 BC, the earlier hunter-gatherer economy of the Mesolithic period was replaced by one dominated by farming, which led to more settled communities in permanent locations. Although there are no recorded sites or monuments of Neolithic date (c. 4000-2500 BC) within the proposed M28 Road Project or its vicinity, there is some evidence for activity during this period, with two stone axe-heads found in Carrigaline townland (NMI IA/9/74 & 1931:321; **Appendix 15D**).

The Bronze Age in Ireland (c. 2500-500 BC) is distinguished by the introduction of metalworking, probably first brought about through trading and cultural contacts. During this period, copper was mined intensively to produce copper and bronze tools and weapons and some of the evidence for Bronze Age activity in the vicinity of the proposed M28 Road Project comes in the form of stray finds of copper, bronze and gold artefacts: among these were a gold disc found at Castletreasure (*Rynne 1993*), a flat copper axehead found at Carrigaline (NMI 1931:330), two amber beads (NMI 1948:46-47) and a unique amber ball (NMI 1931:328) (*Monk 2005a*); other finds include a bronze palstave (1933:936), four bronze axeheads (1933:937-940), three stone spindle whorls (1933:942-944) and a bronze spearhead (1933:941) found in Carrigaline West townland (*CRDS 2009*; **Appendix 15D**).

The sites of two standing stones are recorded in the townland of Ballyhemiken (CO087-113 & CO087-114, within the CPO and c. 20m south of the CPO respectively). Local folklore records the sites of the stones, one of which appears to have been removed during the construction of the present N28 Road (CO087-113, AH10; *CRDS 2009*), while the other was removed in the 1960s during reclamation works (CO087-114, AH11; *RMP file*). The majority of Irish examples are thought to date to the Bronze Age, but without additional associations such as pottery or bronze implements it is difficult to precisely date individual monuments (*CRDS 2009*). Their function is similarly unclear and the stones may have functioned as burial markers, commemorative monuments or indicators of routes or boundaries (*Ibid*.).

Further evidence of Bronze Age activity within and in the landscape surrounding the proposed M28 Road Project comes in the form of *fulachtaí fia* or burnt mounds. *Fulachtaí fia*, although still somewhat ambiguous, are generally accepted to be ancient cooking places, consisting of a water-filled trough into which fire-heated stones were placed to heat the water for cooking (*CRDS 2009*). The used, and often burnt and fragmented, stones were removed and accumulated in a low kidney or horseshoe-shaped mound around the sides of the trough (*Ibid*.). They are usually located close to a water source (marshy areas, streams or springs) and their presence is often indicative of Bronze Age seasonal communal activity in river valleys and boggy ground (*Ibid*.). They often appear in groups and are represented by small grass-covered mounds of burnt stone or spreads of burnt stone ('burnt spreads') where the field has been ploughed and the mound levelled. There is one recorded *fulacht fia* located within the proposed M28 Road Project CPO in Shannonpark townland (CO086-115, AH9) and another in Ballinrea townland immediately adjacent the CPO (CO086-029, AH5). The latter (AH5) is located on the west bank of a stream that forms the Ballinrea/Moneygourney townland boundary; a second *fulacht fia* is recorded on the east side of the stream in Moneygourney

townland, c. 85m northeast of the CPO (CO086-133). These two sites are located in relative proximity, c. 140m apart. The prevalence of *fulachtaí fia* in this area was confirmed during a programme of archaeological testing that was undertaken in 2009 in advance of a proposed golf course development within Ballinrea and Ballinimlagh townlands. The expansive site included the recorded *fulacht fia* (burnt spread) in Ballinrea townland (CO086-029, AH5) and a second recorded *fulacht fia* c. 570m southwest (CO087-030), with the testing identifying a further three levelled *fulachtaí fia* within the proposed site (Online Excavations Bulletin Ref. 2009:123; Licence Ref. 09E0429).

Early Medieval

The early medieval period saw the development of a mixed-farming economy managed by kings, nobles and free farmers. There is a strong continuity between modern and medieval territorial units and often the baronial boundaries can be used to create a picture of early medieval kingdoms. The proposed M28 Road Project falls within the ancient territory of the Ciarraighe-Cuirche, which gives its name to the modern barony of Kerrycurrihy. The Ciarraighe-Cuirche are mentioned in the Annals of Innisfallen in 828 AD when they were involved in a campaign in Múscraige Mittaine. The *Annals of the Four Masters* record the death of Fogartach the Wise, son of Suibhne, lord of Ciarraighe-Cuirche at the battle of Bealach-Mughna in 903AD. After 915AD the Norse from Cork settled Ciarraighe-Cuirche, which became known as the cantred of the Ostmen (*Bradley & Halpin 1993*).

The principal settlement type during this period was the ringfort or rath, the most common monument type in Ireland, with at least 30,000 examples recorded. Ringforts are circular enclosures, essentially habitation sites or farmsteads, which vary in both size and morphology; from simple univallate enclosures measuring 30m diameter to larger bivallate or trivallate sites in strategic locations. They were not simple isolated homesteads, however, and should be considered within their contemporary settlement landscape, which would have consisted of unenclosed settlements, farms and fields, routeways and natural resources (*Stout 2000*). Typically, they are sited on good, well-drained soils, usually over the 100m contour, close to a water source, and often located in proximity to routeways (ridges, eskers, morraines).

The proposed M28 Road Project is situated in an area of median ringfort density which covers most of south Munster (*Stout 2000; CRDS 2009*) and ringforts are recorded in the townlands of Barnahely (CO087-048, AH37) Carrigaline (CO087-035), Ballinrea (CO086-028) and Shanbally (CO087-039, AH14), with the site of a possible ringfort in the townland of Hilltown (CO087-116, AH7). In addition to the presence of the ringfort in Carrigaline, a number of artefacts have been found in the Carrigaline area that are thought to date to the early medieval period, including three bronze pins (NMI 1931:322-324) and three ornamented bone pins (NMI 1931:325:327), which would have been used as dress fasteners (*CRDS 2009*, **Appendix 15D**). Monuments recorded as enclosures in the archaeological record, for example an enclosure in the townland of Shanbally (CO087-040, AH15) and a substantial bivallate enclosure site recorded Barnahely townland (AH26), may also represent the remains of ringforts. This may also be the case for the newly discovered enclosure site revealed by geophysical survey within the proposed M28 Road Project in Barnahely townland (AH48).

Ringforts are sometimes found associated with souterrains, which are underground structures consisting of one or more chambers connected by narrow passageways or creepways, usually constructed of drystone-walling with a lintelled roof over the passages and a corbelled roof over the chambers. Souterrains also occur independently and may represent the only surviving remains of former settlements of the early medieval period that may have been unenclosed (*Clinton 2001*). The recorded souterrain at Shanbally is located within a ringfort (CO087-119 & CO087-039, AH14) and

local folklore records indicate a cave, a term usually used to refer to a souterrain, in the townland of Shanbally (*CRDS 2009*). A ringfort and souterrain recorded c. 35m north of the proposed road project also point to the prevalence of both monument types in the study area and in the wider landscape; both sites lie within Raffeen Quarry and have been destroyed (CO087-034 & CO087-090, AH12).

Later Medieval Period (After CRDS 2009)

Recorded evidence for late medieval activity along the proposed road project is concentrated at Barnahely Castle tower house and bawn in Barnahely townland (CO087-052001 & 003, AH22; the sole exception is the stray find of a 15th century gold brooch that is recorded to Ballinrea townland. NMI Reg. No. 1956:7, **Appendix 15D**). Following the attack and capture of the city of Cork by the Normans in 1177, King Henry II retained the cantred of the Ostmen for the crown as the Royal Manor of Kerrycurrihy. The manor of Kerrycurrihy was based on Carrigaline which was known in the medieval period as Beavor. In 1207 Henry's son King John granted Kerrycurrihy and its manor of Carrigaline to Philip de Prendergast. The deCogans succeeded to the barony some time before 1279 when John de Cogan married the de Prendergast heiress Juliana (*O'Mahony 1993*).

It is not clear when the deCogans came into possession of Barnahely, though the land in which the castle is situated was known as '*Longa-Gowgan*' (the 'Ship of Gowgan or deCogan') by the early 13th century (*O'Mahony 1993*) suggesting that the family's connections with the locality date back at least this far. It is known that the deCogans constructed a number of fortifications to protect their landholdings (*O'Mahony 1993*). The earliest documented record of Barnahely as a placename dates to 1301, when it appears in the Calendar of Plea Rolls as '*Bermehele'* (www.logainm.ie). In 1317, the Barrys and Roches invaded the territory of deCogans, laying waste to their lands from Crookstown to Barnahely, which suggests that there may have been a castle in existence at Barnahely by this time (*O'Mahony 1993*).

The first known castle at Barnahely appears in 16th century records, with Richard deCogan as lord of the manor of 'Bernyhyleye' in Kerrycurrihy in 1536 (*Coleman 1915; Healy 1988*). This ties in with the surviving structural remains on the site; architecturally, the present castle ruins suggest a 15th or 16th century date, with the surviving barrel-vaulted structure being the earliest feature (*RMP file*). The strategic location of the castle is further highlighted in the later 16th century, when it is depicted on Candell's 1587 map of Cork Harbour as one of two castles on the Ringaskiddy peninsula (**Figure 15.2 in Appendix 15I**).

A later medieval graveyard and site of a possible later medieval church are located to the north of the castle (CO087-05101 & 02, AH20). Both are recorded in Bishop Downes visitation to the diocese in the early 18th century. The church, which was constructed of lime and clay, was '28 feet long and 17 broad'. It appears to have been in poor condition by this time with the walls 'above half down', and it is already noted as 'much out of repaire' in the mid-17th century Civil Survey (see below).

In the late 12th century Milo deCogan and Robert FitzStephen made a grant of land to the priory of St Nicholas of Exeter. The grant included lands at 'Babilannocan' (Hilltown) and 'Murivethimelan' (Marmullane, Passage) (*O'Mahony 1993*). It is not clear whether the members of the priory took possession of the grant and constructed buildings on the site. The lands reverted back to the deCogan family and one Phillip Goggin was dispossessed of 84 acres at 'Ballynocane' in 1660 (*O'Mahony 1993*).

The deCogan family occupied the tower house at Barnahely until 1642 when the castle garrison surrendered to Lord Inchiquin, the castle having been used as a magazine and store by the rebels of the barony. William and Edmond Cogan of Barnahely were subsequently indicted for high treason in the Earl of Cork's court in Youghal and the deCogans were driven from their lands (*O'Mahony 1993*). According to the Down Survey Parish Terrier c. 1656, 'William Goggin' (Cogan) an Irish papist forfeited the lands at 'Bernehely', which consisted of 235 acres of profitable land. It describes that there is 'a Castle and some Houses enclosed with a Baune neere which is a Church much out of repaire.' The estate was granted to John Cooke, one of the Cromwellian judges for Munster, but changed hands again in 1660 when Cooke was hung, drawn and quartered on the 16th of October. His lands were distributed among various individuals, notably from the company of a Captain Markams (*Coleman 1915*).

The extent of the estate associated with Barnahely Castle was given in the mid-17th century as 235 acres (in comparison, the present townland of Barnahely is 519 acres and the 19th century Castle Warren demesne on the first edition OS map measures 46 acres). Thus the size of the landholding is known, but its boundaries are not (though it presumably includes the later Castle Warren estate, though not necessarily centred physically on it). Given the importance of the coastal location for trade, resources and defence, it is probable that the lands owned by the deCogan family included the entire Ringaskiddy peninsula. It is not known whether the land immediately surrounding the castle was landscaped during the 17th (or earlier 18th) century.

Post-Medieval Period (After CRDS 2009)

Following a period of rebellion and unrest in the 17th century, the 18th century heralded a period of relative peace linked to dramatic changes in the landscape. A system of estate landholding was imposed that involved the construction of classical houses with demesne landscapes and associated large farms, with the landscaping and house design strongly influenced by social and architectural ideas from Britain and mainland Europe. The presence of rich agricultural land and the proximity of Cork City at the northern end of the proposed road project meant that many large houses were constructed in this area (*Power 1994*), such as Bloomfield, Maryborough and Mounthovel (BH14, BH15 & BH16; Cf. **Appendix 15B** for further detail). There were also several smaller estates at the eastern end of the project, such as Castle Warren (BH11), Prospect Villa (BH6) and Ballybricken (BH13; Cf. **Appendix 15B** for further detail). In recent years, the expansion of residential development into the outer suburbs of Cork City, and industrial development in the vicinity of Ringaskiddy have put pressure on many of the former demesnes, with few surviving intact.

Barnahely Castle and its estate came into the hands of the Warren family in 1796. The family was responsible for the construction of a late 18th century house known as 'Castle Warren' directly onto the foundations of the earlier castle, using stone from the curtain wall. The Warren family were reputedly the descendants of Robert Warren of Kinneigh in East Carberry, Co. Cork (*Coleman, 1915*). Warren was a captain in Cromwell's army, who first came to Ireland in 1649, and at the end of the war he received a grant of lands (Barnahely) for arrears of pay, for past services.

Castle Warren House (CO087-05201/RPS No. 01260; AH22 / BH11) survives as a ruinous five-bay, two-storey building with a shallow breakfront to the centre of the façade, with the remains of the tower house incorporated into the 18th century house. The façade, like many of the large houses in the area, appears to have been covered in weather slating. The east wall of the walled garden survives in farmland to the west of the castle, though the rest was demolished some time ago. The Warrens occupied the house until it was sold by General Burke of Prospect Villa to the Sullivans in 1851. The Sullivans were also most likely responsible for the building of a turret to the southwest of

the complex (as a belvedere or viewing tower), believed to have been built to cover a former well (CO087-05202; AH22). There is no trace of the turret left in the field as noted during field survey in February 2015 and the site lies outside of the proposed CPO.

Prospect Villa (BH6), located to the northwest of Castle Warren was constructed in the late 18th century. The house consisted of a six-bay, two-storey building with a classical entrance. Thomas Burke was leasing Prospect Villa from Mary and Catherine Rogers at the time of Griffith's Valuation (1853), when it was valued at £60, while Lewis refers to it as the seat of Lt. Col. Burke in 1837. The Burkes were a wealthy Cork family; Edmund Burke of Lota Park, Cork, owned over 2000 acres in the county, while Edmund Burke, of Prospect Villa, Parish of Barnahely, owned over 300 acres in the 1870s. The house was included in the sale of the Rogers estate in the Landed Estates Court in February 1862. At the time of Griffith's Valuation, Thomas Burke was among the principal lessors in the parish of Carrigaline, barony of Kerrycurrihy. In 1943 the Irish Tourist Association Survey noted Prospect Villa as the residence of G. Hosford and outlined Burke's association with the house mentioning that he kept a racing stable there (*Landed Estates Database*). The house was demolished in the 1970s to make way for industrial development and all of the features associated with the estate, with the exception of parts of the demesne boundary wall (BH10), have also been lost.

Farming continued to determine the general appearance of the built environment into the 19th century. A hierarchical society had developed comprising landlords, tenants and labourers which was reflected in the diverse nature of the built heritage in this area. The few surviving built heritage sites along or in the vicinity of the proposed road project consist of vernacular cottages, farmhouses and their outbuildings or examples of dry-stone boundary walls of later 19th and 20th century date (e.g. BH8, BH9, BH19). The houses of the area were characterised by single or two-storey houses constructed of locally available materials, including stone and timber. Houses were typically rectangular in plan, the width dictated by the length of available roofing materials. The majority of houses would originally have been thatched or roofed in slate which was locally available. Outbuildings to house animals and store feed were generally constructed around a farmyard to the rear or side of the farmhouse.

The relatively late date of the surviving structures is a pattern that is clearly illustrated in the cartographic sources. Many of the earlier structures built some time prior to the 19th century that are depicted on the first edition OS map had disappeared by the time of the revised editions in the later 19th century. There is a marked change between the first edition OS maps, surveyed in the 1830s, and the revised editions of the later 19th century. The early 19th century landscape was more densely populated, with a patchwork of small fields and network of roads and laneways lined with small houses or cottages. The impact of the Great Famine (1845-52) in the intervening years is clear from the later historic maps, where former roadways have disappeared or survive only in part, the myriad small dwellings are mostly gone and many of the field boundaries have been removed to create larger fields. All of these are the result of a sharp decline in population, caused by either death or emigration during the famine years. Tangible evidence of the Great Famine survives in the wider landscape, with a recorded Famine Graveyard located in Moneygourney townland, sited on Carr's Hill, on the east side of the present N28 road (CO086-103). The burial ground bears witness to the devastating effect the Famine had in this area; this large sub-rectangular area had to be donated by the Carr family during the Famine to alleviate St Joseph's cemetery, which could not cope with the numbers of people dying.

Larger farmhouses also appeared in the 19th century. Broadale (BH18) was constructed in the townland of Moneygourney in the early 19th century and consisted of a three-bay, two-storey house. The house was roofless by the late 20th century and has since been completely demolished with the

land being developed for housing. A similar fate befell another large farmhouse, Belview (BH17), located to the south of Broadale which is also likely to date from the early 19th century. An extensive complex of stone outbuildings associated with Belview survived up to 2009 (*CRDS, 2009*). They were located to the southeast of the site of Belview House, along with a number of high stone walls which may have been a walled garden or orchard. None of these 19th century structures are now upstanding and the lands are entirely occupied by modern housing development. In contrast, a similarly large farmhouse, Ring House (BH3), remains in situ at the eastern end of the project, on the outskirts of Ringaskiddy village.

Another example of domestic architecture along the proposed road project is situated at the northern end of the project, on Rochestown Road, referred to as Beechvale Lawn (BH12). Beechvale Lawn was built in 1933 and is an excellent example of an early 20th century villa, set in its own grounds. At the time the villa was built, this area offered proximity to Cork city whilst also being relatively rural.

The resumption of war between Britain and the French Republic in the early 19th century necessitated the strengthening of the cordon of fortifications around Cork Harbour and the construction of five new Martello towers. The Martello Tower at Ringaskiddy (RMP CO087-053/RPS No. 00575, AH35/BH1) was constructed in the early 1800s on the crest of a low hill with extensive views over Cork Harbour and Spike Island. It is surrounded by a rock-cut moat and may originally have been accessed by a drawbridge. The base of the tower is constructed of random rubble, while the upper parts are constructed of ashlar limestone. The tower construction was completed between 1813 and 1815 and, as with the other coastal defences of the period, its role as an active defensive structure was shortlived following the end of the Napoleonic Wars in 1815. The tower was inhabited for a period in the early decades of the 20th century but appears to have been abandoned by the 1940s. The structure and the surrounding lands became part of the extensive Industrial Development Authority (IDA) land bank within the hinterland of Ringaskiddy port (*Cronin 2016*).

The proposed road project runs through a predominantly limestone area and small-scale quarry activity is depicted in many of the townlands on the historic OS mapping, especially in Raffeen and Ballyhemiken on the site of the modern-day Raffeen Quarry. Limestone of 'very superior quality' was quarried at Shanbally and after being 'hewn into columns, tombstones etc.' was shipped to Cork and other places (*Lewis 1837*). Materials were exported by means of a creek running up to Shanbally (*Lewis 1837*). Limestone extracted from the quarries in the parish of Barnahely 'were worked chiefly for burning' (*Lewis 1837*) which included the manufacture of lime for building, agricultural and related purposes. Lime kilns are often found in close proximity to small quarries, though none were identified within the proposed road project. They were used in the manufacture of quick or burnt lime and were constructed predominantly of dressed or undressed stone, though the openings and funnels were sometimes lined with brick. The small-scale burning of lime became less widespread during the later 19th century and was replaced by large-scale manufacture of lime by quarries.

The earliest section of the Cork, Blackrock and Passage Railway was opened between Cork and Passage in 1850. After the opening of the Queenstown extension of the Cork-Youghal line in 1862 the company extended the route through Carrigaline to Crosshaven (*Rynne 1993*). The extension was constructed between 1897 and 1904 and was opened by the Lord Lieutenant of Ireland, the Earl of Dudley in May 1904. In 1925 the line became part of the Great Southern Railways and was subsequently closed in 1932. Features of industrial heritage interest within the study area include the line of the disused Carrigaline railway (BH5) in the townland of Ballyhemiken, which is crossed by the proposed road project, and the nearby Ballyhemiken Bridge (NIAH 20987009; BH5), which was constructed to carry the public road over the railway.

15.3.2 Archaeological Heritage

The National Monument Act, 1930 (as amended) provides the formal legal mechanism to protect monuments in Ireland (**Appendix 15F**). Protection of a monument is provided via: -

- Record of Monuments and Places (RMP);
- National Monument in the ownership or guardianship of the Minister for Arts, Heritage, Regional; Rural & Gaeltacht Affairs or a Local Authority;
- National Monument subject to a Preservation Order (or temporary Preservation Order);
- Register of Historic Monuments (RHM).

15.3.2.1 National Monuments

There are no National Monuments in the ownership or guardianship of the Minister for the Arts, Heritage, Regional, Rural & Gaeltacht Affairs (DAHRRGA), located within or in the vicinity of the proposed road project.

The tower house and bawn in Barnahely townland (Castle Warren, RMP CO087-052; AH22) is not in Local Authority ownership and is not recorded as a National Monument by the DAHRRGA. The church and graveyard in Barnahely townland (RMP CO087-051; AH20) are in Local Authority ownership but have not been designated a National Monument by the DAHRRGA.

15.3.2.2 Register of Historic Monuments, Preservation Orders, Temporary Preservation Orders

There are no sites or monuments under Preservation Order, Temporary Preservation Order or on the Register of Historic Monuments located within or in the vicinity of the proposed road project.

15.3.2.3 RMP & SMR Sites

Archaeological sites identified since 1994 are placed on the Sites and Monuments Record (SMR) and are scheduled for inclusion on the next revision of the RMP (Cf. **Section 15.2**, Methodology).

There is one RMP site and one SMR site located within the proposed M28 Road Project CPO:-

- A fulacht fia (RMP CO086-115, AH9; **Figure 15.1e** in **Volume 5**) in Shannonpark townland, which presents as a burnt spread in a recently ploughed field;
- An enclosure site (SMR CO087-155, AH33; **Figure** in **15.1h** in **Volume 5**) in Barnahely townland.

The zone of archaeological potential (ZAP) associated with five RMP sites is partly located within the proposed road project:-

- A standing stone site in Ballyhemiken townland (RMP CO087-113, AH10; **Figure 15.1e** in **Volume 5**);
- A ringfort site in Hilltown townland (RMP CO087-116, AH7; **Figure 15.1e** in **Volume 5**);
- A gate lodge site in Barnahely townland (RMP CO087-050002, AH19; **Figure 15.1f** in **Volume 5**);

- A tower house and bawn in Barnahely townland (Barnahely Castle; CO087-052001 & -052003, AH22, **Figure 15.1h** in **Volume 5**); and
- A church site and graveyard in Barnahely townland (Barnahely Church; CO087-05101 & 02, AH20, **Figure 15.1h** in **Volume 5**).

One RMP site (a *fulacht fia*) is located immediately outside the CPO in Ballinrea townland (CO086-029, AH5; **Figure 15.1d** in **Volume 5**).

A further 13 RMP sites are located within the assessment corridor (c. 50m either side of the centreline of the proposed road project), but outside the CPO.

Details of all of these sites are contained in the Inventory of Archaeological Heritage Sites in **Appendix 15A**, along with sites of archaeological potential identified from the cartographic sources, archaeological investigations, aerial photographs and field survey.

15.3.2.4 Topographical Files of the National Museum of Ireland (Stray Finds)

The stray finds recorded within the townlands along the proposed M28 Road Project are referenced in the context of the archaeological and historical background (**Section 15.3.1**) and listed in **Appendix 15D**.

15.3.2.5 Archaeological Investigations in Proximity to Castle Warren, Barnahely Townland

A programme of archaeological investigation was carried out as part of the route options study in 2004 in order to ascertain the full potential of the lands in the vicinity of the tower house and bawn (Castle Warren, CO087-052; AH22) and church site and graveyard (CO087-051; AH20). These investigations included archaeological testing and geophysical, topographical and architectural heritage surveys, the results of which have provided a greater understanding of the below-ground archaeological potential.

An aerial reconnaissance survey was also undertaken within the townland on the 12th of July 2004, which produced good views of the castle structures and surrounding setting. The survey did not reveal any other visible features of archaeological potential around, or extending from, the extant remains and there was no visible evidence of related earthworks or enclosing elements. The survey did, however, clearly reveal the foundations of the late 18th/early 19th century garden walls to the east of the castle and the alignment of the old laneway leading east from the castle, both visible on the 1841-2 first edition OS six-inch map (*CRDS 2009*; **Figure 15.14** in **Appendix 15I**).

Results of Geophysical Survey (2004) in Barnahely Townland, in proximity to Castle Warren

The 2004 geophysical survey at Barnahely was carried out to assess the lands immediately adjacent to Castle Warren, in order to ascertain what buried archaeological remains might exist in the environs of the tower house and graveyard (ArchaeoPhysica Ltd; Licence No. 04R065). A detailed gradiometer survey was undertaken over 6.2 hectares, producing mixed results. Broad areas to the north and west of the tower house contained frequent modern metal debris and other magnetic background 'noise' such that no meaningful geophysical results were possible (*Roseveare, 2004*). Good geophysical results were produced in the large arable field to the east of the tower house, however, where a complex of ditch features defining a set of interlocking enclosures was identified

c. 260m to the northeast of the tower house. According to Roseveare (2004), the complex of features was 'typical of Bronze or Iron Age unenclosed settlement', though the recent archaeological testing undertaken for this assessment suggests a later date (see below). This enclosure site was subsequently placed on the Sites and Monuments Record and registered as CO087-155 (AH33; **Figures 15.1g** in **Volume 5** & **15.20** in **Appendix 15I**).

Results of Archaeological Testing (2004) in Barnahely Townland, in proximity to Castle Warren

Although the results of the geophysical survey to the immediate north and west of the castle were poor, a programme of test excavations was carried out under licence from late July to mid-August 2004 in the general area surrounding Castle Warren (Hanley 2005; Licence Ref. 04E0774). The testing did not include the area containing the enclosure complex revealed by geophysical survey (following a design modification to the proposed M28 Road Project alignment, this latter area was investigated in February/March 2015 and the results are described below). Testing in 2004 involved the insertion of a 1.6m-wide centreline trench with regular offshoots averaging every 10m on alternate sides and a total of 63 test trenches inserted across the target area. Some limited areas could not be tested due to access difficulties and local terrain, while other constraints included particularly wet weather conditions that made visibility and testing conditions difficult.

Archaeological testing in Area E – the area between Castle Warren tower house and bawn (CO087-052, AH22) and the church site / graveyard to the north (RMP CO087-051, AH20) – identified a ditch (AH69) running on a WSW/ENE orientation. It was provisionally interpreted as an early modern field drain, but an earlier date (and / or different function) has not been ruled out (Hanley 2005). The ditch was exposed in two trenches, one of which was located immediately south of the proposed CPO. The orientation of the ditch (AH69, **Figure 15.1g** in **Volume 5**) suggests that it continues within the proposed CPO. Virtually all of the features identified in Area E were considered to be agricultural in nature and testing did not reveal any evidence of domestic or settlement activity and no burials. If the large ditch running through the area is a field drain, this would suggest that the ground may have been poorly drained for prolonged periods (*Hanley 2005*). There was no trace of the footpath linking the castle and church, which is depicted on the historic OS mapping (*Hanley, pers. comm. 2015*).

Overall, testing suggested that, apart from the large ditch in Area E, the whole area was otherwise largely devoid of notable archaeological remains, other than those represented by the walled garden, on the southwest side of the castle complex.

Archaeological Investigations Relating to Enclosure Complex CO087-155, February & March 2015

Following a redesign of the proposed M28 Road Project alignment, additional geophysical survey and subsequent archaeological testing were undertaken in February/March 2015, in order to identify and clarify the possible nature and extent of the recorded enclosure site SMR CO087-115 (AH33).

J. M. Leigh Surveys undertook the second geophysical survey Licence No. 15R0017; **Figure 15.19 in Appendix 15I**, to the immediate east of the 2004 survey area, and identified recorded further archaeological enclosures (AH48) to the east and south-east of the enclosure site (SMR CO087-115, AH33). The detailed gradiometer survey area was located on a plateau at the northern end of a single pasture field, overlooking a steep south-facing slope. The survey area totalled 1.8 ha, encompassing land within the CPO, as well as land to the north, south and southeast of it.

The survey identified three new sites, comprising two large enclosures and a smaller ring-ditch, as well as a number of discrete archaeological features (all designated AH48 for the purposes of this assessment). The proximity of the newly identified site clearly suggests that the recorded enclosure site to the west (C087-115, AH33) represents part of an archaeological complex extending across the two fields (**Figures 15.1g** in **Volume 5 & 15.20 in Appendix 15I**). The results of the survey also indicated signs of habitation activity within the two large enclosures (possible internal ditch and pit-type features), with possible associated agricultural activity on their north side. The eastern extent of the site appears to be defined by two linear responses, perhaps representing an entranceway into the site. To the east of the large enclosures there is a small circular ditched feature measuring c. 5m in diameter, with a possible pit in its interior. The results are also suggestive of an associated outer enclosure around this feature, measuring c. 12m in diameter and while function of this feature is unclear it is possible that the remains of a burial feature such as a barrow site have been identified (*Leigh 2015*).

Further archaeological testing was undertaken in late February/early March 2015 to establish the veracity of the geophysical survey results (*Hanley 2015a*, Licence Ref. 15E0049; **Figure 15.21** in **Appendix 15I**). This testing was undertaken to investigate both the recorded enclosure site (SMR CO087-115, AH33) and the newly identified features (AH48) revealed by the most recent geophysical survey to the east. The testing traversed the northern part of the area covered by the geophysical surveys.

The findings of the archaeological testing correlated well with those features identified by the geophysical survey. In the area of the recorded site (SMR CO087-115, AH33) it confirmed the presence of two sub-circular enclosures, which appear to be broadly contemporary in date (*Hanley 2015a*):-

- A sub-circular enclosure was formed by a steep-sided ditch measuring 12m in diameter, which appeared to be linked with a linear ditch.
- A sub-rectangular enclosure, measuring c. 18.5m by c. 15m, formed by a series of apparently segmented ditches. A small piece of iron slag (a surface find), with possible furnace lining attached, was found to the immediate east of this enclosure.
- The association of iron slag indicates a likely *terminus post quem* date of c. 300 BC, this being the earliest date for the widespread use of iron-working in the Cork region. However, given their apparent association with the suspected ringfort to the east (see below), these sub-circular enclosures are more likely to be early medieval in date. The absence of any later medieval pottery from the areas tested is consistent with the enclosures being of likely early medieval origin (Hanley 2015). (A typographical error in the testing report refers to a date of AD 300, but should read 300 BC; Hanley, *Pers. Comm*. 16/11/2016).

The area east of the recorded site (SMR CO087-115, AH33) has been designated AH48 for the purposes of this assessment. The archaeological testing found the following at site AH48 (*Hanley 2015a*):-

- Testing confirmed the presence of the most northerly of the two large enclosures revealed by the 2015 survey and it has been interpreted as an early medieval ringfort, measuring c. 45m in diameter. Both geophysical survey and testing indicate the presence of outer and inner concentric curvilinear ditches, suggesting that this was a bivallate ringfort, as well as internal features indicative of settlement activity (testing found charcoal-rich pits containing visible evidence of animal bone and a number of linear features).

- A series of arcing trend anomalies identified outside the enclosure by the geophysical survey were found to be shallow ditches, possibly relating to a period of field plot division that pre-dates the early modern field systems that exist at present. It could not be confirmed whether or not these are contemporary with the ringfort.
- Possible prehistoric activity was indicated in the area of pit clusters revealed by the geophysical survey at the eastern end of the test area. Testing uncovered a series of pits, with occasional post-holes and stake-holes, one of which contained what looked like heat-shattered sand-stone.
- Given these results, it is likely that the possible ring-ditch and second large enclosure that were identified by geophysical survey within AH48 are also archaeological in nature.

The testing also identified a stone cluster in Trench 14, Area B, which may correlate with a removed field boundary (AH65, **Figure 15.1h** in **Volume 5**). The first edition OS map (1841-2 & revised edition OS historic maps up to 1926-37) shows a kink in the eastern boundary wall associated with Castle Warren demesne (BH23), where the proposed M28 Road Project crosses it; the wall was straightened some time after 1926-37, removing the kink. It is possible that the kink in the boundary respected an archaeological site or feature that is no longer in place. In this context it is interesting to note that another possible interpretation is that the stone cluster is related to a localised NW–SE-aligned geophysical anomaly recorded near the south-western end of the trench. If so, the feature may, in fact, represent a continuation of ditches uncovered in the adjacent Area A, to form a sub-rectangular enclosure—although this is unproven (Hanley 2015a).

15.3.2.6 Archaeological Investigations in Shannonpark & Hilltown Townlands

In 2005, a geophysical survey in Hilltown townland was undertaken to assess a recorded ringfort site (RMP CO087-116, AH7; the site had no visible surface trace); the site and its environs lay within the proposed land-take for a major road junction on the then proposed N28 Road Project. The results of the survey identified several probable archaeological features, including two concentric arcing ditches at the ringfort site (*Roseveare 2005*). A programme of archaeological testing was undertaken in 2006 in order to provide additional assessment of the area and to investigate some of the anomalies identified in the geophysical survey (Licence Ref. 06E983). The testing revealed eight features of archaeological significance, including a cluster of pits of Neolithic date, a possible *fulacht fia* close to the Glounatouig Stream, as well as pits and possible field boundaries of unknown date (*Noonan & Hallinan 2006*). The ringfort site itself was not subjected to archaeological testing and the proposed interchange design was subsequently changed to avoid the recorded site, with the proposed Shannonpark Interchange for the current project now being confined to the opposite side of the existing N28 road.

In 2008, geophysical survey was undertaken within Shannonpark townland on the west side of the existing N28 road, to inform the design for the proposed new interchange at Shannonpark (Licence No. 08R0111). The survey revealed a landscape seemingly devoid of modern influences apart from the existing field boundaries, which predate construction of the present N28 but seem to bound fields opened up from smaller ones (internal divisions being found during survey). These smaller fields seem to have been cultivated (some relict furrows were identified by the survey) and enclosed a band of open wet ground which was planted with willows (the central wet area is known to have been a commercial source of willows; itis marked as an osiery on the first edition OS map; AH45, **Appendix 15A**). Whether as a result of this cultivation or through a genuine absence, no structures of obvious archaeological interest were found (*Roseveare & Lafuente 2008*).

15.3.2.7 Archaeological Investigations in Proximity to the Martello Tower, Ringaskiddy Townland

A programme of archaeological investigations was undertaken in late 2015/early 2016 within a proposed materials extraction site c. 30m south of the Martello Tower (RMP CO087-053), as part of an Environmental Impact Assessment for Materials Extractions and Land Re-Profiling at Ringaskiddy (*Cronin 2016*). Geophysical survey across the entire landholding (Licence No. 15R0146) was followed by archaeological testing and metal-detecting (Licence Nos 16E0103 & 16R0029). The geophysical survey identified widespread ploughing activity and only a small number of potential archaeological features. Consultation with the farmer leasing the fields confirmed that, while the majority of the fields are now under pasture, they had been subjected to intensive cultivation in recent decades. The testing results confirmed those of the geophysical survey, with no definitive evidence for archaeological remains identified and only localised clusters small features present, such as pits and stake-and-postholes (c. 90m south / southeast of the proposed road project). Given the absence of any identified archaeological artefacts (either by testing or metal-detecting) and the extensive modern agricultural activities within the site, it was considered possible that at least some of these features are of recent origin (*Cronin 2016*).

15.3.2.8 LiDAR Survey

LiDAR (Light Detection and Ranging) is a non-invasive investigative tool that can be used to obtain a better understanding and interpretation of the physical, topographical and cultural heritage landscape. LiDAR is a laser-based remote-sensing system used to collect elevation data, using a sensor-equipped plane or helicopter. It provides a cost-effective and fast method of recording topographic data over large areas, generating detailed contour models that can be investigated for surface archaeological features. The primary benefit of using LiDAR is that it has the ability to map features obscured by vegetation and / or which may be indistinguishable on the ground.

The LiDAR data for the northern half of the proposed road project area - from the Bloomfield Interchange to the Shannonpark roundabout— were commissioned by the National Roads Authority. The LiDAR data received from this section of road included Digital Terrain Model (DTM) data, at 2 m spacing. The coverage spanned c. 450 m on either side of the existing N28 road. The LiDAR data for the eastern half of the project - from the Shannonpark roundabout to Ringaskiddy - was not available at the time of this assessment. The LiDAR data was analysed by Ken Hanley, TII Archaeologist (Hanley 2015b) for the purpose of identifying anomalies of archaeological potential. ArcMap 10.1 was used to convert the LAS height datasets into digital terrain models and corresponding raster (GeoTiff) files. A range of raster dataset visualization techniques were then applied (following Zakšek *et al.* 2011) using the Relief Visualisation Toolbox, v.1.1, (©ZRC SAZU, 2014) in order to highlight topographical anomalies of archaeological potential.

A total of five sites of archaeological potential (AH6, AH18, AH29, AH61, AH62) were identified within the assessment corridor (Cf. **Appendix 15A** for descriptions of each anomaly). Of these, four are located partly within the proposed CPO (AH6, AH18, AH61 and AH62). The locations of these sites are depicted on **Figures 15-1b** to **15-1d** in **Volume 5**.

15.3.2.9 Cartographic Sources

This section provides an overview of the lands through which the proposed M28 road project passes, as presented on the various historic maps that are available for this area. More detailed analysis is contained in **Section 15.3.4**, which describes the results of the field survey on a townland-by-townland basis, providing an account of the existing physical landscape and the historic character and archaeological potential of the proposed road project. Relevant extracts of the historic Ordnance Survey maps used to illustrate features of interest within the proposed road project are referenced in **Section 15.3.4**.

16th and 17th Century Maps

These early maps do not allow for a detailed analysis of discrete areas. Only a general picture of the overall study area and some features within it can be gleaned from these sources.

The earliest available map for the study area, Candell's 1587 *Map of Cork Harbour*, depicts the Ringaskiddy peninsula (**Figure 15.2 in Appendix 15I**). This map appears to have a military focus, denoting as it does the strategic locations of castles around the harbour. Although there is little in the way of detail, it depicts the tower house at Barnahely (named 'Berneyele' on the map, CO087-052001; AH22), along with another further south named 'Colmor' (close to the site of the later Coolmore House on Curraghbinny peninsula).

The Down Survey baronial and parish maps and the accompanying parish terriers (c. 1656) provide some detail for the various townlands through which the proposed road passes. In Carrigaline parish (Liberties of Cork Barony), the land is described as generally arable and pasture with some woods. The terrier notes the 'improvement' of a castle in Castletreasure townland and the presence of a house in 'Monygormy' (Moneygourney townland), with both depicted on the accompanying parish map. The house in Moneygourney is located at the southern end of the townland (the shape of the modern townland boundary is almost identical to that shown on the 17th century map), close to the boundary with Ballinrea townland and the line of the present N28 road. Although it is impossible to accurately identify the exact location and there is no corresponding record of an historic house in the vicinity, the approximate location as depicted on the Down Survey map is at the opposite end of the townland to the proposed road project. As noted in the historical background above, the castle and church at Barnahely are also depicted on the parish map and mentioned in the terrier (**Figure 15.3 in Appendix 15I**). Nothing else of interest is either noted or depicted on the 17th century maps.

Taylor and Skinner's *Maps of the Roads of Ireland* (1777) (not shown)

Despite its relative proximity to Cork City, the rural and isolated nature of this area is highlighted by the absence of an 18th century toll road. Taylor and Skinner's road maps are schematic in presentation and focused on mapping the principal (toll) roads around the country. There is no road depicted in this area on Taylor and Skinner's map that could correspond to the existing N28 road and no representation of the network of smaller roads that would have existed.

Ordnance Survey (OS) Maps, Sheets 86 & 87 (First Edition 1841-2 & Revised Edition 1897-1904, 1927-34)

The mid-19th century first edition six-inch-scale OS maps are the earliest accurate and detailed cartographic representation of the landscape through which the proposed M28 road passes. For much of its length the proposed road follows directly or is closely aligned with the old roads travelling from Ringaskiddy to Cork, as depicted on the first edition OS map. In general, the mid-19th century first edition OS maps show the proposed road travelling through a largely rural landscape, with predominantly dispersed, single properties or farmsteads and only two real settlement clusters; one at Shanbally and the other at Ringaskiddy. There are a few medium-sized country estates, clustered for the most part at the northern (e.g., Bloomfield, Maryborough and Mount Hovel) and eastern (e.g., Prospect Villa and Castle Warren) ends. With the exception of Castle Warren, the demesnes are either only partially surviving (e.g. Bloomfield) or have been entirely subsumed into modern development. Within the rest of the study area, the historic OS mapping provides small glimpses of 19th century life in this area, with an osiery close to the site of the 16th or 17th century 'Old Court' in Shannonpark townland, some small quarry pits on the site of the modern Raffeen Quarry and a spa well close by.

There are hints on the first edition OS map of an older way of life that would soon be gone, such as the huddle of tiny cottages on the seafront to the east of Ringaskiddy village, with its associated patchwork of small fields. These have been cleared by later 19th century, to be replaced by a single large house and its grounds (Ring House, NIAH 20987046, BH3); this represents a clear example of the sharp population decline during and after the Famine years. This is echoed throughout the study area on the later historic OS maps, with small houses and cottages disappearing, roadways becoming defunct and large open fields replacing the earlier small ones. The late 19th century/early 20th century landscape depicted on the revised edition maps is otherwise little changed, retaining the same rural character and with few significant alterations or developments. In some instances, the pre-1840s roads have continued in use, forming part of the local road network; examples include the Rochestown Road, parts of the existing N28 road and Carrigaline Road, as well as local roads crossing Ballinimlagh, Ballyhemiken, Shanbally, Loughbeg, Barnahely and Ringaskiddy townlands.

The location of the proposed Service Area at Ringaskiddy is on reclaimed land. At the time of the first edition OS map of 1841-2 (**Figure 15.15 in Appendix 15I**), this area lay beyond the former shoreline, in the sands, mudflats and water of the River Douglas estuary, just north/northeast of the village of Ring (now Ringaskiddy). The village proper (as named) is located within Loughbeg townland, though there are two additional clusters of settlement depicted along the seafront to the east/northeast and west. Only one of the three NIAH sites recorded in the village is shown on this map, Rock Cottage (NIAH 20987045, BH4), which is located on the seafront and appears to be one of the more substantial properties in Ringaskiddy village. The Martello Tower (CO087-053; AH35 / BH1) occupies a dominant position inland (southeast) of the village, accessed via a wide lane or former roadway which runs from the rear of Rock Cottage; this may have been an existing road or path that was subsequently utilised by the Martello Tower (perhaps a drover's path to the higher pastures above the village) or could have been built at the same time as the tower in order to provide access to the village (c. 1813–15). A second, very straight, roadway is more definitely associated with the Martello Tower, linking it with the shoreline on the eastern side of the peninsula.

By the time of the revised edition OS maps in the late 19th/early 20th century, the location of the proposed Service Area is unchanged, remaining within the mud-flats of the foreshore. In contrast, there has been quite a significant change along the seafront. The majority of the jumble of small dwellings depicted on the 1841-2 OS map, to the east/northeast of the village have been removed and the land cleared for Ring House (depicted but not named; NIAH 20987046, BH3). The large farm

house is set well back from the coast road in a long narrow plot that is situated centrally within a much larger field, with a straight entrance avenue running from the road to the house. There has been further development in and around Ringaskiddy village (now named as such), with new properties infilling former open fields. Although there is a structure shown on the site of the Ringaskiddy Oratory (NIAH 20987044), the present chapel was not built until 1923. According to the NIAH, the single-storey single-cell RC church incorporates fabric of an earlier building (*www.buildingsofireland.ie*). None of the structures mentioned above lie within the proposed Service Area.

Detailed cartographic analysis of each townland along the proposed M28 Road Project is provided in the context of the field inspection and aerial photographic analysis described in the field reports (**Section 15.3.4**).

15.3.2.10 Townland Boundaries and Townland Names

The proposed M28 Road Project travels from Bloomfield at the northern end of the project to Ringaskiddy at the south-eastern end through the following townlands (**Figures 15.1a-h** in **Volume 5**): Monfieldstown, Mounthovel, Maryborough, Moneygourney, Castletreasure, Ballinimlagh and Ballinrea in the parish of Carrigaline and the barony of Cork (formerly the Liberties of Cork); through Shannonpark, Carrigaline Middle and Shanbally in the parish of Carrigaline and the barony of Kerricurrihy; through Ballyhemiken and Raffeen in the parish of Liscleary and the barony of Kerricurrihy; and through Barnahely, Loughbeg and Ringaskiddy in the parish of Barnahely and the barony of Kerricurrihy. The proposed Service Area is located within the townland of Ringaskiddy, in the parish of Barnahely and the barony of Kerricurrihy.

Townland Boundaries

The boundaries were first described and recorded in the surveys that following the land confiscations of the mid-17th century, being 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 manmade features such as roads and walls (*Nolan 1982*). Townlands and other landholdings were further subdivided into individual fields generally by means of earthen banks, which over time were colonised by hedgerow and trees. The typology of the boundaries can vary in different parts of the country, with some areas favouring distinctive high, wide earthen banks or just stone walling; sometimes there is a combination of earth and stone, with a stone-revetment or a facing on an earthen bank. The field and townland boundaries within the proposed M28 Road Project were, for the most part, formed by earthen banks, with some streams. The intensification and mechanisation of agricultural production in the second half of the 20th century has led to the removal of internal field boundaries to create larger fields. The remains of removed field boundaries can survive in the landscape as linear earthworks or ditches, sometimes evident on aerial photographs. The individual townland boundaries crossed by the proposed M28 Road Project are described in the context of the field survey (**Section 15.3.4**) and listed in the table below (**Table 15.1**).

Table 15.1: Townland Boundaries Crossed by the Proposed M28 Road Project

ID. No.	Townlands	Type of Physical Boundary Crossed by Proposed Road Development	Other Admin. Boundary	Fig. No.
TB1 (AH36)	Monfieldstown / Mounthovel	Stream, tributary of Donnybrook Stream, culverted beneath the existing N28	N/A	15.1a
TB2 (AH36)	Maryborough / Mounthovel	Stream, tributary of Donnybrook Stream (Cf. AH36)	N/A	15.1a
TB3 (AH70)	Mounthovel / Moneygourney	Stream (Cf. AH70)	N/A	15.1a
TB4 (AH36)	Maryborough / Moneygourney	Stream, tributary of Donnybrook Stream, & field boundary (Cf. AH36)	N/A	15.1a / b
TB5 (AH39)	Castletreasure / Moneygourney	Stream, tributary of Donnybrook Stream (Cf. AH 39)	N/A	15.1b
TB6	Castletreasure / Ballinimlagh	Earthen bank & mature hedgerow	N/A	15.1b
TB7 (AH39)	Ballinimlagh / Moneygourney	Stream, tributary of Donnybrook Stream (Cf. AH 39)	N/A	15.1c
TB8	Ballinimlagh / Ballinrea	Earthen bank & mature hedgerow	N/A	15.1c
TB9 (BH22)	Ballinrea / Shannonpark	Earthen bank & mature hedgerow. Small section of drystone walling & possible culvert visible in the boundary (Cf. BH22).	Cork / Kerricurrihy Barony	15.1e
TB10	Shannonpark / Hilltown	Road	N/A	15.1e
TB11	Shannonpark / Carrigaline Middle	Earthen bank & mature hedgerow	N/A	15.1e
TB12	Carrigaline Middle / Ballyhemiken	Road	Carrigaline / Liscleary Parish	15.1e
TB13	Ballyhemiken / Raffeen	No longer present. Destroyed by past quarrying activities (Raffeen)	N/A	15.1e
TB14	Raffeen / Shanbally	Earthen bank & mature hedgerow	Liscleary / Carrigaline Parish	15.1f
TB15	Shanbally / Barnahely	Earthen bank & mature hedgerow (runs partly along the scarp of a quarry)	Liscleary / Barnahely Parish	15.1g
TB16	Barnahely / Loughbeg	Road	N/A	15.1h
TB17	Loughbeg / Ringaskiddy	Earthen bank & mature hedgerow	N/A	15.1h
TB18 (AH39)	Maryborough / Castletreasure	Stream, tributary of Donnybrook Stream (Cf. AH 39)	N/A	15.1b
TB19 (AH39)	Ballinrea / Moneygourney	Stream, tributary of Donnybrook Stream (Cf. AH 39)	N/A	15.1c

Placename Evidence

Townland names are a rich source of information, not only on the topography, land ownership and land use within the landscape, but also on its history, archaeological monuments and folklore (See also **Appendix 15E**). Where a monument has been forgotten or destroyed, a place name may still refer to it and may indicate the possibility that the remains of certain sites survive below the ground surface.

Several of the townlands along the proposed road project derive from the names of English landowners or their country houses, which is unsurprising given the relative proximity of Cork City and of Cork Harbour, an important English naval base. Monfieldstown appears as 'Monshyallytowne' in documentary records of 1571 and subsequently as 'Monfieldstowne' (or a variation thereof), and is possibly derived from the personal name 'Mansfield'. Mounthovel, which is written as 'Mount Hovel' in 1811, is the name of a country house within the townland. The first reference to Maryborough is in 1709 (again a country house within this townland) and O'Donovan in 1841 names it as a 'modern title'. The house is described in 1750 as 'Mary-borough... an handsome house... of Mr Richard Newenham merchant in Cork'.

Documentary evidence suggests that the townland name Shannon Park (also written as Shannonpark) was newly created for a portion of land carved out of the once larger Ballinrea townland; the placename appears as 'Bakyn rea' in 1574 and 'Ballinrea' in the census of 1659, which also notes that the land was at that time the property of Francis Viscount Shannon (www.logainm.ie). The first reference to Shannonpark is in 1741 and in 1750 the records that 'Shannonpark alias Ballinrea was formerly the seat of Francis L. Viscount Shannon, who had a neat house and fine park, both intirely gone to ruin'. Ballinrea itself is of Irish origin, *Baile an Réithigh*, meaning 'town of the mountain side' (O'Donovan has '*Baile an réidh*'). It appears in 1588 as 'Ballyrea alias Rethestown', with a reference to 'Adam Ryth, *bailitheóir cánach* [tax collector] *in Ciarraí Cuirche*' (www.logainm.ie).

Ringaskiddy represents a combination of Irish origin placename with an English family name. The first element 'Ring' derives from *rinn*, meaning point or headland. The placename is first recorded as 'Rinskiddye' in 1632, associated with a Thomas Skiddye and according to O'Donovan in 1841, Skiddy was a 'Cromwellian family now in Cork'. The two placename elements appear to have maintained a relative separateness in the local community, with the village on the seafront named using the Irish element 'Ring' on its own on the first edition OS map of 1841-2.

There are other placenames with English forms, or apparent forms, in the surrounding area. Hilltown, immediately north of the proposed road project, is an example of a direct translation of an earlier Irish form, *Baile an Chnocáin*, meaning the 'town of the hill'. The earliest documentary reference is to 'Ballyknockane' in 1587, with the anglicised form 'Hilltown' appearing in 1811. In the case of Castletreasure, while the 'castle' element is likely to derive from the English word 'castle', the second element remains obscure. It is clear from the historical evidence (e.g., 'C.Trestrige', Inq.) that it is not the English word 'treasure'. It appears in 1586 as Castell Trestrige, becoming Castletreasure in the Down Survey c.1655, and 'Castle-treasure alias Frisell's Castle' in 1669 (www.logainm.ie).

Some of the townland names are Irish in origin and relate to topographical or archaeological features or to their place in the landscape. These include Ballinimlagh (*baile an imligh,* the town or land on the verge of a lake), Loughbeg (*an loch beag*, small lake or inlet), Shanbally (*sean bhaile*, old town).

Both Raffeen and Raheens have their origins in the Irish word for ringfort (*rath*) and both townlands contain recorded ringforts or the sites thereof. The earliest record of the name Raffeen is in 1301 and gives 'Rathemyn', with 16th century records providing similar spelling. This changes from the early 17th century onwards, with variations of 'Raphene' (1655) appearing and 'Rathmeene alias Rapheene' occurring in 1666. O'Donovan in 1841 has '*Ráth Finn*', meaning Finn's fort, but it could also derive from '*ráth mín*', with *mín* meaning smooth or mountain pasture. Raheens, a townland immediately south of the proposed road project, is more straightforward, simply meaning 'little forts' (*rathinídhe*; O'Donovan, 1841, www.logainm.ie).

Other Irish-origin placenames are a combination of a topographical or other feature and a personal name, such as Carrigaline (c*harraig Uí Leighin*, the rock of O'Lehane) and Barnahely (*bearn na hÉille*, probably Éille's gap; as noted in the archaeological and historical background above, the placename is first documented in c. 1301). In the case of Ballyhemiken, it is referenced in the Calendar of Carew (1526), as 'the town of Thomikine in Kerry-Currihye' and as 'Ballyhonickine' in 1618, while O'Donovan refers to '*Baile Sheimicín'* meaning 'Little James' town' (www.logainm.ie).

Moneygourney is of probable Irish origin but its second element defies easy translation. The first part of the placename comes from *muine* meaning thicket. The earliest and subsequent references to the name mostly spell the second part of the placename '-gurney' with an 'm' rather than an 'n' (e.g. 'Munygormey' in 1608). The OS field notes of 1841 suggest '*muin na goirme'*, but O'Donovan concludes that the meaning is uncertain (www.logainm.ie).

The names given to the fields – where they survive - can also provide important topographical information on archaeological sites and features, now long forgotten. One such example is located in Carrigaline Middle townland, where a field is annotated 'Glebe' on the first edition OS map of 1841-2, indicating that it was church land. Another is recorded on the north side of the existing N28 road in the neighbouring townland of Hilltown, c. 40m north of the proposed road project. A field containing the site of a possible ringfort (CO087-116, AH7) is known locally as 'the Lios field' or the field of the ringfort. No other field names were identified during the course of this assessment.

15.3.3 Architectural and Cultural Heritage

There are very few recorded structures or features of architectural heritage interest/significance within or close to the proposed M28 Road Project and these are concentrated at its eastern end, in Barnahely and Ringaskiddy townlands, with only one at the northern end of the proposed road project.

15.3.3.1 Area of Architectural Conservation (ACA)

There are no ACAs along or in close proximity to the proposed road project.

15.3.3.2 Record of Protected Structures (RPS)

There is one RPS site located in close proximity to the proposed road project, 'Castle Warren Stronghouse' (RPS 01260; BH11), which incorporates the remains of the late 18th century country house, Castle Warren, as well as those of the medieval tower house and bawn (RMP CO087-052; AH35). The protected structure lies c. 43m south of the proposed CPO (the proposed road is single-

carriageway at this point), enclosed within a boundary of security mesh fencing erected by the IDA in 1999.

As referred to above, a detailed architectural assessment of the Castle Warren House complex was undertaken in 2004 (*Cronin, 2005*). In addition, a visual structural inspection of the building took place in March 2017 (Cf. **Section 15.3.5** below and **Appendix 15H**).

The protected structure is avoided by the proposed M28 Road Project, which is c. 15m to the north. The proposed road traverses the former demesne associated with the house (see **Figure 15.1h** in **Volume 15I**). The present setting of the protected structure is discussed in the field survey report for Barnahely townland below (**Section 15.3.4.11**), with the former demesne landscape also discussed in **Section 15.3.3.5**.

Ringaskiddy Martello Tower is also a protected structure (RPS 00575; RMP CO087-053; BH1). It is situated c. 100m south/southeast of the proposed CPO. A former roadway possibly constructed to provide direct access from the coast to the Martello Tower (although, potentially an older droveway) is crossed by the proposed M28 Road Project (AH54).

At the northern end of the proposed road project, the existing N28 road passes c. 40m west of the grounds associated with Bloomfield House, a protected structure (RPS No. 00476; BH14).

15.3.3.3 National Inventory of Architectural Heritage (NIAH) Building Survey

The proposed M28 Road Project traverses the grounds of one structure listed in the NIAH, Ring House (NIAH 20987046, BH3) and the former grounds associated with another, Rock Cottage (NIAH 20987045, BH4). The two structures form part of a small cluster of architectural heritage structures listed in the NIAH that are located in Ringaskiddy village. These include Rock Cottage (NIAH 20987045, BH4), Ringaskiddy Oratory (NIAH 20987044, which lies beyond the impact assessment corridor) and the Martello Tower (protected structure, BH1).

Ring House (BH3), which was built c.1880, first appears on the 25-inch revised edition OS map (1897-1904, **Figure 15.16**) and was constructed some time after the first edition OS map of 1841-2; the NIAH Building Survey dates it to between 1860 to 1900 (NIAH Ref. 20987046). The large farmhouse is depicted in a long narrow plot, with the house originally set well back from the road and the property plot centrally placed within a larger field. Although the plot and entrance avenue were subsequently shortened by as much as half with the construction of the Ringaskiddy port road, the house and surviving plot boundaries are intact. The larger field surrounding the plot and clearly associated with it is also intact. An entire cluster of small dwellings depicted along this section of sea-front on the 1841-2 map were demolished and cleared to create this large field and to construct the property within it. The larger field is undoubtedly farm land once associated with Ring House; the proposed road crosses the southeastern corner of the field to the rear (c. 50m southeast) of the house. Ring House fronts onto the busy port road (L2545), and so faces away from the proposed road project, but despite some mature trees and shrubs around the boundary, it is not well screened along its eastern and southern sides.

The former grounds of Rock Cottage (NIAH Ref. 20987045; BH4, **Figure 15.15**) have been greatly affected by modern housing development, particularly in the western half. Although some of the agricultural fields to the rear survive, the front of the property has been largely infilled by modern development, effectively separating Rock Cottage from its former grounds. The house itself is located c. 70m north of the proposed CPO.

At the northern end of the proposed road project, Beechvale Lawn (NIAH 20872014, BH12) is located immediately south of the proposed Rochestown Road realignment. The 1930s property sits within its original boundaries on the south side of the existing Rochestown Road, at the east side of its junction with Clarke's Hill. The house is well screened behind its boundary walls with mature planting.

In addition, the proposed road project crosses the line of the disused railway embankment (now in use as a field boundary), associated with, and c. 200m northeast of, a former railway bridge in Ballyhemiken (NIAH 20987009; BH5); the bridge itself lies c. 135m south of the proposed CPO. The railway line dates to the beginning of the 20th century, with the railway bridge constructed in 1903 and service commencing in 1904. The survival of the railway line or features associated with it could not be verified during the field inspection due to overgrowth of vegetation.

15.3.3.4 Undesignated Sites

There were relatively few undesignated sites of built or cultural heritage interest identified during the course of the field survey within the assessment corridor, with some of them representing discrete and / or partial remains.

In addition to the former railway line noted above (BH5), these include two examples of dry-stone walling (BH19 & BH22, in Ballinrea and Loughbeg respectively; the former is a boundary wall associated with Rose Lodge, BH2, and the latter forms part of the Ballinrea / Shannonpark townland boundary, TB9) and three sections of demesne walling in Barnahely townland (BH10 & BH21, a boundary and internal wall respectively, in the former Prospect Villa demesne; and BH23, a boundary wall of the former Castle Warren demesne).

A structure depicted on the first edition OS map in Maryborough townland (BH20) survives as a two-storey house that has been extensively modernised. The house is located within the proposed CPO.

There are two farm complexes in proximity to the proposed M28 Road Project (BH7 & BH8, in Ballinrea and Carrigaline Middle respectively), both of which retain structures depicted on the first edition OS map.

A ruined single-storey vernacular structure (BH9) that is depicted on the first edition OS map was identified in Loughbeg townland, c. 20m outside of the proposed CPO.

A grotto located in Shanbally townland (CH1) is the sole site of cultural heritage interest that was identified within the assessment corridor. The Marian Shrine is located c. 5m outside of the proposed CPO.

A detailed description of each site is provided in the Inventory of Built Heritage Sites (**Appendix 15B**) and Cultural Heritage Sites (**Appendix 15C**) and their locations marked on **Figures 15.1a-15.1h** in **Volume 5**.

15.3.3.5 Demesne Landscapes and Historic Gardens

The proposed road passes through former demesne lands and historic gardens depicted on the first edition OS mapping (1841-2), though in almost all cases, the houses have been demolished and the landscape has been greatly altered, leaving little or no trace of the 18th and 19th century estates and gardens. Many of the demesnes and gardens are referenced in the National Inventory of Architectural Heritage Survey of Historic Gardens and Designed Landscapes (NIAH Garden Survey; Cf. **Appendix 15B**). The NIAH Garden Survey is currently a paper survey only, using the first edition OS maps and current aerial photography to identify the sites (*www.buildingsofireland.ie/Surveys/Gardens*).

The construction of the northern end of the present N28 road carved a path through the substantial former country estates of Maryborough (BH16) and Mount Hovel (BH15) and through the smaller estate of Belview (BH17) (**Figure 15.6, Appendix 15B**). Mount Hovel House has since been demolished and Maryborough House is now in use as a hotel; their associated lands are now entirely occupied by modern housing development. Maryborough House is a protected structure and a recorded archaeological monument (RPS No. 00479; RMP CO074-089). It is located c. 550m west of the proposed CPO and c. 530m west of the existing N28 road, separated from both by modern housing development and woodland planting.

In the case of Belview, an extensive complex of stone outbuildings stood to the southeast of the original house site until relatively recently, along with a number of high stone walls which may have been a walled garden or orchard (*CRDS 2009*). These have since been demolished and the site is currently in use as a compound for the construction of the adjacent housing complex. Another small estate impacted by the existing N28 road (at the Bloomfield Interchange) is Bloomfield House (BH14; **Figure 15.4** in **Appendix 15I, Appendix 15B**); while the house and its immediate setting have remained intact, there is wide-scale development to the surrounding area, including modern housing in the north-western and southern sections of the demesne, as well as the existing N28 curving through the southwestern side of the former demesne.

Similarly, a 19th century country house or large farmhouse and its associated grounds immediately adjacent to these estates has been completely destroyed (BH18; **Figure 15.6** in **Figure 15I, Appendix 15B**). Named Broadale on the first edition OS map and located in Moneygourney townland, it is a recorded archaeological site (Country House RMP CO086-101). The RMP file describes it in 1992 as an 'abandoned three-bay, two-story house, and originally hipped roof. Chimneys were on east walls. One story addition onto right and left wall. Farm buildings to rear collapsed in ruins. Early 19th Century'. Nothing is now left of the structures and a modern housing development has been constructed on the site.

The survival rate is similar at the southern end of the proposed road project. The Castle Warren estate (BH11) represents a very degraded former demesne landscape within a surrounding industrial landscape (described in **Section 15.3.4.11**; the NIAH Garden Survey, Ref. CO-W-774637, concluded that the demesne had virtually no recognisable features surviving). The late 18th century country house partially survives, incorporating earlier medieval structures, as do a courtyard and outbuildings (*Cronin 2005*). Large agricultural fields to the east and northeast of the house complex

occupy the former demesne lands, which are largely free from modern development. However, the industrial nature of this landscape (particularly to the northwest and west / southwest), in addition to the modern housing to the northeast and modern cemetery to the north, detracts from the setting of the house. There are some traces of the former walled garden that is depicted on the first edition OS map of 1841-2, to the west of the house complex (**Figure 15.14** in **Appendix 15I**); these are visible on aerial photography, along with the upstanding remains of the eastern wall (**Figure 15.22** in **Appendix 15I**). There is a record of a designed landscape feature (a belvedere) situated on the southwest side of the castle/house complex, though nothing survives above ground (CO087-052002, AH22). Belvederes were typically sited to take advantage of a fine or scenic view and can take the form of any architectural structure. In this instance it is a turret, which is marked on the late 19th century 25-inch OS map, situated on the high ground close to the castle, overlooking Cork Harbour and Loughbeg to the south. The proposed M28 Road Project traverses the former demesne lands associated with the house (BH11). Only one upstanding feature associated with the former demesne is crossed by the proposed M28 Road Project, the western boundary wall to the demesne (BH23). The wall is in a ruinous state, having fallen down in places, and is largely obscured by vegetation (BH23; **Appendix 15B;** see also **Section 15.3.4**).

Industrial development in Barnahely townland, on the west side of the R163 road has removed the former 18th century country house, Prospect Villa. It has also obliterated almost all trace of its demesne, as well as that of the neighbouring Ballybricken House and demesne (BH6 & BH13; **Figure 15.14** in **Appendix 15I, Appendix 15B**). Only two upstanding features associated with Prospect Villa survive, both of which are demesne walls; part of the demesne boundary wall is extant c. 20m south of the proposed road project, while an internal demesne wall is crossed by the proposed M28 Road Project (BH10 & BH21, **Figure 15.17** in **Appendix 15I**, **Appendix 15B**). Modern development has also impacted the grounds associated with two smaller properties in Ringaskiddy, Ring House and villa Rock Cottage (BH3 & BH4; **Figures 15.15 & 15.16** in **Appendix 15I, Appendix 15B**). In contrast, the former grounds associated with another smaller property in Ringaskiddy village, Rose Lodge (BH2), are intact; the proposed M28 Road Project will traverse the paddocks or agricultural fields at the rear of the property.

15.3.4 Field Survey & Historic Landscape

A historic landscape approach has been used to characterise the receiving cultural heritage environment and to this end, an account of the field survey is described below under the following headings: physical environment, cultural landscape and archaeological potential. The proposed M28 Road Project is discussed sequentially on a townland basis (or townlands, where appropriate), beginning at the northern end. Townland boundaries are described in the context of the field survey results below and listed in **Table 15.1** (Cf. **Section 15.3.2.10** for further discussion on townland boundaries and names). This section should be read in conjunction with **Figures 15.1a-15.1h** in **Volume 5**, which show the locations of archaeological, architectural and cultural heritage sites and of the townland boundaries crossed by the proposed road project.

15.3.4.1 Monfieldstown / Maryborough / Mounthovel Townlands (Figures 15.1a)

Physical Environment

The townlands of Maryborough and Mounthovel are located in the parish of Carrigaline and the Barony of Cork. At this northernmost end of the proposed road, the mainline motorway will be constructed primarily by on-line widening of the existing N28 carriageway (between the Bloomfield Interchange and Carr's Hill). The land to the east and west has been subject to a significant amount

of residential development and Douglas Golf Club is located on the west side of the current road. A tributary of the Donnybrook Stream flows in a northerly direction along the western side of the road and for much of its length forms the townland boundary between Maryborough and Mounthovel (AH36, TB2). This stream also forms the Monfieldstown / Mounthovel townland boundary (TB1); the stream is culverted beneath the existing N28 road. Dense woodland borders the river and the existing N28 road (**Plate 15.1** in **Appendix 15I**).

Cultural Landscape

At the northern end of the proposed road project, where the proposed motorway is aligned precisely with the present N28 road, the now heavily-developed area is unrecognisable on the historic mapping. The existing road curves through an area previously dominated by Maryborough House, Mount Hovel House, Bloomfield House and their landscaped demesnes; of these, only Bloomfield House retains is immediate setting, with wide-scale development now infilling the former demesnes (BH14 to BH16; **Appendix 15B**). Three features within the former demesne landscapes, as shown on the first edition OS map, are located within areas that appear not to have been disturbed by the extensive development (**Figure 15.4** in **Appendix 15I**): a possible mill-pond in the north-eastern corner of the Maryborough estate (AH2); a small structure in woodland on the western side of the Mount Hovel estate (AH55); and a gate lodge associated with Bloomfield House (AH63). Although no trace of the features survives above ground, all three lie within the proposed CPO.

A brickfield (AH1) is shown on the first edition OS map (**Figure 15.4** in **Appendix 15I**), covering an area c. 100m E-W by c. 60m N-S. It is located on the shore of the River Douglas, west of Bloomfield House estate (Cf. BH14). A laneway leads north from the Douglas to Rochestown road to access the brickfield. By the time of the later 19th century 25-inch OS map, the brickfield is no longer depicted. The site lies within an area now covered in dense scrub and will be traversed by a proposed outfall pipe that forms part of the proposed CPO.

There was no north-south road through this area in the 19th century; the present N28 road eventually joins the old road shown on the first and subsequent edition OS maps further south in Moneygourney townland. The present Rochestown Road follows a road already laid out by the time of the first edition OS map; no house is shown at the location of Beechvale Lawn (BH12) on the south side of the Rochestown Road until the revised edition OS map of 1926-37 (**Figure 15.18** in **Appendix 15I**). A two-storey house survives at the site of a structure depicted on the first edition OS map in Maryborough townland (BH20), within the proposed CPO (Plate 15.52, **Figure 15.6** in **Appendix 15I**).

Archaeological Potential

The extent of development in this area has greatly reduced its archaeological potential, while the limited works proposed along this stretch result in relatively few potential impacts. The proposed road project will involve widening the road into the verge and along the banks of the stream (AH36 / TB2) for approximately 110m to the point where it has been culverted beneath the existing road. All riverine environs are considered to have an inherent archaeological potential and the presence of *fulachtaí fia* are noted along stream banks elsewhere (e.g. AH5 & AH9). In this instance the potential is lessened by the dense woodland along the stream banks, which is depicted on the first edition OS map and thus has been in-situ since at least the mid-19th century. Although the vegetation growth may have disturbed any previously unknown archaeological sites or features along the banks of the stream, there remains a possibility, albeit slight, that some remains survive sub-surface. In addition,

the remains of a brickfield (AH1), mill-pond (AH2), gate lodge (AH63) and a pre-1840s structure in Mount Hovel (AH55), may survive subsurface.

15.3.4.2 Moneygourney Townland (Figures 15.1b & 14.4)

Physical Environment

The townland of Moneygourney is located in the parish of Carrigaline and the Barony of Cork. The land is predominantly in pasture, with some large arable fields. The northern section of the townland, through which the proposed road passes, is dominated by residential land use, parts of which are still under construction. The land in the townland slopes down to the west from a highpoint of 127m OD, to the valley of a tributary of the Donnybrook Stream, which forms the boundary between Moneygourney townland and Castletreasure, Ballinimlagh, Mounthovel and Ballinrea townlands (AH36, AH70 & AH39; TB3, TB4, TB5 & TB7). The existing N28 road travels along the base of this valley to the east of the stream, which forms the Castletreasure / Moneygourney townland boundary (AH39 / TB5). The proposed road will diverge from the existing road in the north-western corner of the townland at the proposed Carr's Hill Interchange. From there it will run through the low-lying sections of featureless pasture fields on the west side of the road, following the course of the stream and townland boundary for c. 235m before crossing into Castletreasure townland.

Woodland and shrub verges rise steeply from the east side of the existing road and drop away from the west side of the road. The proposed Carr's Hill Interchange slip roads and roundabouts occupy the densely covered verges to either side of the existing N28 road and extend only partly into the good pasture fields beyond.

Cultural Landscape

The landscape becomes noticeably more agricultural and open on the first edition OS map, where the present N28 crosses into Moneygourney townland, passing the grounds of Belview and Broadale houses (BH17 & BH18) before joining the 19th century Cork/Carrigaline road (the course of the present N28) running along the southwest side of the townland. The two 19thcentury estates are divided by a public road (L6477 road) that runs northwest to southeast, roughly bisecting the townland, with Belview to the east and Broadale to the west.

Nothing survives of Belview house (BH17) or its demesne. At the time of inspection, the site of the former outbuildings and walled garden were in use as a compound for the construction of the adjacent Maryborough Ridge housing estate (**Plate 15.2** in **Appendix 15I**). Broadale, another country house or large farmhouse depicted on the first edition OS map, has also been completely destroyed (BH18). Two houses are depicted on the first edition OS map to the northwest of the Belview demesne, on the west side of the road, each in its own small plot (**Figure 15.6** in **Appendix 15I**). Both lie within the proposed CPO. The slightly smaller structure (AH64) is no longer upstanding. The larger house (BH20, built c. 1800) survives as a three-bay, two-storey house with a garage to east end (**Plate 15.46** in **Appendix 15I**).

Archaeological Potential

While an examination of the first edition OS map reveals a landscape generally devoid of upstanding archaeological sites or features (only one, now levelled, ringfort is depicted in the eastern half of the

townland, CO086-015, well outside of the assessment corridor); this may be the result of tillage farming in the past. A small dwelling shown on the first edition OS map (AH64) is no longer upstanding. The fields within the townland, although almost all under pasture now (where not already occupied by modern housing development), have a level surface typical of former arable fields and inspection of aerial photographs from 1995 to 2005 show traces of plough furrows as crop marks in many of the fields (www.maps.osi.ie). This tallies with an account by Lewis in the mid-19th century, who noted of the land within Carrigaline parish that 'the surface is pleasingly undulated, and the soil is fertile; a considerable part is under an improved system of tillage, and the remainder is in demesne, meadow, or pasture land'. It is possible, therefore, that previously unknown archaeological sites, features or deposits may survive subsurface in the area of greenfield and scrub around the proposed Carr's Hill Interchange.

The proposed road mainline will potentially impact on the stream that flows along the Moneygourney / Castletreasure and Moneygourney / Ballinimlagh townland boundaries (AH39 & AH70; TB3, TB5 & TB7). All riverine environs are considered to have an inherent archaeological potential and this potential is borne out where *fulachtaí fia* have been identified along stream banks elsewhere (e.g. AH9, **Figure 15.9** in **Appendix 15I**).

15.3.4.3 Castletreasure Townland (Figure 15.1b)

Physical Environment

The townland of Castletreasure is located in the parish of Carrigaline and the barony of Cork. The land is predominantly in pasture with some arable fields and some residential land use at the northern end of the townland. The land in the townland slopes to the east to the valley of a small stream, a tributary of the Donnybrook Stream (AH39), which also forms the Castletreasure / Moneygourney townland boundary (TB5). The proposed road project travels only briefly through the southeast corner of this large townland, at the Carr's Hill Interchange, crossing the stream (encompassing both watercourse and banks) and passing through several fields lining the west side of the present N28 road. At this point in its course, the stream is shallow (c. 0.1-0.2m deep), c. 1.5m wide, with dense woodland and scrub growing along its banks (**Plate 15.6** in **Appendix 15I**). The fields to either side of the river slope steeply down to it, with low-lying rough pasture along the banks and reed clumps and waterlogging evident in places. The three fields along the west bank of the river were previously arable (now lying fallow or recently turned to pasture), with the lower-lying rough grazing fenced off. Field boundaries and the Castletreasure / Ballinimlagh townland boundary (TB6) consist of earthen banks and mature hedgerow.

Cultural Landscape

There is little of note on the historic OS maps in this section of the townland, with the 'Site of Castle Treasure' (CO086-013) at a farmstead c. 350m west of the proposed M28 Road Project being the closest feature of interest. The first edition OS map shows a small tributary of the stream that flows along the Castletreasure, Ballinimlagh and Moneygourney townland boundaries (AH39; TB5 & TB7). This small stream (AH8) flows for roughly 300m before joining the larger stream at the junction of the three townlands; it is not depicted by the later 19th century maps. The former watercourse is traversed by the proposed road development. The revised 25-inch edition OS map (1897-1904) depicts a number of areas of bog or marsh along the western banks of the river, at the point where the proposed M28 Road Project crosses from Moneygourney to Castletreasure townland (AH39).

Archaeological Potential

Cartographic sources depict a number of areas of bog or marsh along the western banks of the stream (AH39). Field survey also noted waterlogged and low-lying areas along both banks of the stream, while cartographic analysis identified land along the western bank as the course of a former small tributary of the stream (AH8). All riverine environs are considered to have an inherent archaeological potential and the presence of *fulachtaí fia* are noted along stream banks elsewhere in the project (e.g., AH5, AH9, **Figure 15.9** in **Appendix 15I**).

A LiDAR anomaly (AH18) was identified in Castletreasure townland; it comprises a low c. 25 m-diameter rise in a low (c. 100 m-diameter) depression in a north-east-facing slope, lying partially within the proposed CPO. A second LiDAR anomaly (AH6) was identified where the proposed M28 road project crosses from Castletreasure townland into Ballinimlagh townland. It comprises a concentration of undulating topographic (archaeological/geological) features, leading west from the proposed CPO and continuing south into the townland of Ballinimlagh; one of these features lies partly within the proposed CPO.

15.3.4.4 Ballinimlagh Townland (Figures 15.1b & 14.5)

Physical Environment

Ballinimlagh is located in the parish of Carrigaline and the barony of Cork. The land in the townland slopes generally from a highpoint of 149m OD to between 90 and 100m in the valley of the stream that forms the Ballinimlagh / Moneygourney townland boundary (AH39 / TB7). It is a small townland, with the northeast/southwest oriented Ballinrea Road running through it. The area is dominated by pasture with field and townland boundaries comprising earthen banks covered in mature hedgerow (Ballinimlagh / Castletreasure to the north and Ballinimlagh / Ballinrea to the south; TB6 & TB8). The proposed M28 Road Project runs south-eastwards through several fields of good, undulating pastureland situated along the east/northeast edge of the townland and on the west/southwest side of the stream (AH39). The majority of the original field boundaries north of the Ballinrea Road have been removed, creating one very large land parcel, with subdivision provided by wire-and-post fences. The proposed M28 Road Project crosses the lower slopes of the pasture fields and encroaches into the low-lying, waterlogged level ground along the banks of the stream (**Plate 15.7** in **Appendix 15I**); the proposed road project is in fill at this point.

Cultural Landscape

Mount Imla, a small country house in the north-western corner of the townland, is one of only two properties depicted on the historic OS maps within the townland (the other is a small cottage or farmhouse further southwest on the opposite side of the local road. Neither structure is located within the assessment corridor. Cartographic analysis and field survey revealed no structures or features of interest within or close to the proposed road project. An examination of aerial photography, however, indicated an area of possible burnt spread material extending across the field on the south side of the Ballinrea Road AH40; **Figure 15.5** in **Appendix 15I**). Although the field is now under pasture, aerial photography supplied by RPS Ltd (unknown date) shows the former arable field under plough and the possible burnt spread extending along the west/southwest bank of the stream (AH39). This area of burnt spread lies partially within the proposed road project.

Archaeological Potential

The proposed M28 Road Project runs partly through the low-lying, waterlogged ground along the west/southwest bank of a stream (AH39) and partly encroaches upon an area of possible burnt spread material identified through aerial photographic analysis on the river bank (AH40). All riverine environs are considered to have an inherent archaeological potential and the presence of *fulachtaí fia* in the form of burnt spreads are noted along stream banks elsewhere (e.g. AH9, **Figure 15.9** in **Appendix 15I**).

A LiDAR anomaly (AH6) was identified where the proposed M28 Road Project crosses from Castletreasure townland into Ballinimlagh townland. It comprises a concentration of undulating topographic (archaeological/geological) features, leading west from the proposed CPO and continuing south into the townland of Ballinimlagh; one of these features lies partly within the proposed CPO. A second anomaly (AH61) was also identified comprising a complex of geometric earthwork-like topographical anomalies that cover an area of c. 140m by 70m; approximately 50% of this 'site' lies within the proposed CPO.

15.3.4.5 Ballinrea Townland (Figures 15.1c & 15.1d, 15.6 to 15.8)

Physical Environment

The townland of Ballinrea is located in the parish of Carrigaline and the barony of Cork. The townland is dominated by pasture land with some large arable fields. The land is steeply undulating and slopes generally to the south and east from a highpoint of 110m OD (**Plates 15.10 & 15.11** in **Appendix 15I**). A small tributary of the Glounatouig Stream (AH41) runs northwest to southeast through the townland and is crossed by the proposed road project, with the Glounatouig Stream itself flowing in a deep, steep-sided valley on the eastern boundary between Ballinrea and Hilltown, parallel with the present N28 road. The northern boundary with Ballinimlagh (TB8) and the southern boundary with Shannonpark (TB9) are both defined by earthen banks and mature hedgerow. The proposed route stays roughly parallel with the present N28, running through a mixture of pasture and large arable fields along its southwest side, crossing the tributary stream (AH41). The fields were found to be devoid of features, with the exception of a previously recorded large burnt spread (*fulacht fia* CO086-029, AH5, the RMP ZAP lies immediately outside the proposed CPO; **Figure 15.6; Plate 15.8** in **Appendix 15I**) in a recently ploughed arable field on the southwest side of the Glounatouig Stream and present N28 road. Many of the original field boundaries, particularly north of the tributary stream, have been removed to create expansive tracts of pasture. Where the proposed road crosses the tributary stream (AH41) the land slopes steeply down to the wide valley bottom, with low-lying, waterlogged land visible in places along the stream banks (**Plate 15.9** in **Appendix 15I**). With the exception of an open area to the west, the stream banks are generally obscured by dense woodland and scrub.

Cultural Landscape

The landscape on the mid-19th century OS map is generally featureless and rural along the north and east sides of the townland, with the proposed M28 Road Project crossing south-eastwards through small fields, roughly parallel with the road and the Glounatouig stream. In addition to the recorded burnt spread noted above (AH5), another *fulacht fia* (CO086-133) is recorded on the opposite side of the stream and present N28 road, c. 85m northeast of the proposed road project. Recorded ringfort CO086-028, of which there is now no surface trace, is shown as a hachured enclosure on the first edition OS map, respected by the road and surrounding field fences. Although the ringfort was

levelled in the past, archaeological testing in 2009 confirmed that remains of the monument survive below ground (Online Excavations Bulletin Ref. 2009:123; Licence Ref. 09E0429). The RMP site is c. 110m southwest of the proposed CPO. A tributary of the Glounatouig Stream also flows through Ballinrea townland and is crossed by the proposed M28 project (AH41; **Figures 15.1 & 14.7** in **Appendix 15I**).

A narrow roadway (AH42) meanders through Ballinrea townland from northwest to southeast, with occasional cottages and small houses depicted along its length; none of which are upstanding or lie within the proposed CPO (**Figures 15.7 & 14.8** in **Appendix 15I**). The roadway (AH42) becomes considerably wider after it crosses the stream (AH41 **Figure 15.7** in **Appendix 15I**) and maintains this form until it reaches a substantial cluster of buildings to the south, named 'Wills Ville' (BH7; the site is not recorded by the RMP, RPS or NIAH; **Figure 15.7** in **Appendix 15I**). 'Wills Ville', which lies outside of the proposed road, appears to be a large farm manor, with a series of outbuildings and other small structures arrayed in an unusual formation. They are laid out in rectilinear form, along either side of the wide roadway and with two small structures set across the roadway to close the rectangle and form a courtyard. The complex of buildings lies within a property comprising several paddocks to the west and south and an orchard to the east. The line of the old road continues beyond the complex, by a footpath across a paddock to the south of the house and then as a wide roadway once more, winding its way to the site of 'Old Court', a 16th/17th century house in Shannonpark (CO086-062; **Figure 15.8**) c. 600m to the southwest, and onwards to Carrigaline. To the north of Wills Ville farm complex, a stream appears to have been diverted from the main tributary to run through the fields, before being routed along the edge of the roadway to terminate in a field to the northeast of the farm, just shy of a small triangular pool or marshy area (no surface trace of any of these features survives). The straight lines of the stream and unusual course may suggest an old mill-race (AH43; **Figure 15.7** in **Appendix 15I**), no longer in use as its course is broken in places, though there is no other evidence for a mill in this area. The broad routeway, stream and unusual layout of Wills Ville may indicate a settlement at the site of the present Wills Ville property (BH7; outside of the proposed project), perhaps with a mill that was associated with the 16th/17th century Old Court. The proposed M28 Road Project traverses the line of the former roadway (AH42) and possible mill-race (AH43).

Wills Ville is indicated as 'in ruins' on the late 19th century 25-inch OS map, with only one structure extant, two others in a state of ruin, and the remainder gone. The surviving structure is rectilinear in shape and, given its position and orientation, it represents either part of the old house that was retained or a completely new, smaller structure on the site of the house. The old roadway has become defunct and is shown overgrown with rough pasture and furze, with many of the small cottages in the area no longer depicted. The roadway continues to be depicted on the historic OS maps as a distinct, narrow strip of rough pasture running along the various field boundaries. The feature has little or no surface expression today, with the fields ploughed as close to the edge of the field boundaries as possible, though a small section survives as a farm access track that runs north from Wills Ville to allotments.

By the time of the six-inch revised edition of 1926-37, the single structure has been incorporated into a new farm complex, with a more typical small, almost square farmyard. The site of Wills Ville now lies within a modern farmstead, well screened from the surrounding fields and the present road. An examination of aerial photography indicates that there is still a building on the site of the old house (as depicted on the later OS maps editions); the house is not visible from either the existing N28 road or from the adjacent fields to the north and west. The proposed M28 Road Project passes through several large arable fields (shown as a network of small fields on the historic OS mapping) to the rear of Wills Ville, outside of the boundary of the northwest paddock and c. 130m

west of the modern farm complex. The farm lies downslope of the proposed road project, which runs along an area of high ground; the road is in cut where it passes to the rear of the farm complex.

A small area of cleared hedgerow revealed a section of drystone walling in the Ballinrea / Shannonpark townland boundary, within the line of the proposed M28 Road Project (BH22 / TB9); it is situated to the west of Wills Ville, although not along the line of the former roadway (AH42). The section hinted at the curve of a possible arch, perhaps a culvert in the wall (BH22; **Figure 15.1; Plate 15.12** in **Appendix 15I**). The dense hedgerow and earthen-bank field boundaries may contain similar features along the line of the former roadway (AH42).

Archaeological Potential

Field survey confirmed that the extensive burnt spread associated with the recorded *fulacht fia* is still visible in the plough soil (CO086-029, AH5). The presence of a recorded *fulacht fia* in the townland (AH5), a second c. 140m northwest on the banks of the same stream, and the proximity of two watercourses (the Glounatouig Stream and its tributary) greatly increases the likelihood that further such sites may survive below ground. Such potential was confirmed during archaeological testing elsewhere in the townland, where three levelled *fulachtaí fia* were identified (Online Excavations Bulletin Ref. 2009:123; Licence Ref. 09E0429). The archaeological potential is heightened where the proposed M28 Road Project crosses the tributary stream (AH41) and the low-lying, waterlogged land along its banks. As has been noted elsewhere along the proposed road project, many of the pasture fields were found to be devoid of features and exhibited a level ground surface typical of former arable fields. Evidence of former ploughing can be seen in aerial photographs of the proposed M28 Road Project and its environs (www.maps.osi.ie). Intensive cultivation over centuries would have removed the surface presence of any previously unrecorded archaeological sites or features that may have been situated in these fields. This is evident in the lack of surface expression of the former roadway (AH42) depicted on the historic OS maps, which ran along the lines of the present field boundaries and which is crossed by the proposed M28 Road Project to the northwest of Wills Ville (BH7) and again to the south in Shannonpark townland (see below).

A section of drystone walling (BH22) visible in a small area of cleared hedgerow in the Ballinrea / Shannonpark townland boundary lies within the proposed road project, to the southwest of Wills Ville and the line of the former roadway (AH42). The section hinted at the curve of a possible arch, perhaps a culvert in the wall. The proposed M28 Road Project will also traverse a section of the former roadway (AH42) and possible mill-race (AH43).

A LiDAR anomaly (AH62) was identified as a linear feature crossed twice by the proposed road project, in Ballinimlagh and Hilltown townlands. It comprises a long linear topographic anomaly that crosses through the townland of Ballinrea in a NW–SE direction; it is evident again crossing the townland of Hilltown in a similar direction. The nature of this anomaly, which will be traversed by the proposed CPO, suggests that it is a backfilled modern, large-scale service trench, servicing Ringaskiddy, and as such, it is unlikely to be of archaeological origin. A second LiDAR Anomaly (AH29) was identified in Ballinrea townland, which comprises a rectilinear enclosure-like anomaly, encompassing an area of c. 64m by 56m. This feature lies c. 30 to the west of the proposed CPO.

15.3.4.6 Shannonpark & Hilltown Townlands (Figures 15.1d, 14.8, 14.9a & b)

Physical Environment

The townland of Shannonpark formed part of the demesne of the Earl of Shannon and is located in the parish of Carrigaline and the barony of Kerrycurrihy. Prior to the 16th or 17th century, Shannonpark appears to have formed part of a much larger townland of Ballinrea and its topography is similarly undulating, with areas of low-lying waterlogged pasture (**Plate 15.11** in **Appendix 15I**). The townland is a mixture of pasture and arable fields, with the land sloping generally to the north and east and several heights of 100m OD. The field and townland boundaries generally comprise earthen banks with mature hedgerow but there are also a number of wet ditches. The site of a *fulacht fia* (CO086-115, AH9; **Figures 15.1 d (Volume 5) & 15.9 (**in **Appendix 15I)**) is recorded along one of the ditches (described in the RMP file as a stream) with a large expanse of burnt spread material extending north and northwest from it (the RMP site lies within the proposed M28 Road Project. The proposed road crosses the Ballinrea / Shannonpark townland boundary (this is also a Barony boundary between Cork and Kerrycurrihy; TB9) and continues southwards through a mixture of pasture and arable fields in Shannonpark, crossing the R611 road to the west of the Shannonpark roundabout.

Although the proposed M28 Road Project passes briefly into Hilltown townland, where the proposed interchange links into the existing N28 road, it does not extend beyond the existing N28 road. This small section of land between the Hilltown / Shannonpark townland boundary (TB10) and the N28 road is covered in dense trees and scrub at the base of the Glounatouig Stream valley, with the boundary itself mostly formed by the stream (AH30; where it is intersected by the proposed road project, the townland boundary diverts from the stream to follow the old N28 road). This townland also formed part of the demesne of the Earl of Shannon. It is generally dominated by pasture land with some rough ground and former osieries along the banks of the Glounatouig Stream in the south (where the proposed M28 Road Project enters the townland). The land in the townland slopes generally to the south and west to the valley of the Glounatouig Stream.

Cultural Landscape

There are several features of interest in Shannonpark depicted on the first edition OS map, principally the cluster of buildings c. 80m to the east/southeast of the proposed road project, marked ‘Site of Old Court’ (CO086-062; **Figure 15.8** in **Appendix 15I**) and the continuation of an old roadway noted in Ballinrea townland (AH42; **Figure 15.8** in **Appendix 15I**). The cluster of 19th century structures are shown on the south side of a public road that runs southeast from a staggered crossroads; this is the recorded location for a 16th/17th century house, the ‘Old Court’ noted on the map (the RMP site CO086-062 is c. 70m west of the proposed M28 Road Project). According to the RMP file, 'Old Court' refers to Shannon Court, a house built by the Earl of Shannon in the 17th century, which was described in the middle of the 18th century as 'a neat house, and fine park, both entirely gone to ruin' (Smith 1750; Cf. RMP File). This house probably stood on the site of the Cogan Castle of Ballinrea. Cartographic analysis indicates that the associated ‘fine park’ described in 1750 was more likely to have been located west of the old Carrigaline road and outside of the proposed CPO.

By the time of the 25-inch edition OS map, the site of Old Court is no longer marked. There is no visible indication, either cartographic or in the field of the ‘fine park’ described in 1750, though it was perhaps more likely to have occupied the western half of the townland. The area is now completely obscured by 19th and 20th century properties and farm buildings, dense field boundaries

and vegetation. A section of the old roadway that links Wills Ville in Ballinrea to Old Court in Shannonpark (AH42), was identified during the field survey **(Figure 15.8** in **Appendix 15I**). It survives as a narrow, tarmacadam road, c. 3m wide, with hedgerow boundaries along either side (**Plate 15.13** in **Appendix 15I**); it is now in use for farm access only.

The original line of the old Carrigaline road was also identified (now bypassed by the R611 link road from Shannonpark roundabout). This old road (AH44) survives as a narrow laneway, measuring c. 1.5m wide, with a metalled surface visible in places. It is largely overgrown at its southwest end, with vegetation along its sides, though it opens where it runs alongside a farm to join the present N28 to the northeast (**Plates 15.14 & 15.15** in **Appendix 15I**).

The proposed M28 Road Project runs south-eastwards through the small fields along the north-eastern edge of Shannonpark townland, roughly parallel with the principal Cork/Ringaskiddy road (N28), to the east of 'Old Court'. Features of note on the first edition OS map include an osiery situated on the west bank of a small stream (AH45 & AH32**; Figure 15.8** in **Appendix 15I**). It is indicated in a field just south and east of the public roads and lies partly within the proposed road project. An osiery is an area used for growing willows; basic craft items were often woven from osiers, such as baskets, fish traps, wattle-and-daub house walls, wattle fences. Osiers are rod-like willow shoots that are often grown in coppices, as appears to be the case here. The stream (AH32) has been canalised along the side of the Carrigaline road and south along the side of the osiery and flows south and southeast along field boundaries; the stream is crossed several times by the proposed road project. There is also an area indicated as marshy or boggy to the west/southwest of the proposed road project, further along the banks of the stream. A footpath runs east/west across the fields, linking the two public roads (the Carrigaline road and the present N28), with a footbridge providing a crossing at the stream to the south of this pathway (beyond the proposed CPO). None of these features, excepting the stream, are depicted on any of the revised edition OS maps. The present Shannonpark roundabout and R611 road cut through the historic landscape, with the R611 road tying into the old Carrigaline road shown on the historic OS maps. The site of the osiery is contained within several fields of very rough pasture, with a gentle rise at the north/northwest end, bounded by the roundabout and R611 road along the east/southeast. All of the field boundaries have been removed and the vegetation dumped in the centre and along the roadside (**Plates 15.11 & 15.16** in **Appendix 15I**). There are distinct low-lying, slightly boggy areas, particularly in the centre, south and west. The canalised stream is not evident where the field boundary has been removed.

An osiery is also shown just north of the Hilltown / Shannonpark townland boundary (TB10), where it lies partly within the proposed M28 Road Project (AH31).

The site of a *fulacht fia* (CO086-115, AH9) is recorded in the low-lying, southwestern corner of a steeply sloping arable field, and is located within the proposed CPO. The site is recorded on the east side of the wet ditch that forms the eastern field boundary and the Ballinrea / Shannonpark townland boundary (TB9). The RMP file describes a stream flowing along this boundary, but it could not be confirmed during field inspection due to dense vegetation (**Plate 15.17** in **Appendix 15I**). There are, however, two small watercourses branching out from the southwestern corner of the field on the revised edition OS map of 1926-37, which might suggest that there is a natural spring in this area, giving rise to streamlets or wet ditches. A very large area of blackened soil was identified at the southern end of the field during the recent field survey, indicating an extensive burnt spread associated with the recorded *fulacht fia* site (**Plate 15.18**; **Figure 15.9** in **Appendix 15I**). The *fulacht fia* site is described in the RMP file as 'a large spread of burnt material in a ploughed field. Levelled spread of *Fulacht fia* material measuring 18m E-W, 30m N-S.' This corresponds roughly with the site as identified during field survey, though subsequent ploughing over the years appears to have

spread the material further (it now measures c. 25m E-W by c. 40m N-S, occupying the entire southernmost corner of the field). The dense vegetation overgrowth and trees along the townland boundary (TB9) to the east of the site obscured the ground surface.

Archaeological Potential

The recorded *fulacht fia* site, and the associated burnt spread surrounding it, lie within the proposed CPO (CO086-115, AH9). Given the tendency for *fulachtaí fia* to occur in groups, there is a strong possibility that further sites or features may survive within the inaccessible area of ground that survives unploughed along the townland boundary (at proposed access road), close to the recorded site. The presence of the recorded site and the topography of the landscape through which the proposed M28 Road Project travels further south in the townland (low-lying and waterlogged in places, with small streams, e.g. around the osieries, AH45 & AH31), indicates that there is a strong possibility that further such sites will be revealed. The proposed M28 Road Project will also cross the remains of two former (pre-1840) roadways depicted on the first edition OS map: an old route southwards towards Carrigaline and the castle there and an east/west routeway that crosses it in Shannonpark (AH42 & AH44).

15.3.4.7 Carrigaline Middle Townland (Figures 15.1d & 14.10)

Physical Environment

The townland of Carrigaline Middle is located in the parish of Carrigaline and the barony of Kerrycurrihy. The land is predominantly low-lying and in pasture, becoming gently undulating at its northern end where it meets the present N28 road. The townland and field boundaries are predominantly earthen banks covered in mature hedgerow, with a public road forming the Carrigaline Middle / Ballyhemiken townland boundary (TB12; this public road also forms the boundary between the parishes of Carrigaline and Liscleary). The proposed road project runs through the northern tip of the townland, crossing a narrow arable field that rises to the west and a small, relatively level pasture field. Both fields were devoid of features.

Cultural Landscape

The proposed M28 Road Project passes only partly through the northern narrow spur of Carrigaline Middle townland, sandwiched between Shannonpark on the west and Ballyhemiken on the east. It passes immediately south of a field marked 'Glebe' on the first edition OS map of 1841-2, before continuing eastwards into Ballyhemiken townland. Generally, glebe refers to land either belonging to the church or yielding revenue to it, through farming. A small L-shaped structure is depicted on the first edition OS map in the southeast corner of the Glebe field (**Figure 15.8 Appendix 15I**); the structure has gone by the time of the revised 25-inch OS edition of 1897-1904 and its site lies just within the CPO for the proposed M28 Road Project (AH68). It is possible that the glebe land was once more extensive; dashed lines along the boundaries of the glebe field (and one to the south) indicate that new field boundaries were under construction at the time of the Ordnance Survey in the 1840s, subdividing the land.

Also in Carrigaline Middle townland, a small house (BH8) is depicted on the first edition OS map in the field to the south of the proposed road project, situated on the west side of the public road; by the time of the 25-inch OS edition in the later 19th century, a new complex of structures had been erected on the site of the earlier building. Part of this 19th century farm complex survives, namely the farmhouse and an adjacent outbuilding (BH8; **Figure 15.10; Plates 15.19 & 15.20** in **Appendix**

15I). They stand alongside modern barns and sheds, with the survival of the older buildings providing an attractive example of the vernacular architecture in this area. The 19th century farmhouse comprises a two-storey, four-bay structure, with rendered walls and a pitched slated roof; it appears to have been extended from an originally three-bay house, with the fourth bay added to the north end. The rendered outbuilding is a one-and-a-half storey structure, with a pitched, slated roof and access to the mezzanine or loft level provided via external stone staircase to a doorway in the east gable. There are two small windows just below the eaves on the north façade and three on the south façade. Access at ground level is via a single doorway in the north façade and a double barn door in the south façade.

By the time of the revised six-inch edition OS map (1926-37), the Carrigaline Railway line is depicted to the south and east of the farm complex (in Ballyhemiken townland), having been constructed at the start of the 20th century (c. 1903; **Figure 15.10** in **Appendix 15I**). The railway line approaches from Carrigaline in the southwest, crosses the road into Ballyhemiken on the Ballyhemiken Bridge (BH5, described below in **Section 14.3.4.8**). The farm complex is located c. 25m south of the proposed M28 Road Project and is not well screened by existing field boundaries; the proposed M28 Road Project is in fill at this point, with an underbridge providing access for the existing Ballyhemiken Road (Rock Road). The farm complex is not recorded by the RPS or NIAH and is located outside of the proposed CPO.

Archaeological Potential

The site of a pre-1840s house (AH68) located in a former Glebe field lies within the proposed road project CPO. In the areas of greenfield traversed by the proposed M28 Road Project in this townland, there remains the potential that previously unknown sites or features may survive below the present surface.

15.3.4.8 Ballyhemiken Townland (Figures 15.1d & 14.10)

Physical Environment

The townland of Ballyhemiken is located in the parish of Liscleary and the barony of Kerrycurrihy. It is generally low-lying rising to a maximum height of only 41m OD. The landscape is dominated by pasture, with a large quarry and a golf course (Fernhill Golf and Country Club) located along its eastern boundary. The western boundary to Carrigaline Middle consists of a local public road, with the former Ballyhemiken / Raffeen townland boundary (TB13) removed by the quarry works. The proposed M28 Road Project traverses two large fields, before crossing into the quarry. The boundary between the two fields is formed by the line of the disused Carrigaline Railway (BH5). The generally level northern field is currently under pasture, but has been ploughed in the past; it contains the recorded sites of two standing stones (CO087-113 & CO087-114; AH10 & AH11; **Figure 15.1** in **Volume 5**). The southern field rises to the south and has recently been ploughed, with a row of modern housing constructed along its southern boundary.

Cultural Landscape

Ballyhemiken is separated from Carrigaline Middle townland by a north/south public road, which forms the townland boundary (TB12). Although now dominated by two large arable fields, at the time of the first edition OS map, Ballyhemiken townland was divided into a number of much smaller fields. Few features are depicted on the first edition OS map in this location. A small quarry pit is shown to the east (within the area of the present Raffeen Quarry) and a natural pond in the

southwest corner. A small farm complex straddles the Ballyhemiken / Carrigaline townland boundary to the south of the pond, beyond the proposed CPO (BH8, described above in **Section 15.3.4.7**). Two small structures are depicted in the north-western part of the townland, one of which lies within the proposed CPO (AH3; **Figure 15.8** in **Appendix 15I**). The sites of two possible standing stones are recorded in the townland, though neither monument is depicted on the historic OS maps (CO087-113 & CO087-114; AH10 & 11). The RMP files record that both stones have been removed, with the original site of the northern stone (AH10) lying beneath the present N28 road and within the proposed CPO. The second standing stone site is located c. 30m south of the proposed M28 Road Project (CO087-114; AH11), in a low-lying, waterlogged corner of the pasture field (**Plate 15.21** in **Appendix 15I**); this field has previously been under the plough and there are no visible surface features. According to the RMP file, the stone was removed during reclamation works, which suggests that this part of the land has always been waterlogged; the proposed M28 Road Project travels along the slightly higher, dry ground to the north.

The line of the former Carrigaline Railway (BH5; **Figure 15.10** in **Appendix 15I**) separates the two fields, running southwest to northeast and is crossed by the proposed road project. It survives as a broad field boundary, displaying the same width and tapering shape in modern aerial photographs as appears on the historic maps (www.maps.osi.ie). Apart from the distinctive width, there is no other indication of the former railway line, with the dense vegetation along the field boundary obscuring almost all of its length (**Plates 15.22 & 15.23** in **Appendix 15I**). A small section has been cleared to provide access between the two fields, but there was no visible trace on the ground of the former line at this point. Further southwest along the field boundary it was possible to see a wide, flat linear feature with trees along either side (**Plate 15.22** in **Appendix 15I**). Although the disused line is not recorded by the RPS or NIAH, it is associated with Ballyhemiken Bridge, the former railway bridge located to the southwest, which is ascribed a regional rating (NIAH 20987009). The railway line and bridge were built c. 1903, with the triple-span red-brick bridge constructed to carry the road over the railway line. The line only operated for a brief time; after its official opening on 31st May 1904 by the Earl of Dudley, the Lord Lieutenant of Ireland, the line lasted less than 30 years, closing in 1932 (www.buildingsofireland.ie). While the line of the railway is preserved in length and width by the present field boundary, given the extent of vegetation overgrowth it was not possible to confirm the presence of any physical remains (e.g. tracks or rails) where it is crossed by the proposed road project. Both the disused line and the bridge are examples of early 20th century industrial heritage in this area and act as a reminder of the scale of the railway network which once criss-crossed the country.

Archaeological Potential

Given the proximity of two recorded standing stone sites and the waterlogged ground evident during field survey to immediately south of the proposed M28 Road Project (close to a former pond marked on the first edition OS map), this area is considered to have a high archaeological potential. It represents a wetland/dryland interface, between the site of the standing stone to the north (CO087-114; AH11), on the banks of the Glounatouig Stream, and the site of the standing stone to the south (CO087-114; AH11), close to a former pond and a waterlogged, low-lying area; the proposed M28 Road Project traverses the dryland between the two (AH53). There is also the possibility that features associated with the former railway line (BH5) survive within the field boundary crossed by the proposed road project.

15.3.4.9 Raffeen Townland (Figures 15.1e)

Physical Environment

The townland of Raffeen is located in the parish of Liscleary and the barony of Kerrycurrihy. The proposed road project crosses through the southern part of the large townland, where the natural topography has been disrupted by the presence of an extensive quarry located to the south of the existing N28 road. The proposed M28 Road Project crosses through the quarry, c. 35m to the south of the recorded sites of a destroyed ringfort and souterrain (CO087-034 & -090, AH12; **Figure 15.1f (Volume 5), Plate 15.24** in **Appendix 15I**). The Raffeen / Ballyhemiken townland boundary (TB13) once ran through the area now occupied by the quarry; no trace of the boundary survives within the quarry. The Raffeen / Shanbally townland boundary (TB14) survives as an earthen bank with mature hedgerow, which also forms the boundary between Liscleary and Carrigaline parishes.

The proposed M28 Road Project crosses two surviving arable fields within Raffeen townland on the east side of the quarry, separated by a north/south local public road. The irregular-shaped arable field on the west side of the road had, as evident at the time of field survey, been recently ploughed, sloping down to the Glounatouig stream along its northern boundary with the N28 road (**Plate 15.25** in **Appendix 15I**). Several modern houses occupy its north-eastern corner. A substantial rock outcrop, heavily covered in vegetation is located at its western boundary with the quarry and the field is crossed by a number of power lines. These power lines emanate from the electricity sub-station located a short distance southeast. The expansive arable field to the east of the road rises from the north/northeast, becoming relatively level in the southern half. It was formerly two fields, with traces of the east/west boundary evident in aerial photography and a stone gate-post surviving in the field c. 50m north of the proposed road project. No other features were noted in this area.

Cultural Landscape

Raffeen Quarry extends across an area shown on the first edition six-inch OS mapping as large fields to the east and west of the townland boundary between Ballyhemiken and Raffeen. There are few features of interest depicted on the 1841-2 OS map in the vicinity of the proposed road project in Raffeen townland. One of these is a lightly hachured circular enclosure depicting the now-destroyed ringfort (AH12). The ringfort is bisected east-west by a field fence and is located adjacent and west of the Ballyhemiken/Raffeen townland boundary. A small house is also depicted on the first edition OS map on the east side of the local road running north/south through the townland lies within the proposed CPO (AH34; no surface trace survives of this structure or associated garden plot; **Figure 15.11** in **Appendix 15I**).

Archaeological Potential

The proposed M28 Road Project traverses the earthen-bank and hedgerow boundary between Raffeen and Shanbally townlands and Liscleary and Carrigaline parishes (TB14); this townland boundary bisects a specific area of archaeological potential (AH46) that was identified during the course of this assessment and is described below under Shanbally Townland, **Section 15.3.4.10**. In addition, the site of a pre-1840s structure (AH34) lies within the proposed CPO on the opposite (east) side of the local public road. As with all areas of greenfield, there remains the potential that previously unknown sites or features may survive below the present surface in the two surviving fields on the east side of the quarry (Chainage 7750-8250).

15.3.4.10 Shanbally Townland (Figures 15.1e & 15.11)

Physical Environment

The townland of Shanbally is located in the parish of Carrigaline and the barony of Kerrycurrihy, with the land generally sloping gently down to the Owenboy River to the south, from a height of 100m OD in the centre of the townland; the proposed road project crosses this ridge of higher ground. The land is predominantly in pasture and the townland and field boundaries are mostly earthen banks covered in mature hedgerow. The proposed road project crosses the southern half of Shanbally townland, from east to west, roughly following the lines of the 110kv cables stretching from the substation in Raffeen to a second substation in Barnahely townland, just east of the Shanbally/Barnahely townland boundary. The route runs through relatively flat fields of good, level pasture and one arable field, located on the ridge of higher ground, with extensive views south over the Owenboy River valley; such conditions tend to be attractive for settlement in all periods (**Plates 15.26 & 15.27** in **Appendix 15I**). One of the fields is in use as a football pitch by Hibernian Football Club. The route passes between two recorded archaeological monuments; a ringfort and souterrain (CO087-039 & -119, AH14) to the north in a recently ploughed arable field and an enclosure to the south in a large pasture field (CO087-040, AH15). The proposed CPO is c. 25m north of the RMP zone of archaeological potential (ZAP) for the enclosure site and c. 55m from the outer bank of the monument (which is preserved in a field boundary); the CPO is c. 50m south of the RMP ZAP for the ringfort and c. 90m from the outer bank of the monument (which is preserved in a field boundary). The level ground surface of the pasture fields suggests that most if not all of these fields have been ploughed in the past; there is evidence for plough furrows as crop marks in some of the fields on aerial photography (www.maps.osi.ie).

Cultural Landscape

The proposed M28 Road Project runs roughly eastwards through the centre of Shanbally townland, to the south of the principal Cork/Ringaskiddy road (N28), and north of Shanbally village proper. There is a marked difference in the landscape north and south of the N28 road on the first edition map, with a patchwork of small fields and roads to the south, through which the proposed road project travels, and larger fields – some wooded – and a quarry to the north. The quarry, which is marked on all of the historic OS maps produced good quality stone in the mid-19th century, which was exported by boat to Cork and other locations (*CRDS, 2009*).

There are two distinct clusters of settlement to the south, beginning at the junction of the principal Cork/Ringaskiddy road (named Shanbally Cross Roads), where there is a R. C. Chapel, School House and several houses. More houses and cottages are depicted along the public road leading south from the crossroads to Shanbally village (so-named on the first edition OS map; **Figure 15.11** in **Appendix 15I**). The village is laid out along a broad stretch of road, with additional houses to the east and west. By the time of the 25-inch edition OS map in the later 19th century, the two settlement clusters were distinguished by name: Lower Shanbally at the crossroads and Upper Shanbally to the south, the latter being greatly reduced in size by this time. The greater map scale provides additional detail, indicating a Dispensary in Upper Shanbally and a Smithy as one of the structures situated along the road between the two settlements. In contrast, the settlement at the crossroads is relatively unchanged, perhaps a result of its location at the crossroads on a principal road. This is reflected in the almost total absence of vernacular architecture in the area closest to the proposed road project: one small derelict cottage, obscured by vegetation, survives on the south side of Upper Shanbally; another, now in use as a metal workshop, is extant on the road north to the crossroads. Although there is a small grouping of 20th century housing on the south side of the proposed road project, on the site of old Upper Shanbally, most of the modern and surviving 19th

century architecture is centred on the crossroads to the north. None of the upstanding pre-1840s structures are located within the proposed CPO. The sites of four small structures depicted on the first edition OS mapping in Upper Shanbally lie within the proposed CPO (AH38, AH4, AH52 and AH66).

A considerably later, mid-20th century grotto was noted during the field survey in Upper Shanbally. The Marian Shrine (CH1) stands just south of (c. 5m) the proposed CPO.

The first edition OS map also depicts the recorded ringfort and enclosure that lie north and south of the proposed road project (**Figure 15.11; Plates 15.28** and **15.29** in **Appendix 15I**). The ringfort to the north (CO087-039, AH14) is shown as a circular earthwork with a substantial gravel pit on its north side, accessed by a laneway from the main road to the north. By the time of the revised edition OS maps, the northwest quadrant is depicted as removed, presumably as a result of quarrying the adjacent pit. A souterrain is recorded in the southeast quadrant of the ringfort (CO087-119, AH14). According to local information, an earth-cut souterrain with an opening (W 0.88m; H 0.65m) in the southeast quadrant of the ringfort was accessible in the 1960s. It consisted of passages and some possible chambers. Also according to local information, in the early 1990s a part of the sports field to the northeast of the monument collapsed but it was filled in (*RMP file*). The ringfort was found to be inaccessible due to overgrowth, both during the Archaeological Survey of Ireland surveys of 1985 and 2004 and during the present field survey, rendering a thorough examination impossible (**Plate 15.28** in **Appendix 15I**).

The RMP file also noted two swallow holes c. 100m south of the ringfort (within the proposed CPO; AH16), which may indicate that the souterrain extends southwards rather than, or perhaps in addition to, north eastwards. Neither of the swallow holes was evident in the field, with both lying in an area that was recently ploughed at the time of inspection (nor is there any indication on the first or subsequent edition OS maps). The recorded ringfort (CO087-040, AH15) to the south of the proposed M28 Road Project is depicted as a D-shaped enclosure and was probably originally bivallate (*RMP file*). The revised edition OS maps show that it was greatly disturbed sometime in the later 19th century, with only the northern half depicted. It now survives only as a curve in a field boundary. A significant earthen bank covered in mature hedgerow runs in a north-south direction for approximately 75m (passing through the proposed road), connecting the ringfort and souterrain (AH14) with the D-shaped enclosure (AH15). The area within the proposed CPO containing both field boundary and swallow holes is designated as a specific area of archaeological potential (AH16).

A third swallow hole is depicted on the first edition OS map, c. 300m southwest of the ringfort, on the south side of an unusual kink or curve in the field boundary at the juncture of three fields (within the proposed road; AH46). As above, the swallow hole was not evident in the field, which had been recently ploughed at the time of survey.

Archaeological Potential

Both the recorded ringfort and enclosure (CO087-039 & -040, AH14 & 15) occupy the higher ground in the townland, as does a second recorded enclosure site (CO087-041) c. 270m to the south. The swallow hole and curving field boundary (AH46) depicted on the first edition OS map also occur on this elevated contour, on the south-facing slope overlooking the Owenboy river valley. Two swallow holes (AH16) were noted by the Archaeological Survey of Ireland as indicating the possible continuation of a recorded souterrain (CO087-119, AH14; associated with the ringfort located c. 300m northeast, CO087-039). In addition, a significant earthen bank covered in mature hedgerow runs in a north-south direction for approximately 75m (passing through the proposed road project),

connecting the ringfort and souterrain (AH14) with the D-shaped enclosure (AH15). While the swallow hole depicted on the historic map may represent a natural geological feature, it is also possible that it marks the location of a souterrain, with a possible enclosure site fossilised in the curve of the field boundary (AH46). Given the intensive cultivation of the fields in this area in the past, it is possible that there were further ringforts and souterrains situated along this south-facing ridge, of which there is now no surface trace. In addition, the sites of four pre-1840s structures lie within the proposed M28 Road Project (AH38, AH4, AH52 & AH66). The proposed M28 Road Project also traverses the earthen-bank and hedgerow boundary between Shanbally and Barnahely townlands and Liscleary and Barnahely parishes (TB15).

15.3.4.11 Barnahely Townland (Figures 15.1f, 15.1g, 15.1h, 15.2, 15.3, 15.12 to 15.14)

Physical Environment

The large townland of Barnahely, is located in the parish of Barnahely and the barony of Kerrycurrihy. The townland, which is located between Monkstown Creek in the north and the Owenboy River in the south, is dominated by pasture with some tillage fields. In the past, however, the land has been largely arable; Lewis describes the parish of Barnahely in 1837 as being 'almost entirely under tillage... [with] no waste land [and] a tract of marshy land on the estate of Castle-Warren [that] has lately been reclaimed and is now applied to grazing'. This tallies with the findings of the field survey, where the majority of pasture fields encountered were found to have a level ground surface typical of previously ploughed fields. The topography is gently undulating, with a ridge of higher ground that runs through the townland and highpoints of 50m OD, such as the rocky outcrop occupied by Castle Warren.

The landscape is noticeably impacted by the level of industrialisation in the area, which is influenced by proximity to Cork Harbour and Ringaskiddy Port. Pylons carrying 110kV cables cross the townland from the substation at the Shanbally/Barnahely townland boundary (TB15), roughly along the line of the proposed M28 Road Project (**Plate 15.31** in **Appendix 15I**). The Barnahely Substation is located just southeast of the proposed Shanbally Interchange, which occupies much of a large arable field. To the east of the R613 road, a large wind turbine has been erected to the rear (west) of the expansive site occupied by Janssen Biologics Ireland, both of which are located immediately north of the proposed road project. Another very large site immediately south of the proposed M28 Road Project is occupied by Novartis, a pharmaceutical company. Further south, on the west side of the R613, are modern farm buildings and a manufacturing plant (Carbon Group Ltd).

The townland includes the highest number of recorded archaeological sites / monuments in the study area (**Figures 15.1f & 15.1g** in **Volume 5**), including the site of a gate lodge (CO087-05002, AH19), a recorded enclosure site (CO087-106, AH26), a graveyard and church site (CO087-05101 & 02; AH20), a tower house and bawn and the site of an ornamental tower (RMP CO087-05201 & 03, -052002, RPS 01260; AH 22 / BH11). The townland also contains the former demesnes of three large 18th century houses, Prospect Villa (BH6; no trace of the house surviving), Ballybricken (BH13; no trace of the house surviving) and Castle Warren (RPS 01260, RMP CO087-05201; BH11 & AH22).

Cultural Landscape

Barnahely Townland (West of Castle Warren)

The proposed M28 Road Project crosses east from Shanbally into the very large townland of Barnahely, the name of which dates to as early as c. 1301 (*www.logainm.ie*). The proposed Shanbally

Interchange extends north and south across the Shanbally/Barnahely townland boundary (TB15, which also forms the boundary between the parishes of Carrigaline and Barnahely).

The proposed Shanbally Interchange traverses an area depicted as a cluster of properties on the first edition OS map, named 'The Kennel' (AH50). The irregular grouping of structures and yards access the fields to the south and east via by two laneways or tracks (**Figure 15.12** in **Appendix 15I**). Some of the buildings have disappeared by the time of the revised edition OS maps, while the associated laneways / tracks have been truncated. The settlement cluster lies immediately south of demesne lands that form part of the Ballybricken estate to the north (BH13). Bearing in mind the name (The Kennel) associated with the remaining structures, it is possible that some of these structures were once operated as kennels by the Ballybricken estate. Certainly at the time of Griffith's Valuation in the 1850s, the houses and land were being leased from Daniel Connor Esq. of Ballyhemiken House (*www.askaboutireland.ie/griffith-valuation*). A broad thoroughfare, c. 20m wide and c. 700m long, with trees lining each side is depicted on the first edition OS map (1841-2), immediately north of The Kennel (AH50). This is an unusual feature, as it does not form part of the pleasure walks associated with Ballybricken estate (no footpath indicated), nor is it a carriageway or entranceway (no associated entrance to the estate is shown here). While it is possible that it fossilises a former entrance avenue (entrance since removed), it is also possible that it formed an exercise area or racing area associated with The Kennel. The entire area now comprises one large arable field crossed by pylons, with crop stubble obscuring the ground surface, and a new road accessing the Janssen plant forming the northern field boundary (**Plate 15.30** in **Appendix 15I**). There was no visible surface trace of any of the features depicted on the historic OS mapping.

The southern boundary of this field forms the Barnahely/Shanbally townland boundary as well as the Carrigaline / Barnahely parish boundary (TB15); the area around the boundary is very overgrown and the land immediately south has been quarried out (within Shanbally townland, in the location of the proposed Shanbally South roundabout). A small structure in a rectangular garden plot is depicted on the first edition OS map just west of the Prospect Villa demesne; there is no surface trace of the structure; the plot lies within the proposed CPO (AH21, **Figure 15.14** in **Appendix 15I**; **Appendix 15B**).

From here the proposed M28 Road Project crosses into the former demesne of Prospect Villa (BH6), a substantial country manor depicted on the first edition OS map, along with associated gate lodge and entrance avenue off the Shanbally road and a walled garden in its south-eastern corner (a small structure, possibly a gardener's cottage, is attached to the north-western side of the garden; neither is upstanding and the site of the walled garden, AH60, lies partly within the proposed CPO). The RMP files record another gate lodge associated with Prospect Villa (CO087-050002, AH19), which is depicted on the later 19th century revised edition OS map (having replaced the earlier lodge to the northwest); the site lies partially within the proposed CPO. The lodge is depicted on the late 19th century 25-inch edition OS map as a pair of small structures situated either side of an entrance way, at the demesne boundary (**Figure 15.13** in **Appendix 15I**). The structures were described in 2009 as a pair of hexagonal gate lodges (*CRDS 2009*); the site is now occupied by material mounded up along the dense field boundary, completely covered in vegetation. There was no visible trace of the recorded structures, though it is possible that above-ground foundation remains may survive that are obscured by vegetation and, if not, it is likely that remains of the structures survive subsurface.

Prospect Villa house and most of the associated features depicted on the historic OS maps have been removed, with a large part of the former demesne now occupied by the Janssen plant and a smaller factory on its east side. The only extant upstanding demesne features are boundary walls: the external stone boundary wall that survives in part along the north side of the Barnahely Road

and also along the southwestern demesne boundary where it is mostly obscured by furze (BH10, now a field boundary; the proposed CPO is c. 20m north of the surviving stretch of walling); and an internal stone demesne wall (BH22, now a field boundary) which is traversed by the proposed M28 Road Project (**Plates 15.32, 15.33 & 15.2** in **Appendix 15I**).

A recorded enclosure site (CO087-106, AH26) is located c. 30m northeast of the proposed CPO (measured from the edge of the ZAP for the RMP site; measurement to edge of visible outer bank is c. 40m). The site was first identified as a cropmark on Cambridge University Aerial Photograph No. AIE 62, from which it was described as a bivallate circular enclosure (int. diam. c. 54m; ext. diam. c. 75m; *RMP file*). The site is not visible on most of the available aerial imagery, but an aerial photograph provided by TII Project Archaeologist Ken Hanley clearly shows the monument (**Figure 15.23**), suggesting a bi-vallate ringfort-like enclosure that is substantial in size, with external measurements of c. 70 m by 64 m. Given that the visible outer ditch of the bivallate enclosure is just c. 33m to the northeast of the CPO, there is the possibility that associated field enclosures or other features relating to the monument may extend within the proposed CPO.

A recorded ringfort is depicted on the historic OS mapping, appearing as a sub-circular enclosure (CO087-048; AH37. RMP ZAP c. 85m south of the proposed CPO & c. 115m from outer bank of ringfort to CPO). The monument stands within a large pasture field and is well-screened by its setting and the mature field boundaries. It occupies the same ridge of high ground as the ringforts noted to the west in Shanbally townland, with the sites of another three ringforts and souterrains recorded in Raheen townland (in the grounds of the Novartis pharmaceutical company) to the southwest (CO087-046 to -048 & CO087-102 to -104). The ringfort (CO087-048, AH37) was subject to archaeological testing in 2012 (Licence Ref. 12E0109), carried out to inform a potential research project, with additional investigations including geophysical survey (Licence Ref. 11R0115), topographical survey and metal-detecting (Licence Ref. 12R0040) of the entire ringfort site. In spite of modern disturbance in the interior, the testing confirmed the presence of structures within the north-east quadrant and also revealed a pit, two quern stones, possible hearth or kiln and two dry-stone lined linear features that were cut into the subsoil. The full extent of the linear features could not be ascertained but they have been tentatively interpreted as the possible remains of at least one souterrain (*Online Excavations Bulletin Ref. 2012:096*). This is significant in terms of the surrounding archaeological landscape of the study area, as it confirms the pattern of ringfort and associated souterrain seen, for example, in Shanbally townland. It also highlights the possibility that other previously unknown souterrains may survive below ground elsewhere in the townland and along the proposed road project. In addition to the recorded ringfort (RMP CO087-048) with possible souterrain, archaeological testing to the west and northwest of the monument in 2004 (in advance of a proposed factory development) identified two corn-drying kilns and a burnt spread (now designated as SMR sites CO087-145, CO087-146, CO087-156; AH37). The proximity of the kilns to the ringfort (c. 10m west) suggests an early medieval date but archaeological excavation would be necessary to confirm this (Cummins 2007, cited in SMR file CO087-156 & -146).

Barnahely Townland (Castle Warren)

The proposed M28 Road Project traverses the former demesne lands associated with Castle Warren (BH11, RPS 01260), c. 43m north of the protected structure and clips the northern boundary of the RMP zone of archaeological potential for the tower house and bawn, c. 43m north of the upstanding remains (AH22, RMP CO087-052). The proposed road runs east/northeast as a single-carriageway between Castle Warren and the recorded church and graveyard (AH20) and continues through an expansive arable field within the former demesne (formerly two separate fields on the first edition OS map; Chainage 11000-11250; **Figure 15.14** in **Appendix 15I**).

The substantial 18th century country house (Castle Warren, BH11), which incorporates the remains of the late medieval castle, is depicted on the first edition OS map on the eastern side of the Shanbally / Ringaskiddy road junction, along with a gate lodge (AH13), a series of outbuildings, courtyard (bawn), orchard and walled garden (AH22). Although the demesne associated with Castle Warren is delineated on the first edition OS map by the Ringaskiddy/Carrigaline road along the west and a smaller, public road along the southwest and south, it is likely to have once extended across these roads to incorporate the fields containing the gate lodge (AH13) and walled garden that are also depicted on the first edition OS map (**Figure 15.14** in **Appendix 15I**).

The tower house and church site / graveyard at Barnahely were once linked historically, with the church presumably serving the occupants of the castle. This association had been lost by the beginning of the 18th century, if not before (see below & **Appendix 15A**), and the immediate setting of both sites has greatly altered over the ensuing centuries.

The first edition OS map shows a carriageway curving around from the east side of the house before branching to the west and north. The western carriageway leads to the gate lodge and curved entrance at the western corner of the estate. The second carriageway branches northwards, passing east of the graveyard and site of Barnahely Church (CO087-05101 & 02, AH20) and continuing to a secondary entrance to the estate at its north-eastern corner (thus accessing Ringaskiddy village). Given the antiquity of the castle and church site and their important temporal and spiritual connection, it is possible that the line of the northern-branching carriageway partially preserves the line of an original route linking the two sites. By the time of the first edition OS map, that direct connection appears to have been already lost, though it is possible that this occurred some time previously; the church is noted as being in much need of repair in the 1640s (and may have already fallen out of use) and was in ruin by 1700. There is no surface trace of this carriageway / pathway in the field of rough pasture on the northwest side of the castle (**Plates 15.35** and **15.36** in **Appendix 15I**), though a faint line can be seen in aerial photography from 2000 (www.maps.osi.ie). Archaeological testing undertaken in the field between between Castle Warren tower house and bawn (CO087-052, AH22) and the church site / graveyard to the north (RMP CO087-051, AH20) did not identify the path nor did it reveal any features that could be directly associated with either the castle or the church site (Hanley, Licence Ref. 04E0774 & *Pers. Comm*. February 2015; Cf. **Section 15.3.2.5** for discussion of a ditch uncovered in this area).

Views of Castle Warren from the east are marred by the presence of large factories, manufacturing plants and pylons (**Plate 15.37** in **Appendix 15I**). The line of pylons also dominates the views to the north/northeast, with modern housing also visible in this direction. The best views from the castle are away from the proposed road development, over the undulating fields sweeping down to Loughbeg to the southwest and extending to the south (**Plate 15.38** in **Appendix 15I**). The architectural assessment undertaken in 2005 noted that the retention of this visual connection between Castle Warren and Lough Beg was important, both in terms of visual amenity and also the historical relationship between the two (the castle would appear to have been originally constructed to protect this inlet of Cork Harbour; *Cronin 2005*). The setting of the medieval tower house on a height was undoubtedly a strategic decision, but there is no doubt that the creation of a formal demesne in the 18th century took full advantage of the extensive views and sweeping landscape. One example of this is the former belvedere tower (of which no surface trace survives) constructed a short distance south of the house (CO087-052002; AH22); such structures were architectural features of demesne landscaping, designed to take advantage of fine or scenic views within the grounds of an estate ('Belvedere' derives from Italian, meaning 'fair view'). The tower appears on the first edition OS map as a small square structure and is indicated as 'Turret' on the late 19th century 25-inch edition (**Figures 15.13** and **15.14** in **Appendix 15I**).

The setting of the former demesne (BH11) has been almost completely degraded – with the only original feature being the ruinous remains of the country house itself – though the surviving views to the south/southwest and the large undulating fields give a glimpse of its former character. The partly industrial and residential surrounds detract from the setting of the protected structure and RMP site. Small sections of stone walling (BH23, **Plate 15.4** in **Appendix 15I**) were visible along the former eastern demesne boundary, which is traversed by the proposed road project. These were mostly low in height and of dry-stone wall construction, more typical of a simple field boundary than a formal demesne boundary wall. Although one section was considerably higher and of mortared random-rubble construction, it appears to have been rebuilt at some stage in the past; this section lies outside of the proposed road project. An unusual kink in the boundary wall is depicted on the first edition OS map and the subsequent editions up to c. 1926-37 (AH65; Chainage 11250). The wall was straightened out some time in the 20th century and there is no visible surface trace of the earlier line of the boundary (Cf. AH65, **Appendix 15A** for results of archaeological testing in this area).

A modern breeze-block wall surrounds the later extensions to the original graveyard site (visible behind the pylons in **Plate 15.37** in **Appendix 15I**). There is no sense of the antiquity of the site from the exterior or indeed the presence of a former church site, when within the former demesne (the presence of an old graveyard at least is evident from the R613 road). It has the appearance of a later 20th century cemetery, rather than a medieval church site and burial ground. The first edition OS map shows a small rectangular graveyard with the possible outline of the ruined church drawn in the northeast corner (**Figure 15.14** in **Appendix 15I**). By the time of the 25-inch OS edition in the later 19th century, the graveyard had been extended to the northeast (**Figure 15.14** in **Appendix 15I**). During the 20th century, the graveyard was again extended, with an additional burial area created to the northeast along the roadside. Two further extensions between 2000 and 2005 to the east mean that the present cemetery is more than three times the length and width of the original small graveyard, which serves to dwarf and obscure the medieval site. In addition, a small yard enclosed by hedgerow now sits on the south side of the old graveyard, with sheds built up against the graveyard boundary.

From the interior of the original medieval graveyard, in the southeast corner of the modern cemetery, the antiquity of the site is evident in the higher ground level, old headstones and the mature yew trees growing close to a raised rectangular platform, possibly the site of the old church (**Plate 15.40** in **Appendix 15I**). There are some restricted views of Barnahely Castle / Castle Warren from the church site, with mature trees both inside and outside of the graveyard (**Plate 15.40** in **Appendix 15I**). It is not clear, however, that a visual link between the two sites would ever have been of primary concern; churches and graveyards commonly have an enclosed aspect and insular focus, rarely being designed to take in views of the surrounding landscape. The first edition OS six-inch map (1841-2) and subsequent revised editions show the Barnahely to Ringaskiddy Road (R613) running along the western graveyard boundary; this road was widened in the later 20th century and the proposed road project CPO is aligned with the new road. The recorded church site and earlier graveyard are now enclosed within a larger, modern cemetery.

It is not known whether the land immediately surrounding the castle was landscaped during the 17th (or earlier 18th) century. Unlike the expansive naturalised parkland of later demesnes (from the 1740s onwards), 17th century landscape design tended to be formal and symmetrical, in the immediate vicinity of the house, with a focus on geometrical shapes (common elements included tree- or shrub-lined avenues and allées, parterres, knot gardens and bowling greens). No such elements are fossilised in the 19th century Castle Warren demesne (as represented on the first edition OS map) and none were identified during archaeological testing along the proposed route in

this area. While this may indicate that there was never any formal landscaping design pre-1700, it is possible that all surface trace of such features has simply been removed.

Barnahely Townland (East of Castle Warren)

The proposed M28 Road Project leaves Castle Warren demesne and continues east through two long narrow pasture fields (Chainage 11250-11500) (**Plate 15.41** in **Appendix 15I**). The fields are depicted almost in their present form on the first edition OS map, with the exception of an additional field boundary subdividing the eastern field, creating a smaller field at its north end. A lane or pathway (AH47) is shown running roughly along the line of the present dividing north/south field boundary before crossing east/west through the eastern field, where a small structure is depicted on its north side (AH23; within the proposed road project), then turning north along the Barnahely/Loughbeg townland boundary (**Figure 15.14** in **Appendix 15I**). At its south end, the footpath terminates at a small L-shaped building in a large plot. This is most likely a school house (it has been enlarged and named 'Ringaskiddy School' on the 25-inch edition OS map) with the footpath providing access from the village of Ring (Ringaskiddy) depicted to the north. By the time of the revised edition OS maps, the slightly meandering footpath has been replaced by a simple field fence, with a new pathway created along the opposite (eastern) field boundary to provide access to the school, and the small structure to the north has disappeared. There was no visible surface trace of either feature in the field.

There is no indication on the historic mapping of the enclosures and other features revealed through geophysical survey and archaeological testing in the two fields either side of the Castle Warren demesne boundary (CO087-155, AH33 & AH48; described in **Section 15.3.2.4**). A faint crop mark is visible in the aerial photograph of the probable ringfort and it is identifiable in the field as a curved, slightly raised plateau on the highest point in the field (www.maps.osi.ie; **Plates 15.39** and **15.41** in **Appendix 15I**).

Archaeological Potential

The archaeological potential within the proposed CPO in Barnahely townland is high. It includes two areas of known archaeological significance identified through geophysical survey and confirmed by archaeological testing to the northeast of Castle Warren: the recorded enclosure site SMR CO087-115 (AH33) and the newly identified possible bi-vallate ringfort, a possible ring-ditch, parts of a second large enclosure and early field system, and a cluster of pits in the adjacent field (AH48).

The recorded site of the former Prospect Villa gate lodge lies partially within the proposed CPO (RMP CO087-050002, AH19). In addition, a specific area of archaeological potential (AH17) has been identified within the proposed CPO in the former Prospect Villa demesne where the proposed M28 Road Project is in proximity to a recorded ringfort, souterrain, kilns and burnt spread (AH37, c. 85m south). Archaeological potential is also high at the western end of the townland where the proposed road project is in proximity to a recorded enclosure site (AH26).

A number of structures or features depicted on the first edition OS map (within the proposed CPO) are no longer upstanding and there is the potential that remains associated with them may survive subsurface: the settlement cluster named 'The Kennel' (AH50); a small structure (AH21) just west of the former Prospect Villa demesne; the site of the walled garden (AH60) within the former Prospect Villa demesne; a kink in the demesne boundary wall (AH65); and a small dwelling and lane or pathway (AH23 & AH47) to the east of Castle Warren demesne. The site of the former Castle Warren

gate lodge (AH13) lies c. 6m west of the CPO; the associated curved entrance way opposite the lodge lies partly within the CPO.

15.3.4.12 Loughbeg Townland (Figures 15.1g, 15.15 to 15.17)

Physical Environment

The townland of Loughbeg is located in the parish of Barnahely and the barony of Kerrycurrihy. The land is generally low-lying, sloping up towards a highpoint of 43m OD in the neighbouring townland of Ringaskiddy. The townland is bounded to the south by a small inlet, 'Lough Beg' or small lake, which gives the townland its name, and is roughly bisected by the north / south line of Old Post Office Road. The field boundaries consist predominantly of earthen banks covered in mature hedgerow, as does the Barnahely / Loughbeg townland boundary (TB16). The one exception to this was a boundary wall of dry-stone construction (BH19) dividing two of the small pasture fields on the west side of Old Post Office Road, which once formed part of the property associated with Rose Lodge in Ringaskiddy village (BH2). The boundary between Loughbeg and Ringaskiddy townlands has been replaced with a new road leading south from the coast road, providing access to new housing developments and two large industrial plants further southeast. The proposed M28 project crosses a number of relatively flat, level pasture fields, generally devoid of features, and through the grounds of an unoccupied industrial / business park.

Cultural Landscape

The proposed M28 Road Project continues eastwards from Barnahely townland into the narrow townland of Loughbeg. The first edition OS map shows the area subdivided into a network of small fields, through which the proposed M28 Road Project travels before crossing the public road running south from Ringaskiddy (named Post Office Lane on the 25-inch OS edition). One of the fields (Chainage 11750) appears to be associated with Rose Lodge, a property to the rear of 'Ring' village (Ringaskiddy), comprising a house, outbuildings, walled garden and entranceway (BH2; **Figure 15.15** in **Appendix 15I**). The small rectangular field or paddock is separated from the principal property plot, however, and no features are depicted within it on the historic maps. Field survey identified a boundary wall of dry-stone construction dividing two of the small pasture fields on the west side of Old Post Office Road (BH19); the wall aligns with the boundary along the west side of the paddock associated with Rose Lodge and is probably the remains of an original property boundary associated with the house (**Plate 15.42** in **Appendix 15I**). Rose Lodge survives into the early 20th century, but is depicted as a much smaller structure on the revised edition OS map of the 1930s and is now in ruins. This small stretch of wall represents a rare survival in this area of vernacular features associated with the rural landscape, such as boundary walls, gates, gate posts etc. It is an attractive feature of the built heritage in this area and is of local heritage interest.

Several small structures are grouped together on Post Office Lane on the first edition OS map (**Figure 15.15** in **Appendix 15I**), one of which lies within the proposed CPO (AH25; this structure is no longer upstanding). The structures have been greatly altered by the time of the 25-inch OS map (1897-1904; **Figure 15.16** in **Appendix 15I**); either enlarged or entirely replaced by larger structures. The ruins of one of these structures (BH9) survives within the plot boundaries, although it is entirely obscured by vegetation (**Plate 15.43** in **Appendix 15I**); the structure lies outside of the proposed CPO, c. 20m south. The first edition OS map also depicts scattered housing strung out along the east/west local road to the south; six of these structures, none of which are upstanding, are located within the proposed CPO (AH24, AH55 to AH59; **Figure 15.15** in **Appendix 15I**).

Continuing further eastwards, the proposed M28 Road Project passes through a series of neat fields arranged to the rear (south) of Rock Cottage (BH4; **Figure 15.15; Plate 15.44** in **Appendix 15I**). The fields slope steadily down to north, towards the sea, with new housing along the north boundary, within the former grounds of Rock Cottage. A house is shown on the site of Rock Cottage on the first edition OS map and later 19th century revised edition, with a similar footprint (and also named Rock Cottage on the later map); it is located on the seafront within Loughbeg townland and appears to be one of the more substantial properties in Ringaskiddy at the time (BH4). According to the NIAH Building Survey much of the building's fabric appears to date from the first decades of the 20th century, at which time it may have been rebuilt or renovated (NIAH Ref. 20987045). The now-derelict cottage is not visible from the proposed road project, being set well downslope and clustered within both 19th century and modern housing development, and screened by existing field boundaries. The proposed M28 Road Project crosses a lane depicted on the first edition OS map (AH51; **Figure 15.15** in **Appendix 15I**) accessing a small structure to the south of Rock Cottage; the structure does not lie within the proposed road. Although the structure and access lane are depicted on all of the historic OS maps, there is no surface trace of either; the arable fields to either side of the laneway are under crop stubble, with a wide access gap in the hedgerow field boundary that separates them (**Plate 15.45** in **Appendix 15I**). Large mounds of soil and vegetation have been dumped at either end of the western field.

A second structure listed in the NIAH is located in Loughbeg townland, within Ringaskiddy village. Ringaskiddy Oratory (NIAH 20987044) was not constructed until 1923 and appears on the revised edition OS six-inch map (1927-36); as with Rock Cottage, the structure fronts onto the coast road and is not visible from the proposed road project.

Archaeological Potential

The sites of seven pre-1840s structures lie within the proposed CPO in Loughbeg townland (AH24, AH25, AH55 to AH59). Although none of the structures is upstanding, it is possible that features relating to them may survive subsurface. The proposed M28 Road Project will also traverse the earthen-bank boundary between the townlands of Barnahely and Loughbeg (TB16). In addition, the proposed M28 Road Project travels through previously undeveloped greenfield, towards the east end of the ridge of higher ground that extends from Shanbally to the west, with good views over Cork Harbour and the estuary. The inherent archaeological potential of greenfield areas is increased by the topography, with a prevalence of ringforts, enclosures and souterrains recorded elsewhere along this elevated contour in Shanbally and Barnahely townlands. The area has been intensively cultivated in the past and continuous ploughing would have destroyed any upstanding archaeological sites or features that may once have been present. There remains the possibility that previously unknown archaeological sites or features may survive below ground.

15.3.4.13 Ringaskiddy Townland (Figures 15.1g, 14.15 & 14.17)

Physical Environment

The townland of Ringaskiddy is located in the parish of Barnahely and the barony of Kerrycurrihy, at the eastern limit of the proposed road, where it connects to Ringaskiddy Port and to the proposed Service Area. The landscape is dominated by an east-west trending ridge of land, which rises to a maximum height of 43m OD. The land is predominantly in pasture, with some rough ground on the northern slopes of the ridge; the proposed road crosses from the level fields along the port road, through these slopes (**Plates 15.47** and **15.48** in **Appendix 15I**). It passes close to the Martello Tower, which is located on the crest of the ridge and takes strategic advantage of the extensive

views over Cork Harbour and Spike Island (**Plates 15.49** and **15.50** in **Appendix 15I**). The Martello Tower is the only protected structure recorded in the vicinity of the proposed M28 Road Project in Ringaskiddy townland and is also a recorded archaeological monument (RMP CO087-053 / RPS 00575, AH35 / BH1).

Extensive tracts of land within the townland are given over to industrial development, such as the car lot within which the proposed service area is partly sited. There has been a significant amount of land reclamation along the coastline, with the original shoreline some 340m inland of its current location.

Cultural Landscape

The proposed M28 Road Project crosses the Loughbeg/Ringaskiddy townland boundary (TB17) and runs eastwards through the townland. The most prominent feature on the first edition OS map is the Martello Tower, set in its wide circular fosse. The Martello Tower (AH35 / BH1) has extensive views over the estuary to the north and is relatively well screened by the topography of the surrounding fields and the field boundaries and the proposed M28 Road Project will be in fill where it crosses to the north of the tower. There are extensive views over the estuary from the tower.

A former road or track (AH54; crossed by the proposed road project) leads south from the coast to the Martello Tower, cutting through a patchwork of small fields to provide direct and easy access from the seafront at the village to the tower (**Figure 15.15** in **Appendix 15I**). It is possible that the road / track was constructed to access the Martello Tower in the early 19th century. Alternatively, it may be that this was an existing route that led from Ringaskiddy, pre-dating the construction of the Martello Tower (e.g. a drover's road to the pastures above the village). The line of the road / track is still partially visible as a cropmark in aerial photographs to the east / southeast of the proposed road (www.maps.osi.ie), but there was no surface trace visible during the field survey. Where the proposed M28 Road Project crosses it (Chainage 12250), the line of the former road runs along the southern edge of an area of dense woodland.

The location of the proposed Service Area is on reclaimed land, shown as an area of sands, mud-flats and estuarine water on the first edition OS map (**Figure 15.15** in **Appendix 15I**), just north/northeast of the village of Ring (now Ringaskiddy). The village proper (as named) is located within Loughbeg townland, though there are two additional clusters of settlement along the seafront to the east/northeast and west. By the time of the revised edition OS maps in the late 19th/early 20th century, the location of the proposed Service Area is little changed, remaining within the mud-flats of the foreshore. In contrast, there has been quite a significant change along the seafront. The majority of the jumble of small dwellings depicted on the earlier map to the east/northeast of the village have been removed and the land cleared for Ring House (depicted but not named; NIAH 20987046, BH3; **Figure 15.17**; **Plate 15.52** in **Appendix 15I**). The large farmhouse is set well back from the coast road in a long narrow plot that is situated centrally within a much larger field, with a straight entrance avenue running from the road to the house. The proposed M28 Road Project passes through the low-lying level field in which the house and its plot are situated (c.45m southeast) and continues along the ridge of high ground. It runs to the rear (south/southwest) of the house, which is not very well screened by its existing boundaries. There has been further development in and around Ringaskiddy Village (now named as such), with new properties infilling former open fields.

Archaeological Potential

The proposed road crosses the low-lying level fields of rough pasture along the south side of the coast road that are depicted on the first edition OS map as open field along the sea-front, with no change on subsequent historic OS maps. Given the topography and the reclamation of the mud flats along the foreshore in the 20th century, it is possible that this low-lying area at the base of the high ridge to the south also formed part of the foreshore in the past. This land has an inherent archaeological potential, given its position at a wetland / dryland interface (AH49). The proposed road project also crosses the line of a road depicted on the first edition OS map (AH54; **Plate 15.51** in **Appendix 15I**), possibly an access road associated with the Martello Tower, though it may also be earlier routeway.

The archaeological potential of the wetland / dryland interface (AH49) is also relevant to the proposed Service Area of c. 1.77Ha, which is located in the Port of Cork lands to the east of Ringaskiddy village. It occupies part of the vast tarmac-surfaced car lot of National Vehicle Distribution Ltd, as well as a greenfield site to the east. As is evident from the cartographic analysis, the land on which it sits has been reclaimed; from at least the early 19th century, this area lay north of the former shoreline, within the sands, mudflats and water of the River Douglas estuary. The topography depicted on the first edition OS map (1841-2) remains unchanged on subsequent revised editions until 1927-34, with the land reclaimed sometime after this (AH49). Aerial photography from 1995 shows the land to be undeveloped, rough pasture, with the car lots expanding into part of the proposed Service Area site between 2000 and 2005 (www.maps.osi.ie). As there has been no major structural development within the brownfield part of the site, any modern disturbance to this area may not extend far beneath the current surface. Given that this land was reclaimed, it is also possible that there is a considerable depth of reclamation material, which may overlie any archaeological deposits that may be present. The archaeological potential of wetland/dryland interface is particularly high, with preservation levels in former mudflats being potentially good for organic material. The number of middens recorded elsewhere around the Ringaskiddy and Curraghbinny peninsula suggests a high level of coastal activity in this area from (possibly) as early as the prehistoric period onwards. This further increases the archaeological potential of the proposed Service Area site.

There are no other specific areas of archaeological potential within the proposed M28 Road Project in Ringaskiddy townland, however, the proposed road travels through previously undeveloped greenfield, at the east end of the ridge of higher ground that extends west from Ballyhemiken, with good views over Cork Harbour and the estuary (Chainage 12020-12300). The inherent archaeological potential of the greenfield areas is increased by the topography, with a prevalence of ringforts, enclosures and souterrains recorded elsewhere along this elevated contour in Shanbally and Barnahely townlands.

15.3.5 Results of Visual Structural Inspection, Castle Warren

A visual structural inspection of the Castle Warren ruins was carried out in March 2017 by a Chartered Structural Engineer in order to assess if the proposed roadworks might have an adverse effect on the structural integrity of the remaining ruins (See **Appendix 15H** for full report and photographs).

The ruins that currently exist (ruins to the west were apparently demolished in the 1980s) measure approximately 32m x 32m on plan, and enclose a central courtyard approximately 20m x 16m. No floors remain, but evidence of intermediate floors exist, with corbels and spaces for floor joists

visible in many areas. The ruins appear to have been used for farming purposes in the recent past, with mass concrete walls dividing some rooms, and a significant concrete wall at the northern end of the ruin. A portion of the courtyard also appears to have a mass concrete slab bearing on the ground.

The majority of the visible / accessible structure appears to be in relatively good condition, given its age, and the fact that the ruin has not been maintained to any degree. The majority of areas of deterioration are to be expected, such as where timber lintels have rotted away, resulting in the masonry overhead beginning to collapse. These collapses will continue until they are addressed.

Vegetation growth is also a significant issue throughout the ruin. Creeping vegetation such as ivy etc. makes its way into the joints, breaking mortar, resulting in masonry units becoming unbonded, and susceptible to failure. It is likely that the vegetation growth is aiding holding the structure together at this stage. Any plans to remove vegetation should involve immediate repointing of all masonry joints with a suitable mortar (likely lime mortar mix).

There are areas that are cause for concern; these more vulnerable areas are generally associated with the higher parts of the ruin to the east and south. The primary area of concern is the wall between areas 4 and 5 (Cf. **Appendix 15H**). This is a significant ope, with considerable load overhead. There is no lintel apparent (it is not clear if there was ever an original ope here). Also, there is significant masonry loss to the walls below the bartizan. Again, it is not clear as to why there is so much loss in such a local area.

In terms of the proposed roadworks, it is proposed to import fill to raise the levels 2 - 3.5m over the existing levels. The closest the proposed roadworks (bottom of the embankment) will be to the ruin is approximately 50m. Given that there is no excessive excavation required, and there will be no rock-breaking in the area etc., it is likely that vibrations from the works will be solely from normal plant movement and compaction machinery. Given the distance between the works and the ruin (c. 50m), it is unlikely that any significant vibrations will travel as far as the ruin. However, there are likely to be collapses at the ruin in the future (similar to the collapses that have happened in the past). These collapses may occur with or without the proposed M28 Road Project.

15.4 POTENTIAL IMPACTS

The determination of the impacts is assessed with reference to the Glossary of Impacts provided in *the Advice Notes on Current Practices in the preparation of Environmental Impact Statements, EPA, 2003, Guidelines for the Assessment of Architectural Heritage Impact of National Road Schemes, NRA, 2006 and Guidelines for the Assessment of Archaeological Heritage Impact of National Road Schemes, NRA, 2006*. The overall level of impact is calculated by assessing the sensitivity/ significance of the asset (i.e. baseline rating) against the magnitude of the impact producing an overall significance rating (**Appendix 15D**).

Details of each asset is contained in the inventories of archaeological, architectural and cultural heritage in **Appendices 15A-15C**, which also provide the locations of the assets, distance from CPO, impact magnitude, baseline rating, type and quality of impact, and mitigation measures.

Summary tables outlining impact assessment and mitigation measures are provided at the end of this chapter (**Tables 15.2 & 15.3**).

15.4.1 Archaeological and Cultural Heritage

15.4.1.1 Impacts on RMP & SMR Sites

Direct Impacts on RMP & SMR Sites

There will be a direct profound negative impact on a *fulacht fia* in Shannonpark townland (AH9, RMP CO086-115) and an enclosure site in Barnahely townland (AH33, SMR CO087-155; two sub-circular enclosures, possible early medieval metal-working sites, identified through geophysical survey and confirmed by archaeological testing).

There will also be a direct significant negative impact on two RMP sites: a standing stone site in Ballyhemiken townland (AH10, RMP CO087-113); and the site of a gate lodge associated with Prospect Villa in Barnahely townland (AH19, RMP CO087-05002).

Indirect Impacts on RMP & SMR Sites

There will be an indirect significant negative impact on Castle Warren tower house and bawn (RMP CO087-052001 and -052003, AH22) and the nearby church site and graveyard (RMP CO087-051001 and -051002, AH20) in Barnahely townland. The proposed road will run between the two RMP sites which were once historically linked (Cf. **Section 15.3.4.11**):-

- The proposed CPO clips the northern boundary of the RMP zone of archaeological potential (ZAP) for the tower house and bawn. The upstanding remains of the tower house and bawn are located within the ruined Castle Warren country house, c. 43m south of the CPO and will not be directly impacted.
- The proposed CPO also traverses the zone of archaeological potential (ZAP) for the church site and graveyard, to the west and south of the historic graveyard boundaries as represented on the early 19th century Ordnance Survey mapping. The proposed mainline CPO is c. 20m south of the southern graveyard boundary wall and avoids the church site and associated graveyard. The proposed works along the existing Barnahely to Ringaskiddy R613 road (on the west side of the graveyard) will take place within the roadtake of the existing road and therefore will avoid the boundaries to the graveyard. The proposed road project avoids the known and visible extents of the church site and graveyard, and as such, there will be no direct impact on the RMP site.
- It is possible that features associated with the RMP sites may survive subsurface within the proposed CPO. Archaeological investigation of the area in between the graveyard and tower house has, to date, yielded very little of interest, with no evidence for domestic / settlement activity, no burials, and no features directly associated with either the tower house or the church identified (Cf. Section 15.3.2.5). There is the potential that discrete features may survive within the areas outside of the test-trenches (these may include features associated with pre-1700 demesne landscape, if any were present) or that burials may extend outside of the known graveyard boundaries to the west, beneath the R613 road.
- The proposed road project will also negatively impact upon the visual amenity of the two sites, though the partially industrial nature of the surroundings already detracts from the immediate setting of both sites, as does the large modern cemetery extension to the original graveyard. The proposed M28 Road Project will serve to augment the industrial feel of the area surrounding the sites, by cutting through the surviving agricultural fields within the former

Castle Warren demesne; one of the few remaining rural aspects left in the vicinity. The castle will retain a reasonably sound connection with the rural landscape towards the south, southeast and southwest, where there are still some good rural vistas and where shallow boats most likely once ferried goods to and from the castle. This visual connection between Castle Warren and Lough Beg was significant, both in terms of visual amenity and of the historical relationship between the two (the castle would appear to have been originally constructed to protect this inlet of Cork Harbour).

- In general, the proposed M28 Road Project will open up views to Castle Warren, which is, at present, somewhat hidden in the landscape. The original medieval tower house was constructed on a prominent site, both to capture significant views for strategic purposes and also to be seen, thus allowing it to dominate the local landscape (in much the same way as the later Martello Tower in Ringaskiddy). With the proposed road increasing its visibility once more, the Castle Warren complex has the potential to become a landmark site. This should be considered beneficial in an area where the landscape has been largely stripped of its historic character.

There will be an indirect significant negative impact on three other RMP sites, a *fulacht fia* in Ballinrea townland (AH5, RMP CO087-029), a ringfort site in Hilltown (AH7, RMP CO087-116), and an enclosure site in Barnahely townland (AH26, RMP CO087-106).

There will be an indirect moderate negative impact on six RMP / SMR sites, a standing stone site in Ballyhemiken townland (AH11, RMP CO087-114), a ringfort and souterrain (AH14, RMP CO087-034 and -090) and an enclosure site in Shanbally townland (AH15, RMP CO087-040), a pit in Barnahely townland (AH28, SMR CO087-148) and a Martello Tower in Ringaskiddy (AH35, CO087-053).

There will also be an indirect slight negative impact on a cluster of four RMP / SMR sites in Barnahely townland, a ringfort and souterrain, two kilns and a burnt spread (AH37, RMP CO087-048 and SMR CO087-145, CO087-146, CO087-156).

15.4.1.2 Impacts on Newly Identified Archaeological Sites

One newly identified archaeological site is partly located within the proposed M28 Road Project, AH48 in Barnahely townland, an enclosure complex (including two possible ringforts, as well as an earlier possible ring-ditch), revealed by geophysical survey and partly investigated by archaeological testing. The testing confirmed the presence of a probable bivallate ringfort, field system, and possible prehistoric activity to the east (to the east of SMR CO087-155, AH33). Newly identified archaeological sites are ascribed a medium baseline rating. The proposed M28 Road Project will directly impact upon the probable bivallate ringfort, part of the early field system, a possible ring-ditch, and the northern half of the second large enclosure to the south. It will also directly impact upon the cluster of pits, post-holes and stake-holes.

15.4.1.3 Impacts on Specific Sites / Areas of Archaeological Potential

The assessment of the terrain potential, historic mapping, and aerial photography, along with the examination of the type, density and distribution of archaeological sites within that landscape, give rise to the identification of areas or sites of heightened archaeological potential (baseline rating as yet unknown).

The proposed M28 Road Project will have a direct, negative and potentially moderate / significant impact on any subsurface features which may survive within eight specific areas of archaeological potential that were identified within the proposed CPO:-

- AH16 in Shanbally townland. Presence of two swallow holes (possible location of a souterrain) and proximity to a recorded ringfort and souterrain c. 90m north and recorded enclosure c. 55m south (these two monuments are also connected by a field boundary that runs through the proposed CPO in this area);
- AH17 in Barnahely townland. Proximity to cluster of recorded archaeological sites c.85m south, comprising a ringfort and souterrain, two kilns and a burnt spread. In addition, this land forms part of ridge of higher ground overlooking the Owenboy River to the south, with enclosures and souterrains elsewhere along this elevated contour in Shanbally townland to the west.
- AH40 in Ballinimlagh. A possible burnt spread identified during field survey, which lies partly within the proposed CPO;
- AH46 in Shanbally townland. Swallow hole depicted on the first edition OS map in Shanbally townland, on the south side of an unusual kink or curve in the field boundary at the juncture of three fields. The feature occurs on a ridge of higher ground overlooking the Owenboy River valley, an elevated contour on which three ringforts and a souterrain are also recorded. While the swallow hole may represent a natural geological feature, it is also possible that it marks the location of a souterrain, with a possible enclosure site fossilised in the curve of the field boundary;
- AH49 in Ringaskiddy townland. Former wetland / dryland interface and possible former foreshore and mudflats in Ringaskiddy townland. Wetland provides unusually good preservation conditions for organic materials, such as wood, leather, textiles and human remains. In addition, middens have been recorded elsewhere along this coastline;
- AH53 in Ballyhemiken townland. Former wetland / dryland interface between two recorded standing stone sites;
- AH65 in Barnahely townland. A kink in the otherwise notably straight eastern boundary wall associated with Castle Warren demesne depicted on the first edition OS map. It is possible that the kink in the boundary respected an archaeological site or feature that is no longer in place. A stone cluster identified in archaeological testing may correlate with the removed boundary or may form part of a sub-rectangular enclosure that is suggested by geophysical survey and archaeological testing; and
- AH69 in Barnahely townland. A ditch identified during archaeological testing in the area between Castle Warren tower house and bawn and the church site / graveyard to the north. Provisionally interpreted as an early modern field drain but an earlier date and / or different function has not been ruled out. The orientation of the ditch (AH69) suggests that it continues within the proposed CPO and, if so, it will be directly impacted by the proposed road development.

15.4.1.4 Impacts on Possible Sites identified by LiDAR

Five LiDAR anomalies of archaeological potential were identified within the assessment corridor along the northern half of the proposed road project, one of which (AH29) will not be impacted by the proposed road project. The remaining four (AH6, AH18, AH61, AH62) lie partially within the proposed CPO. Should these anomalies prove to be archaeological in nature, there will be a direct, negative and potentially moderate / significant impact on any subsurface features which may be present.

15.4.1.5 Impacts on Structures / Features Depicted on 1st Edition OS Map ('sites of')

The sites of structures or features depicted on the first edition OS map are ascribed a low baseline rating. Where these sites are directly impacted, it will result in a moderate negative impact.

The proposed M28 Road Project will have a direct moderate negative impact on the sites of 18 pre-1840s structures in the following townlands: Maryborough (AH64), Mounthovel (AH67), Ballyhemiken (AH3), Carrigaline Middle (AH68), Shanbally (AH4, AH38, AH52, AH66), Barnahely (AH21 & AH23), and Loughbeg (AH24, AH25 & AH55 to AH59).

It will also have a direct moderate negative impact on the sites of the following features: a brickfield (AH1) and a gate lodge (AH63) in Monfieldstown townland; a possible millpond in Maryborough townland (AH2); possible mill-race in Ballinrea townland (AH43); the sites of two osieries (AH31 in Hilltown townland & AH45 in Shannonpark townland); and a walled garden (AH60), a former settlement cluster (AH50), and the entrance associated with a gate lodge (AH13) in Barnahely townland.

The proposed road project will traverse five pre-1840s roads or lanes, resulting in a direct moderate negative impact: AH42 in Ballinrea townland, AH44 in Shannonpark townland, AH47 in Barnahely townland, AH51 in Loughbeg townland, and AH54 in Ringaskiddy townland.

A former watercourse in Castletreasure townland (AH8) is also depicted on the first edition OS map. The baseline rating of this site is as yet unknown. There will be a direct, negative and potentially moderate / significant impact on any archaeological features which may be present subsurface.

15.4.1.6 Impacts on Riverine Environs

All riverine environs are considered to have an inherent archaeological potential, having attracted human activity since prehistoric times. A number of streams flow through the study area; this topography and the proximity of streams as a water source is typical of the locations in which *fulachtaí fia* (or burnt mounds) are found, and there are numerous examples of such sites along the banks of the streams in the study area (as well as one within the proposed road). The presence of burnt mounds or *fulachtaí fia* is often indicative of Bronze Age seasonal communal activity in river valleys and boggy ground.

The baseline rating for the watercourses crossed by the proposed road project is as yet unknown. Where sections are impacted, there will be a direct, negative and potentially moderate / significant impact on any archaeological features which may be present subsurface.

The proposed road project crosses six watercourses, two of which are also townland boundaries. Some of the watercourses are crossed more than once (noted below). All of the watercourses are shallow, averaging 0.1m-0.2m in depth:-

- AH30: Glounatouig Stream. Crossed in Hilltown townland;
- AH32: Stream in Shannonpark townland, a small tributary of the Glounatouig Stream, crossed three times.

- AH36: Stream tributary of the Donnybrook Stream, forming the townland boundaries between Maryborough, Monfieldstown, Mounthovel and Moneygourney (Cf. TB1, 2 & 4, Table 15.1). Crossed three times in Maryborough townland;
- AH39: Stream tributary of the Donnybrook Stream, forming the Moneygourney / Castletreasure and Ballinimlagh / Moneygourney townland boundaries (Cf. TB5 & TB7, Table 15.1). Crossed twice, in Castletreasure and Ballinimlagh townlands;
- AH41: Stream in Ballinrea townland, a small tributary of the Glounatouig Stream, crossed once; and
- AH70: Stream tributary of the Donnybrook Stream, forming the townland boundary between Mounthovel and Moneygourney, crossed once.

15.4.1.7 Impacts on Townland Boundaries

The proposed M28 Road Project will directly impact upon 19 townland boundaries. These boundaries are listed in **Appendix 15.E**, which details their physical form and locational information. It also notes where the townland boundaries coincide with barony or parish boundaries (e.g., TB9, TB12, TB14 and TB15). The boundaries take various forms, including streams, roads, and earthen bank with mature tree / hedgerow. The proposed road will remove sections of these boundaries resulting in a moderate impact on cultural heritage features of medium/low baseline rating, causing an overall negative, direct and moderate impact.

15.4.1.8 Impacts on Greenfield Areas

The proposed road travels predominantly through undeveloped agricultural land that is presently a mixture of pasture and arable. The majority of the pasture fields inspected had a level ground surface typical of former ploughed fields, which was confirmed by analysis of aerial photography from the 1990s onwards. This past focus on arable cultivation is also echoed in the documentary sources, with references to large tracts of arable land in the study area contained in the mid-17th century Down Survey and also in Lewis' Topographical Dictionary of 1837. Such agricultural practices tend to obscure any surviving surface archaeology but it is important to note that even if the landscape does not retain surface traces of archaeological remains, it does not mean that it is devoid of archaeological value. This potential is supported by the recorded archaeological sites, stray finds and archaeological investigations along and in the vicinity of the proposed road project, which attest to the importance of the area for settlement since the prehistoric period. There is a potential that previously unknown subsurface archaeological features and finds will be uncovered in greenfield areas along the proposed road project.

15.4.1.9 Impacts on Cultural Heritage – Undesignated Sites

One undesignated site of local cultural heritage interest was identified c. 5m south of the proposed CPO. The mid-20th century grotto (a Marian shrine, CH1) will not be directly impacted by the proposed road. There will be a slight indirect negative impact due to the proximity of the proposed road, which presents a visual intrusion on the site.

15.4.2 Architectural Heritage

15.4.2.1 Impacts on Structures of Architectural Heritage Merit (RPS Sites)

The proposed M28 Road Project will have no direct impacts on any protected structures.

Indirect impacts were identified in relation to two protected structures, 'Castle Warren Stronghouse' in Barnahely townland (RPS 01260; BH11) and the Martello Tower in Ringaskiddy (RPS 00575, BH1), both of which are also recorded archaeological monuments (Cf. AH22 and AH35).

Castle Warren, BH11

The proposed road project will have an indirect significant negative impact upon the protected structure 'Castle Warren Stronghouse' (RPS 01260; BH11). The recorded complex incorporates the remains of the late 18th century country house, Castle Warren, as well as those of the medieval tower house and bawn (Cf. AH22). The protected structure lies c. 43m south of the proposed CPO and will not be directly impacted by the proposed road project.

The proposed M28 Road Project traverses the former demesne associated with Castle Warren. There is only one partially surviving demesne element, the boundary wall, and this will be partly impacted by the proposed road project on the eastern side of the former demesne (see BH23 below). The Castle Warren estate represents a much degraded former demesne landscape, recognised by the NIAH Garden Survey as having virtually no recognisable features. Large agricultural fields to the east and northeast of the house complex occupy the former demesne lands, which are largely free from modern development. Views of Castle Warren from the east are marred by the presence of large factories, manufacturing plants and pylons. The line of pylons also dominates the views to the north/northeast, with the modern breeze-block graveyard wall and modern housing also visible in this direction. These elements of the modern landscape detract from the immediate setting of the protected structure. The best views from the castle are away from the proposed road project, over the undulating fields sweeping down to Loughbeg to the southwest and extending to the south. The retention of this visual connection between Castle Warren and Lough Beg is important, both in terms of visual amenity and also the historical relationship between the two (the castle would appear to have been originally constructed to protect this inlet of Cork Harbour). The setting of the medieval tower house on a height was undoubtedly a strategic decision, but there is no doubt that the creation of a formal demesne in the 18th century took full advantage of the extensive views and sweeping landscape (one example of this is the former belvedere tower constructed a short distance south of the house; Cf. AH20).

While the relative proximity of the proposed road project will have a significant negative visual impact on the protected structure and its setting, it also presents a positive opportunity to open up good quality views into the site from the eastern approach, presenting the principal façade of the 18th century house to large numbers of motorists and tourists.

Martello Tower, BH1

Although the extensive views over the estuary from the Martello Tower in Ringaskiddy will not be significantly affected by the proposed road, an indirect moderate negative visual impact was identified in relation to the site.

15.4.2.2 Impacts on Structures of Architectural Heritage Merit (NIAH Building Survey)

An indirect moderate negative visual impact was identified for Ring House (BH3) in Ringaskiddy village. The proposed M28 Road Project passes through the low-lying level field in which the house and its plot are situated and continues along the ridge of high ground. It runs to the rear (south / southwest) of the house, which is not very well screened by its existing boundaries.

15.4.2.3 Impacts on Demesne Landscapes & Historic Gardens

The proposed road traverses eight former demesnes depicted on the first edition OS mapping: Ballybricken (BH13), Bloomfield (BH14), Mount Hovel (BH15), Maryborough (BH16), Belview (BH17), Broadale (BH18), Prospect Villa (BH6) and Castle Warren (BH11).

Castle Warren (BH11) is discussed above in the context of the protected structure (RPS Site).

The proposed road will have only an indirect imperceptible negative impact on the former demesnes of Ballybricken (BH13), Mount Hovel (BH15), Maryborough (BH16), Belview (BH17), Broadale (BH18), Prospect Villa (BH6). All have been significantly impacted already by modern development and have been given a low baseline rating because of poor preservation and poor survival of contextual associations.

No predicted impact was identified for the former Bloomfield demesne (BH14). Although Bloomfield House, a protected structure (RPS 00476), has retained its immediate setting, there is wide-scale development to the surrounding area, including modern housing in the north-western and southern sections of the demesne, as well as the existing N28 curving through the southwestern side of the former demesne. The proposed M28 road is on-line with the existing N28 road at this point. This part of the former demesne no longer forms part of the setting associated with the protected structure.

The proposed road also traverses the grounds of three pre-1840s houses, Rose Lodge (BH2), Ring House (BH3) and Rock Cottage (BH4), all of which are in Ringaskiddy village:-

- The grounds Rose Lodge (BH2) are largely intact, however, and the field boundaries depicted on the first edition OS map still in place. That being said, there is little sense of a direct association between the fields to the rear of the property and the house itself, which stands in ruin, in a copse of trees. The proposed road will have a direct moderate negative physical impact on a surviving boundary wall to the property (see BH19 below);
- An indirect moderate negative visual impact was identified for Ring House (see NIAH sites above, BH3). The road traverses agricultural fields to the rear of the house, which have no designed landscape or other features within them; and
- With regard to Rock Cottage (BH4), no predicted impact was identified. Although some of the agricultural fields to the rear survive, part of the grounds has been infilled by modern development. These fields no longer form part of the setting of the house.

15.4.2.4 Impacts on Undesignated Sites

Direct Impacts on Undesignated Sites

The proposed road will have a direct moderate negative physical impact on six undesignated sites of built heritage interest identified through field survey and cartographic analysis, all of which have a low baseline rating:-

- BH5: Disused railway line in Ballyhemiken townland constructed c. 1903, associated with a former railway bridge c. 220m south (NIAH site 20987009);
- BH19: A property boundary wall of dry-stone construction (BH19), associated with a pre-1840s house Rose Lodge, both of which are depicted on the first edition OS map (the house is in ruins and will not be impacted);
- BH20: Pre-1840s house now heavily modernised, in Maryborough townland;
- BH21: Demesne wall (internal, Prospect Villa);
- BH22: A section of dry-stone walling and possible culvert in the Ballinrea / Shannonpark townland boundary; and
- BH23: Demesne boundary wall (Castle Warren).

Indirect Impacts on Undesignated Sites

The proposed road will have an indirect slight negative visual impact on two farm complexes depicted on the first edition OS mapping, both of which are still in use: BH7 in Ballinrea and BH8 in Carrigaline Middle. Both sites have a low baseline rating.

15.4.3 Construction Phase

15.4.3.1 Archaeological and Cultural Heritage

Where possible, all archaeological and cultural heritage issues will be resolved at the pre-construction stage of the development. It is possible, however, that some areas will be resolved during construction phase.

The remains of the medieval structures at Castle Warren in Barnahely townland (tower house and bawn, AH22) are in relatively good condition, albeit with some more vulnerable areas (Cf**. Section 15.3.5**). It is unlikely that any significant vibrations during the construction works will travel as far as the ruin. According to the structural engineer's report, there are likely to be collapses at the ruin in the future (similar to the collapses that have happened in the past) with or without the proposed road, as the building has not been maintained to any degree. Vibration monitoring will be undertaken during the construction phase to monitor the risk of any collapses. In the event that vibration levels approach 3mm/s at frequencies below 10 Hz additional appropriate vibration control measures will be implemented to protect the structure.

15.4.3.2 Architectural Heritage

The remains of the 18th century Country House, Castle Warren, in Barnahely townland (BH11) are in relatively good condition, albeit with some more vulnerable areas (Cf. **Section 15.3.5**). It is unlikely

that any significant vibrations during the construction works will travel as far as the ruin. According to the structural engineer's report, there are likely to be collapses at the ruin in the future (similar to the collapses that have happened in the past) with or without the proposed road, as the building has not been maintained to any degree. In order to avoid those collapses occurring during the proposed roadworks, vibration monitoring will be undertaken to monitor the risk of any such collapses occurring. In the event that vibration levels approach 3mm/s at frequencies below 10 Hz additional appropriate vibration control measures will be implemented to protect the structure.

15.4.4 Operational Phase

15.4.4.1 Archaeological and Cultural Heritage

No impacts were identified for the operational phase.

15.4.4.2 Architectural Heritage

No impacts were identified for the operational phase.

15.5 MITIGATION MEASURES

The mitigation strategy outlined below details the procedures that will be adopted to ameliorate the impacts outlined above in **Section 15.4**.

15.5.1 Archaeological & Cultural Heritage

15.5.1.1 Geophysical Survey within the Proposed CPO

A geophysical survey will be undertaken to assess the greenfield lands within the proposed CPO (where not already undertaken), subject to approval by the appointed TII Project Archaeologist in consultation with the National Monuments Service. This work will be carried out by a suitably qualified and competent geophysical archaeologist, under ministerial directions. The survey will be carried out in areas where ground conditions are appropriate; the suitability of land for survey will be ultimately assessed by a geophysical archaeologist.

The survey will also seek to identify whether any archaeological features or deposits survive within the proposed CPO at the following locations (detailed in **Section 15.4** & located on **Figures 15.1a-h** in **Volume 5**):-

- within RMP zones of archaeological potential (AH9 & AH20);
- in close proximity to RMP zones of archaeological potential (AH5, AH7, AH15, AH28, AH26, AH35);
- at specific areas /sites of archaeological potential (AH16, AH46, AH17, AH48, AH65 & AH69, AH40, AH49, AH53); and
- at the locations of structures and features depicted on the first edition OS mapping that are no longer upstanding (AH1 to AH4, AH8, AH13, AH34, AH38, AH21, AH23 to AH25, AH31, AH42 to AH45, AH47, AH50 to AH52, AH54 to AH60, AH63, AH64, AH66 to AH68).

Given the nature of the brownfield site within part of the proposed Service Area (tarmacadam surface), geophysical survey may not be feasible in this location. It is recommended, however, that the use of Ground Penetrating Radar (GPR) will be explored as a means to assess this area. GPR uses pulses of energy to image the subsurface and can be applied on a variety of surfaces including rock, soil, ice, fresh water, pavements, and concrete structures.

15.5.1.2 Archaeological Testing within the Proposed CPO

A detailed programme of archaeological test excavation will be undertaken within the land acquisition area. This will involve the excavation of a centreline test-trench, with off-sets placed at regular intervals. The quantity of testing will, where conditions allow, typically represent a 12% sample coverage of the area being tested. Archaeological testing will be carried out by a team (or teams) of suitably qualified archaeologists, under ministerial directions.

The purpose of this blanket-testing strategy is to help determine the location, date, nature and extent of any previously unknown archaeological sites. The results of the geophysical survey can be used to inform the archaeological test excavation, by incorporating specific areas of archaeological potential that may have been identified by the survey.

Where sites of archaeological significance are identified, due regard will be given to the feasibilty of preserving such remains *in-situ*. Where preservation *in*-situ is not deemed feasible, all features of agreed archaeological significance will, subject to ministerial directions, be preserved by record (by means of archaeological excavation, post-excavation analysis, reporting and dissemination).

Archaeological Excavation (Preservation by Record)

Any archaeological features revealed by the test-trenching, or by any other means, which will be directly impacted by the proposed works, will be preserved by record by means of archaeological excavation, recording and publication of results. This includes the recorded enclosure site (AH33, two sub-circular enclosures, possible metal-working sites) and part of the adjacent enclosure complex (AH48) in Barnahely townland.

Where deemed appropriate by the National Monuments Service (DAHRRGA) archaeological features or sites revealed by the test trenching, which will be directly impacted by the proposed works, may be preserved in-situ (by avoidance or design).

It is anticipated that where possible all archaeological excavation will be completed pre-construction, or if not, then during the early stages of construction phase. This is in accordance with the Code of Practice between the National Roads Authority (now TII) and the Minister for Arts, Heritage, Gaeltacht and Islands in 2000.

Wade Surveys

A wade survey will be undertaken at all of the (active) watercourses where they are traversed by the proposed road (AH30, AH32, AH36, AH39, AH41 and AH70). The survey will be carried out by a qualified underwater archaeologist under ministerial directions.

15.5.2 Architectural Heritage

A photographic record, using appropriate scaling, and written description will be undertaken of the dry-stone walling in Ballinrea and Loughbeg townlands (BH22 & BH19), and the demesne boundary walls in Barnahely townland (BH10 & BH23).

A photographic record, measured survey and written description will be undertaken of the pre-1840s house now heavily modernised (BH20) in Maryborough townland.

A section of the early 20th century railway line (BH5) in Ballyhemiken townland will be recorded by a suitably qualified archaeologist.

Appropriate screening will be put in place to mitigate the visual impacts identified at Castle Warren (BH11), the Martello Tower (BH1), Ring House (BH3), and the farm complexes in Ballinrea and Carrigaline Middle (BH7 & BH8) (refer to **Chapter 16: Landscape and Visual - Figure 16.5** in **Volume 5** which details the screening in the vicinity of these structures).

15.5.3 Construction Phase

Archaeological and cultural heritage issues will be resolved at the pre-construction and construction stages of the development. This will include any necessary archaeological monitoring and inspection work required along the proposed M28 Road Project during the site preparation/ advanced works phase of the project. This is in accordance with the Code of Practice between the National Roads Authority and the Minister for Arts, Heritage, Gaeltacht and Islands, 2000. During the construction phase, a mechanism for recording, protecting and (where necessary) resolving existing archaeological monuments and newly revealed sites within the landtake will have to be agreed with the TII Project Archaeologist and the National Monuments Service of the DAHRRGA.

If features are to be left *in-situ*, details plans will be required as to the layout and extent of these features/ sites as well as a geographical location. Before and after photographs will be required as well as a full report on the preservation of the site and how this was achieved, by the National Monuments Service.

Vibration Monitoring

Vibration monitors will be installed at the remains of the 18th century Country House and the earlier medieval structures at Castle Warren (AH22 / BH11) prior to commencement of works, with alerts to identify any undue level of vibration at the structure during construction of the road. (refer to **Chapter 14: Noise & Vibration** and in **Appendix 15H** for further detail).

15.6 RESIDUAL IMPACTS

There are no predicted residual impacts on archaeological, architectural or cultural heritage assets.

15.7 MONITORING MEASURES

No further monitoring measures required.

Table 15.2: Summary of Archaeological & Cultural Heritage Impacts

ID No.	Legal Status	Site Type	Townland	Baseline Rating	Magnitude of Impact	Type & Quality of Impact	Mitigation Measures	Residual Impact
AH1	None	Brickfield (site of)	Monfieldstown	Low	High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH2	None	Possible millpond (site of)	Maryborough	Low	High	Direct moderate negative	Archaeological testing	None
AH3	None	Pre-1840s structure (site of)	Ballyhemiken	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH4	None	Pre-1840s structure (site of)	Shanbally	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH5	RMP	*Fulacht fia* (burnt spread)	Ballinrea	High	High	Indirect significant negative	Geophysical survey and/or archaeological testing	None
AH6	None	LiDAR anomaly	Castletreasure / Ballinimlagh	Unknown	High	Potentially direct moderate / significant negative	Geophysical survey and/or archaeological testing	None
AH7	RMP	Ringfort	Hilltown	High	Medium	Indirect significant negative	Archaeological testing	None
AH8	None	Former watercourse	Castletreasure	Low	High	Potentially direct moderate / significant negative	Geophysical survey and/or archaeological testing	None
AH9	RMP	*Fulacht fia* (burnt spread)	Shannonpark	High	Very High	Direct profound negative	Geophysical survey and/or archaeological testing	None
AH10	RMP	Standing Stone	Ballyhemiken	High	High	Direct significant negative	Archaeological testing	None
AH11	RMP	Standing Stone	Ballyhemiken	High	Low	Indirect moderate negative	Geophysical survey and/or archaeological testing	None
AH12	RMP	Ringfort & Souterrain	Raffeen	n/a	n/a	No predicted impact – site already destroyed	No mitigation required	None

ID No.	Legal Status	Site Type	Townland	Baseline Rating	Magnitude of Impact	Type & Quality of Impact	Mitigation Measures	Residual Impact
AH13	None	Gate lodge (site of)	Barnahely	Low	High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH14	RMP	Ringfort & Souterrain	Shanbally	High	Low	Indirect moderate negative	See AH16	None
AH15	RMP	Enclosure	Shanbally	High	Low	Indirect moderate negative	See AH16	None
AH16	None	Specific Area of Archaeological Potential – possible souterrain	Shanbally	Unknown	Very High	Potentially direct moderate / significant negative	Geophysical survey and/or archaeological testing	None
AH17	None	Specific Area of Archaeological Potential – possible souterrain / enclosure	Shanbally	Unknown	Very High	Potentially direct moderate / significant negative	Geophysical survey and/or archaeological testing	None
AH18	None	LiDAR anomaly	Castletreasure	Unknown	High	Potentially direct moderate / significant negative	Geophysical survey and/or archaeological testing	None
AH19	RMP	Gate Lodge	Barnahely	High	High	Direct significant negative	Archaeological testing	None
AH20	RMP	Graveyard & church site	Barnahely	High	Medium	Indirect significant negative	Geophysical survey and/or archaeological testing along the Barnahely-Ringaskiddy road to determine if features associated with the church site and graveyard survive within the CPO. Additional archaeological testing to determine if features associated with the church site survive to the south within the CPO (See also AH69).	None

ID No.	Legal Status	Site Type	Townland	Baseline Rating	Magnitude of Impact	Type & Quality of Impact	Mitigation Measures	Residual Impact
AH21	None	Pre-1840s structure (site of)	Barnahely	Low	High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH22	RMP	Tower house & bawn	Barnahely	High	Medium	Indirect significant negative	Additional archaeological testing to determine if features associated with the medieval tower house survive within the CPO. Appropriate screening to reduce visual intrusion (Cf. Chapter 16: Landscape & Visual). Vibration monitoring (Cf. Chapter 14: Noise & Vibration & Appendix 15H).	None
AH23	None	Pre-1840s structure (site of)	Barnahely	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH24	None	Pre-1840s structure (site of)	Loughbeg	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH25	None	Pre-1840s structure (site of)	Loughbeg	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH26	RMP	Enclosure	Barnahely	High	Medium	Indirect significant negative	Geophysical survey and/or archaeological testing	None
AH27	RMP	Midden	Barnahely	High	-	No predicted impact	No mitigation required	None
AH28	SMR	Pit	Barnahely	High	Low	Indirect moderate negative	Archaeological testing	None
AH29	None	LiDAR anomaly	Ballinrea	Unknown	n/a	No predicted impact	No mitigation required	None
AH30	None	Stream (riverine environs)	Hilltown	Unknown	High	Potentially direct moderate / significant negative	Wade survey and archaeological testing	None
AH31	None	Osiery (site of)	Hilltown	Low	High	Direct moderate negative	Archaeological testing	None

ID No.	Legal Status	Site Type	Townland	Baseline Rating	Magnitude of Impact	Type & Quality of Impact	Mitigation Measures	Residual Impact
AH32	None	Stream (riverine environs)	Shannonpark	Unknown	High	Potentially direct moderate / significant negative	Wade survey and archaeological testing	None
AH33	SMR	Two sub-circular enclosures. Possible metal-working sites.	Barnahely	High	Very high	Direct profound negative	Preservation by record - archaeological excavation	None
AH34	None	Pre-1840s structure (site of)	Raffeen	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH35	RMP	Martello Tower	Ringaskiddy	High	Low	Indirect moderate negative	Geophysical survey and/or archaeological testing to determine if any features associated with the tower survive within the CPO (see also AH54. Appropriate screening to reduce visual intrusion (Cf. Chapter 16: Landscape & Visual).	None
AH36	None	Stream (riverine environs) & townland boundary	Maryborough / Mounthovel	Unknown	High	Potentially direct moderate / significant negative	Wade survey and archaeological testing	None
AH37	RMP / SMR	Ringfort, souterrain, kilns & burnt spread	Barnahely	High	Very low	Indirect slight negative	No mitigation measures required – see AH17	None
AH38	None	Pre-1840s structure (site of)	Shanbally	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH39	None	Stream (riverine environs) & townland boundary	Moneygourney/ Castletreasure	Unknown	High	Potentially direct moderate / significant negative	Wade survey and archaeological testing	None
AH40	None	Possible burnt spread	Ballinimlagh	Unknown	High	Potentially direct moderate / significant negative	Geophysical survey and/or archaeological testing	None
AH41	None	Stream (riverine environs)	Ballinrea	Unknown	High	Potentially direct moderate / significant negative	Wade survey and archaeological testing	None

ID No.	Legal Status	Site Type	Townland	Baseline Rating	Magnitude of Impact	Type & Quality of Impact	Mitigation Measures	Residual Impact
AH42	None	Former road	Ballinrea	Low	High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH43	None	Possible mill-race	Ballinrea	Low	High	Direct moderate negative	Archaeological testing	None
AH44	None	Former road	Shannonpark	Low	High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH45	None	Osiery	Shannonpark	Low	High	Direct moderate negative	Archaeological testing	None
AH46	None	Specific Area of Archaeological Potential - possible souterrain / enclosure site	Shanbally	Unknown	Very High	Potentially direct moderate / significant negative	Geophysical survey and/or archaeological testing	None
AH47	None	Former road	Barnahely	Low	High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH48	None	Enclosure complex – Direct impact on part of this complex: the probable ringfort; part of the earlier field system; northern half of the second large enclosure to the south; a possible ring-ditch; and the cluster of pits, post-holes and stake-holes. (Adjacent AH33 to the east)	Barnahely	Medium	High	Direct significant negative	Additional archaeological testing will be carried out to investigate the second large enclosure and possible ring-ditch identified by geophysical survey to south of main alignment, within the proposed CPO. Preservation by record – archaeological excavation – for all archaeological sites / features that will be directly impacted.	None

ID No.	Legal Status	Site Type	Townland	Baseline Rating	Magnitude of Impact	Type & Quality of Impact	Mitigation Measures	Residual Impact
AH49	None	Specific Area of Archaeological Potential - Former wetland / dryland interface & possible former foreshore	Ringaskiddy	Unknown	High	Potentially direct moderate / significant negative	Geophysical survey and/or archaeological testing	None
AH50	None	Pre-1840s settlement cluster (site of)	Barnahely	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH51	None	Former laneway	Loughbeg	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH52	None	Pre-1840s structure (site of)	Shanbally	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	
AH53	None	Specific Area of Archaeological Potential - Dryland / wetland interface between two standing stone sites	Ballyhemiken	Unknown	Very High	Potentially direct moderate / significant negative	Geophysical survey and/or archaeological testing	None
AH54	None	Former road / track	Ringaskiddy	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH55	None	Pre-1840s structure (site of)	Loughbeg	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH56	None	Pre-1840s structure (site of)	Loughbeg	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH57	None	Pre-1840s structure (site of)	Loughbeg	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH58	None	Pre-1840s structure (site of)	Loughbeg	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH59	None	Pre-1840s structure (site of)	Loughbeg	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None

ID No.	Legal Status	Site Type	Townland	Baseline Rating	Magnitude of Impact	Type & Quality of Impact	Mitigation Measures	Residual Impact
AH60	None	Walled garden (site of)	Barnahely	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH61	None	LiDAR anomaly	Ballinimlagh	Unknown	High	Potentially direct moderate / significant negative	Geophysical survey and/or archaeological testing	None
AH62	None	LiDAR anomaly	Ballinrea, Hilltown	Unknown	High	Potentially direct moderate / significant negative	Geophysical survey and/or archaeological testing	None
AH63	None	Gate Lodge (site of)	Monfieldstown	Low	Very High	Direct moderate negative	Archaeological testing	None
AH64	None	Pre-1840s structure (site of)	Maryborough	Low	High	Direct moderate negative	Archaeological testing	None
AH65	None	Specific Area of Archaeological Potential – kink in field boundary / possible enclosure	Barnahely	Unknown	High	Potentially direct moderate / significant negative	Further archaeological testing at this location to assess the extent, nature and date of this feature	None
AH66	None	Pre-1840s structure (site of)	Shanbally	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH67	None	Pre-1840s structure (site of)	Mounthovel	Low	Very High	Direct moderate negative	Archaeological testing	None
AH68	None	Pre-1840s structure (site of)	Carrigaline Middle	Low	Very High	Direct moderate negative	Geophysical survey and/or archaeological testing	None
AH69	None	Ditch	Barnahely	Unknown	High	Potentially direct moderate / significant negative	Further archaeological testing within the CPO to establish the extent, nature and date of this feature.	None
AH70	None	Stream (riverine environs)	Shannonpark	Unknown	High	Potentially direct moderate / significant negative	Wade survey and archaeological testing	None

ID No.	Legal Status	Site Type	Townland	Baseline Rating	Magnitude of Impact	Type & Quality of Impact	Mitigation Measures	Residual Impact
CH1	None	Grotto	Shanbally	Low	Low	Indirect slight negative	A fence will be provided around the grotto to protect the site during construction. Appropriate screening will be put in place to reduce any visual intrusion on the site (Cf. Chapter 16: Landscape & Visual).	None

Table 15.3: Summary of Architectural Heritage Impacts

ID No.	Legal Status	NIAH Survey	Site Type	Townland	Baseline Rating	Magnitude of Impact	Type & Quality of Impact	Mitigation Measures	Residual Impacts
BH1	RPS/ RMP	NIAH Building Survey	Martello Tower	Ringaskiddy	High	Low	Indirect moderate negative visual impact	Appropriate screening will be put in place to reduce any visual intrusion on the structure (Cf. Chapter 16: Landscape & Visual).	None
BH2	None	No	Grounds of pre-1840s house (Rose Lodge)	Loughbeg (Ringaskiddy village)	Low	Medium	Direct moderate negative physical impact (see BH19)	See BH19	None
BH3	None	NIAH Building Survey	House (Ring House)	Ringaskiddy	Medium	Medium	Indirect moderate negative visual impact	Appropriate screening will be put in place to reduce any visual intrusion on the site (Cf. Chapter 16: Landscape & Visual).	None
BH4	None	NIAH Building Survey	House (Rock Cottage)	Loughbeg (Ringaskiddy village)	Medium	Medium	No predicted impact	No mitigation required	None
BH5	None	No	Former railway line	Ballyhemiken	Low	High	Direct moderate negative physical impact	Photographic record and written description	None
BH6	None	NIAH Garden Survey	Former Demesne (Prospect Villa)	Barnahely	Low	Very low	Indirect imperceptible negative impact	No mitigation required	None
BH7	None	No	Pre-1840s farm complex	Ballinrea	Low	Low	Indirect slight negative visual impact	Appropriate screening will be put in place to reduce any visual intrusion on the site (Cf. Chapter 16: Landscape & Visual).	None
BH8	None	No	Pre-1840s farm complex	Carrigaline Middle	Low	Low	Indirect slight negative visual impact	Appropriate screening will be put in place to reduce any visual intrusion on the site (Cf. Chapter 16: Landscape & Visual).	None

ID No.	Legal Status	NIAH Survey	Site Type	Townland	Baseline Rating	Magnitude of Impact	Type & Quality of Impact	Mitigation Measures	Residual Impacts
BH9	None	No	Pre-1840s Structure (upstanding)	Loughbeg	Low	Very low	Indirect imperceptible negative impact	No mitigation required	None
BH10	None	No	Demesne boundary wall (Prospect Villa)	Barnahely	Low	Very low	Indirect imperceptible negative impact	No mitigation required	None
BH11	RPS/RMP	Garden Survey	Castle Warren Country House & former demesne	Barnahely	High	Medium	Indirect significant negative visual impact.	Appropriate screening to reduce visual intrusion (Cf. Chapter 16: Landscape & Visual). Vibration monitoring (Cf. Chapter 14: Noise & Vibration& Appendix 15H).	None
BH12	None	Building Survey	House (Beechvale Lawn)	Monfieldstown	Medium	n/a	No predicted impact	No mitigation required	None
BH13	None	Garden Survey	Former Demesne (Ballybricken House)	Barnahely	Low	Very low	Indirect imperceptible negative impact	No mitigation required	None
BH14	None	Garden Survey	Former Demesne (Bloomfield House)	Monfieldstown	Low	n/a	No predicted impact	No mitigation required	None
BH15	None	Garden Survey	Former Demesne (Mount Hovel House)	Mounthovel	Low	Very low	Indirect imperceptible negative impact	No mitigation required	None
BH16	None	Garden Survey	Former Demesne (Maryborough House)	Maryborough	Low	Very low	Indirect imperceptible negative impact	No mitigation required	None

ID No.	Legal Status	NIAH Survey	Site Type	Townland	Baseline Rating	Magnitude of Impact	Type & Quality of Impact	Mitigation Measures	Residual Impacts
BH17	None	Garden Survey	Former Demesne (Belview)	Maryborough	Low	Very low	Indirect imperceptible negative impact	No mitigation required	None
BH18	None	Garden Survey	Former Demesne (Broadale)	Moneygourney	Low	Very low	Indirect imperceptible negative impact	No mitigation required	None
BH19	None	No	Boundary wall	Loughbeg	Low	High	Direct moderate negative physical impact	Photographic record and written description	None
BH20	None	No	Pre-1840s Structure (upstanding)	Maryborough	Low	High	Direct moderate negative physical impact	Photographic record, measured survey and written description	None
BH21	None	No	Demesne wall (internal, Prospect Villa)	Barnahely	Low	High	Direct moderate negative physical impact	Photographic record and written description	None
BH22	None	No	Drystone walling & possible culvert	Ballinrea	Low	High	Direct moderate negative physical impact	Photographic record and written description	None
BH23	None	No	Demesne boundary wall (Castle Warren)	Barnahely	Low	High	Direct moderate negative physical impact	Photographic record and written description	None

16 LANDSCAPE AND VISUAL IMPACT

16.1 INTRODUCTION

This chapter examines the potential landscape and visual impact (LVIA) on the area southeast of Cork City and its environs of the proposed M28 Road Project, during construction and operation stages. For all figures and photomontages referred to in this chapter, please see **Volume 5**. The overall approach is summarised as follows:-

a) Establish the baseline conditions:-

Record and analyse the existing character, quality and sensitivity of the landscape and visual resource. This should include elements of the landscape such as;

- Landform;
- Land cover including the vegetation, the slopes, drainage, etc.;
- Landscape character;
- Current landscape designations and planning policies; and
- Site visibility, comprising short, medium and long distance views.

b) Analyse baseline conditions:-

Comment on the scale, character, condition and the importance of the baseline landscape, its sensitivity to change and the enhancement potential where possible.

A visual analysis (illustrated by photographic material) describing characteristics which may be of relevance to the impact of the design and to the method of mitigation.

c) Describe the proposal;

d) Identify the impacts of the proposal on the Landscape and Visual Resources -

Identify the landscape and visual impacts of the proposed M28 Road Project at different stages of its life cycle, including:-

- Direct & indirect *landscape impacts* of the proposed road project on the landscape of the site and the surrounding area; and
- *Visual impacts* including: the extent of potential visibility; the view and viewers affected; the degree of visual intrusion; the distance of views; and resultant impacts upon the character and quality of views.

e) Assess the significance of the landscape and visual impacts in terms of the sensitivity of the landscape and visual resource, including the nature and magnitude of the impact.

f) Detail measures proposed to mitigate significant adverse landscape and visual impacts and assess their effectiveness.

g) Assess the ability of the landscape and visual resource to absorb the proposal with any mitigation proposed.

16.2 ASSESSMENT METHODOLOGY

16.2.1 General Approach

The methodology for the LVIA has been derived from *Guidelines for Landscape and Visual Impact Assessment,* Third Edition (The Landscape Institute and Institute of Environmental Management & Assessment, 2013) (GLVIA3). The landscape mitigation measures have given regard to the NRA *Guide to Landscape Treatments for National Road Schemes in Ireland*.

The landscape has been appraised to allow it to be described and classified into landscape character areas that in turn enable the classification of landscape quality. The capacity of the landscape to accept change of the type proposed is assessed by determining the sensitivity of each landscape character area. Overall key landscape components are normally landform, vegetation and historical and cultural components. Landform relates to topography, drainage characteristics and geology. Historical and cultural components include historic landscapes, listed buildings, conservation areas and historic designed landscapes. Vegetation plays an important role in how the landscape and visual resources of an area are viewed and is an integral component of a landscape character.

Assessment has been undertaken through analysis of:-

- Up to date digital copies of OS Discovery Series raster and OS vector maps;
- Aerial photography;
- Cork County Landscape Character Assessment and Draft Landscape Strategy 2007;
- Cork County Development Plan (CDP), 2014-2020;
- Draft Ballincollig-Carrigaline Municipal District Local Area Plan, 2016;
- Zone of Theoretical Visibility (ZTV) mapping **Figure 16.1**);
- Photomontages from selected viewpoints; and
- Detailed drawings of the proposed M28 Road Project including lighting proposals as described in **Chapter 3: Description of the Proposed Road Development** and the proposed location of noise barriers as described in **Chapter 14: Noise and Vibration**.

Site visits were undertaken to assess the existing environment, to establish the existing visual resource and to identify sensitive receptors, i.e., residential properties, scenic viewpoints. Site visits were also used to establish the perceived extent of landscape and visual impacts that may be associated with the proposed road project.

The proposed M28 Road Project is then applied to this landscape and visual baseline and potential impacts predicted.

16.2.2 Scenarios Assessed

The following scenarios have been assessed:-

- Do-Nothing; and
- Do-Something, the proposed M28 Road Project as described in **Chapter 3: Description of the Proposed Road Development**.

16.2.3 Identifying Effects

Assessing the significance of an effect is a key component of the LVIA and is an evidenced based process combining professional judgments on the nature of a landscape or visual receptor's sensitivity, their susceptibility to change and the value attached to the receptor. It is important to note that judgments in this LVIA are impartial and based on professional experience and opinion informed by best practise guidance.

The effects of the proposed M28 Road Project are of variable duration and are assessed as being either short-term or long-term, and permanent or reversible. Effects related to operations and infrastructure such as temporary construction compounds and stockpiling, apparent only during the construction period are considered to be short-term effects.

16.2.4 Assessment Criteria

The objective of the assessment process is to identify and evaluate the predicted significant effects arising from the proposal. Significance is a function of the:

- Sensitivity of the affected landscape and visual receptors; and
- Scale or magnitude of impact that they will experience.

These definitions recognise that landscapes vary in their capacity to accommodate different forms of development according to the nature of the receiving landscape and the type of change being proposed.

Significance is not graded in bands, and a degree of informed judgement is required. Even with the application of pre-defined criteria, interpretation may differ between individuals, but this allows the process of reaching these conclusions to be transparent.

16.2.5 Landscape Impact Assessment

The LVIA firstly assesses how the proposal would impact directly on any landscape features and resources. This category of effect relates to specific landscape elements and features (e.g. woods, trees, walls, hedgerows, watercourses) within the site that are components of the landscape that may be physically affected by the proposal. Physical effects are restricted to the area within the site boundary, and are the direct effects on the fabric of the site, such as the removal or addition of trees and alteration to ground cover and levels.

The LVIA then considers impacts on landscape character at two levels. Firstly, consideration is given to how the landscape character is affected by the removal or alteration of existing features and the introduction of new features. This is considered to be a direct impact on landscape character. Secondly, the indirect impacts of the proposal on the wider landscape are considered. The assessment of impacts on the wider landscape is discussed using the surrounding character areas identified in the relevant regional or county landscape character assessments and further refined by this LVIA. It is acknowledged there is an overlap between perception of change to landscape character and visual amenity, but it should be remembered that landscape character in its own right is generally derived from the combination and pattern of landscape elements within the view.

The significance of effects on landscape features and character is determined by cross referencing the sensitivity of the feature or landscape character with the magnitude of impact.

Consideration of the sensitivity of the landscape resource against the magnitude of impact caused by the proposal is fundamental to landscape and visual assessment and these two criteria are defined in more detail below.

16.2.6 Landscape Sensitivity

The determination of the sensitivity of the landscape resource is based upon an evaluation of each key element or characteristic of the landscape likely to be affected. The evaluation reflects such factors as its quality, value, contribution to landscape character and the degree to which the particular element or characteristic can be replaced or substituted.

For the purpose of this assessment, landscape quality is categorised as:-

- **Very High:** Areas of especially high quality acknowledged through designation as Areas of Outstanding Natural Beauty (AONB) or other landscape based sensitive areas. These are of landscape significance within the wider region or nationally;
- **High Quality:** Areas that have a very strong positive character with valued and consistent distinctive features that gives the landscape unity, richness and harmony. These are of landscape significance within the district;
- **Medium Quality:** Areas that exhibit positive character but which may have evidence of alteration/degradation or erosion of features resulting in a less distinctive landscape. These may be of some local landscape significance with some positive recognisable structure; and
- **Low Quality:** Areas that are generally negative in character, degraded and in poor condition. No distinctive positive characteristics and with little or no structure. Scope for positive enhancement.

As previously discussed, landscape sensitivity is influenced by a number of factors including value, condition and the type of change brought about by the proposal. In order to assist with bringing these factors together the following five point scale has been used as presented in **Table 16.1**. The table defines the criteria that have guided the judgement as to the Sensitivity of the Landscape Resource.

Table 16.1: Landscape Sensitivity

Definition		Sensitivity
Landscape Resource Sensitivity	**Landscape Resource Value**	
Exceptional landscape quality, no or limited potential for substitution. Key elements / features well known to the wider public. Little or no tolerance to change.	Nationally / internationally designated/ valued landscape, or key elements or features of national / internationally designated landscapes. Little or no tolerance to change	Very High
Strong / distinctive landscape character; absence of landscape detractors. Low tolerance to change.	Regionally / nationally designated / valued countryside and landscape features. Low tolerance to change.	High
Some distinctive landscape characteristics; few landscape detractors. Medium tolerance to change	Locally / regionally designated / valued countryside and landscape features. Medium tolerance to change	Medium
Absence of distinctive landscape characteristics; presence of landscape detractors. High tolerance to change	Undesignated countryside and landscape features. High tolerance to change	Low
Absence of positive landscape characteristics. Significant presence of landscape detractors. High tolerance to change	Undesignated countryside and landscape features. High tolerance to change	Negligible

16.2.7 Magnitude of Landscape Impacts

Direct resource changes on the landscape character in the study area are brought about by the introduction of the proposal and its impact on the key landscape characteristics. The categories and criteria used are given in **Table 16.2** below:-

Table 16.2: Magnitude of Landscape Impact

Definition	Magnitude
Total loss or addition or/ very substantial loss or addition of key elements / features / patterns of the baseline, i.e., pre-development landscape and/ or introduction of dominant, uncharacteristic elements with the attributes of the receiving landscape.	Large
Partial loss or addition of or moderate alteration to one or more key elements / features / patterns of the baseline, i.e., pre-development landscape and / or introduction of elements that may be prominent, but may not necessarily be substantially uncharacteristic with the attributes of the receiving landscape.	Medium
Minor loss or addition of or alteration to one or more key elements / features / patterns of the baseline, i.e., pre-development landscape and or introduction of elements that may not be uncharacteristic with the surrounding landscape.	Small
Very minor loss or addition of or alteration to one or more key elements / features / patterns of the baseline, i.e., pre-development landscape and/or introduction of elements that are not uncharacteristic with the surrounding landscape approximating to a 'no-change' situation.	Negligible
No loss, alteration or addition to the receiving landscape resource.	No change

16.2.8 Visual Impact Assessment

The assessment of effects on views is an assessment of how the introduction of the proposal will affect views throughout the study area. Assessment of visual effects therefore needs to consider:-

- Direct impacts of the proposal upon views of the landscape through intrusion or obstruction;
- The reaction of viewers who may be affected, e.g., residents, walkers, road users; and
- The overall impact on visual amenity.

Viewpoints have been selected to meet the following criteria, with locations illustrated on **Figure 16.2:-**

- A balance of viewpoints from where main direction of view is towards the proposed road project;
- A range of views of the proposed road project covering the extent of the study area ZTV. Selected viewpoints have all been located within the study area associated with the proposed road project;
- A proportion representing areas known to be available to the community where people may frequently congregate; and
- Locations of interest, e.g., settlements; amenity or recreation areas.

16.2.9 Photographs, Photomontages and Zone of Theoretical Visibility (ZTV)

As the site survey for the proposed road project was limited to the footprint and immediate surrounds of the site it was necessary to acquire additional elevation data from the OSI to include all viewpoint locations selected for photomontage. Enhanced digital terrain model (DTM) was chosen for this purpose. A digital terrain model was prepared for the entire visual study area with a simplified 3D model of the proposed M28 Road Project for use in the field. Viewpoint locations were selected by RPS landscape architects in consultation with the Cork County Council, the EIS co-ordinator and RPS design engineers. This included a detailed map with reference photography. In selecting the viewpoint locations, issues raised by the public during the consultation events were also taken into consideration.

The photographer was equipped with a professional level SLR camera (Canon 5D Mark II). Specifically to meet the requirements of best practice this houses a full frame sensor and is fitted with a 50mm lens. A specialised panoramic head was fitted to the camera tripod for those viewpoints adjacent to the site. This enables the capture of multiple photographs in a linear sequence for the preparation of a panoramic image. Such imagery is required to include sufficient landscape context to depict the entire proposed road project at close quarters. A mapping grade GPS (Trimble GeoXH) was used to record the precise coordinate position of the camera at each viewpoint (details below). This offers corrected accuracy typically in the range of +/- 30cm in the xy plane. In addition the photographer had all necessary information per viewpoint to capture the correct photographic detail – viewpoint map, photographic reference, Google Earth with a KMZ model of the proposed road project (laptop), interactive topographic model of the proposed road project and surrounding terrain (laptop). All photography was captured at a focal length of 50mm in RAW format for post-processing. The camera was consistently set up at 1.7m above ground level at each viewpoint location. The photography was captured in the clearest possible weather in the available time frame. This saw a mixture of broken cloud with sunny spells.

A completed 3D model of the proposed M28 Road Project was provided. A full specification of finishes, textures and colours was provided in addition to reference photography and previous high quality renders. The photomontage team utilised all of the above to prepare a finished textured 3D model of the final design in 3D Studio Max.

The information captured at each viewpoint location was used to simulate a replica camera view in the 3D environment: Easting *(from GPS);* Northing *(from GPS);* Elevation *(calculated from the Enhanced DTM data from OSI; GPS does not offer an accurate z-value reading);* Angle of View *(specific to focal length and camera sensor size);* Direction of View *(from GPS coordinate info);* Date *(from photography meta-data);* Time of Day *(from photography meta-data);* Weather Conditions *(from photography and recorded on site).*

Draft renders were output and integrated into the photography for review. This was an iterative process involving tweaks to textures and lighting. Upon sign-off a full set of final calibrated renders were prepared ready for integration into the photography. The final renders were integrated into the photography with masking aided by detailed street maps and Google Earth photography. The final set of renders were formatted at A3 (dimensions 36cm x 24cm) for a recommended viewing distance of 50cm.

The ZTV illustrates the extents from which a feature would theoretically be visible and defines the study area.

The ZTV maps do not take account of the orientation of a viewer, such as the direction of travel and there is no allowance for attenuation of visibility with distance, weather or light. A further assumption of the ZTVs is that climatic visibility is 100% (i.e. visibility is not impeded by moisture or pollution in the air). Climatic conditions inevitably reduce visibility with increasing distance from the proposed M28 Road Project.

These limitations mean that the ZTV maps tend to overestimate the extent of the influence on the landscape and visibility of the proposed development and they should be considered only as a tool to assist in assessing the theoretical visibility of developments and not a measure of the visual impact. Nevertheless ZTVs are a useful tool in representing the worst-case scenario when predicting the likely visibility of a development. They are particularly useful as a basis for selecting viewpoints where there may be significant impacts for which further assessment is required.

16.2.10 Visual Sensitivity

Visual sensitivity is defined with reference to the landscape sensitivity of the viewpoint location and the view. Other factors affecting visual sensitivity include:-

- The location and context of the viewpoint;
- The expectations and occupation or activity of the receptor; and
- The importance of the view.

Although the interpretation of viewers' experience can have preferential and subjective components, there is generally clear public agreement that the visual resources of certain landscapes have high visual quality.

Viewer sensitivity, as set out in **Table 16.3** below, is a combination of the sensitivity of the human receptor (for example resident, commuter, tourist, walker, recreationist or worker, and the numbers of viewers affected) and viewpoint type or location (for example house, workplace, leisure venue, local beauty spot, scenic viewpoint, commuter route, tourist route or walkers' route).

Table 16.3: Viewer Sensitivity

Definition		Sensitivity
Visual Resource Sensitivity	**Visual Resource Value**	
Views of remarkable scenic quality, of and within internationally designated landscapes or key features or elements of nationally designated landscapes that are well known to the wider public. Little or no tolerance to change.	Observers, drawn to a particular view, including those who have travelled from around Ireland and overseas to experience the views. Little or no tolerance to change.	Very High
Views from residential property. Public rights of way, National Trails, long distance walking routes and nationally designated countryside/ landscape features with public access. Low tolerance to change.	Observers enjoying the countryside from their homes or pursuing quiet outdoor recreation are more sensitive to visual change. Little tolerance to change.	High
Views from local roads and routes crossing designated countryside / landscape features and 'access land' as well as promoted paths. Medium Tolerance to change.	Observers enjoying the countryside from vehicles on quiet/promoted routes are moderately sensitive to visual change. Medium tolerance to change.	Medium
Views from work places, main roads and undesignated countryside / landscape features. High tolerance to change.	Observers in vehicles or people involved in frequent or infrequent repeated activities are less sensitive to visual change. High tolerance to change.	Low
Views from within and of undesignated landscapes with significant presence of landscape detractors. High tolerance to change.	Observers in vehicles or people involved in frequent or frequently repeated activities are less sensitive to visual change. High tolerance to change.	Negligible

16.2.11 Magnitude of Visual Impacts

The magnitude of impact on the visual resource results from the scale of change in the view, with respect to the loss or addition of features in the view, and changes in the view composition. Important factors to be considered include: proportion of the view occupied by the proposal, distance and duration of the view. Other vertical features in the landscape and the backdrop to the proposal will all influence resource change. Magnitude of visual impact is defined in **Table 16.4**.

Table 16.4: Magnitude of Visual Impact

Definition	Magnitude
Complete or very substantial change in view dominant involving complete or very substantial obstruction of existing view or complete change in character and composition of baseline, e.g., through removal of key elements	Large
Moderate change in view: which may involve partial obstruction of existing view or partial change in character and composition of baseline, i.e., pre-development view through the introduction of new elements or removal of existing elements. Change may be prominent, but would not substantially alter scale and character of the surroundings and the wider setting. Composition of the view would alter. View character may be partially changed through the introduction of features which, though uncharacteristic, may not necessarily be visually discordant	Medium
Minor change in baseline, i.e., pre-development view - change would be distinguishable from the surroundings whilst composition and character would be similar to the pre change circumstances.	Small
Very slight change in baseline, i.e., pre-development view - change barely distinguishable from the surroundings. Composition and character of view substantially unaltered.	Negligible
No alteration to the existing view	No change

16.2.12 Significance of Effects

The purpose of this LVIA is to determine, in a transparent way, the likely significant landscape and visual effects of the proposal. It is accepted that, due to the nature and scale of proposed road project, the proposal could potentially give rise to some notable visual and landscape effects.

GLVIA3 identifies that *'The Regulations require that a final judgment is made about whether or not each effect is likely to be significant. There are no hard and fast rules about what effects should be deemed 'significant' but LVIAs should always distinguish clearly between what are considered to be significant and non-significant effects'*.

Significance can only be defined in relation to each particular development and its specific location. The relationship between receptors and effects is not typically a linear one. It is for each LVIA to determine how judgements about receptors and effects should be combined to derive significance and to explain how this conclusion has been arrived at.

As a general guide it is considered that the following are likely to be considered effects of the greatest significance:-

- Major loss or irreversible negative effects, over an extensive area, on elements and/or aesthetic and perceptual aspects that are key to the character of nationally valued landscapes; or
- Irreversible negative effects on people who are particularly sensitive to changes in view, on recognised and important viewpoints or scenic routes, large-scale change which introduces non-characteristic, discordant or intrusive elements into the view.

The identification of significant effects would not necessarily mean that the effect is unacceptable in planning terms. What is important is that the likely effects on the landscape and visibility are transparently assessed and understood in order that the determining authority can bring a balanced, well-informed judgement to bear when making the planning decision.

The significance of effects on landscape, views and visual amenity are evaluated according to a six-point scale: Substantial, Major, Moderate, Minor, Negligible or None.

For those effects indicated as being Moderate to Major the assessor will exercise professional judgement in determining if the effect is considered significant.

For the purposes of this assessment those effects indicated as being of Substantial, Major to Substantial are considered significant as highlighted in **Table 16.5**, below. Effects of 'Moderate' and lesser significance have been identified in the assessment, but are not considered significant upon the character and quality of the landscape and on views although they remain worthy of consideration throughout the decision making process.

Table 16.5: Significance of Effects Matrix

Magnitude of Impact	Sensitivity				
	Negligible	***Low***	***Medium***	***High***	***Very High***
No Change	None	None	None	None	None
Negligible	Negligible	Negligible to Minor	Negligible to Minor	Minor	Minor
Small	Negligible to Minor	Negligible to Minor	Minor	Minor to Moderate	Moderate to Major
Medium	Negligible to Minor	Minor	Moderate	Moderate to Major	Major to Substantial
Large	Minor	Minor to Moderate	Moderate to Major	Major to Substantial	Substantial

Change can be adverse or beneficial. A conclusion that an effect is 'significant' should not be taken to imply that the proposal is unacceptable. Significance of effect needs to be considered with regard to the scale over which it is experienced.

16.2.13 Landscape & Visual Assessment Definitions

The following provides a list of landscape and visual definitions for the terms used within this assessment:-

- **Landscape Capacity:** The capacity of a particular type of landscape to absorb change without unacceptable adverse effects on its character;
- **Landscape Character Area:** Distinct types of landscape which are generic in character in that they may occur in different parts of the country, but wherever they are they share broadly similar combinations of geology, topography, drainage patterns, vegetation and historical land use and settlement pattern. Landscape character area (LCA) names are generic, for example 'upland hills', 'river valley' and 'urban landscape';

- **Landscape Fabric:** Is the physical pattern of elements and features such as vegetation, landform and land use that combine to create landscape character. The effects of a development on landscape fabric are those that alter the physical pattern of elements. These effects are restricted to the landscape within which the proposal is located as it is within this area that the physical pattern will alter, for instance through loss of vegetation, re-contouring or changes to land use;
- **Landscape Quality (or Condition):** Is based on judgements about the physical state of the landscape, and about its intactness, from visual, functional, and ecological perspectives. It also reflects the state of repair of individual features and elements which make up the character in any one place;
- **Landscape Resource:** The combination of elements that contribute to landscape context, character and value;
- **Landscape Value:** The importance attached to a landscape (often as a basis for designation or recognition) that expresses national or local consensus, because of its quality, cultural associations, scenic or aesthetic characteristics;
- **Sensitivity:** Vulnerability of a sensitive receptor to change;
- **Sensitive Receptor:** Physical or natural resource, special interest or viewer group or observer that will experience an impact;
- **Magnitude:** Size, extent and duration of an impact;
- **Visual Amenity:** The value of a particular area or view in terms of what is seen;
- **Visual Character:** When a viewer experiences the visual environment, it is not observed as one aspect at a time, but rather as an integrated whole. The viewer's visual understanding of an area is based on the visual character of visible features and aspects and the relationships between them. The visual character is descriptive and not evaluative;
- **Visual Effect:** Is a change to an existing view as a result of development or the loss of particular landscape elements or features already present in the view;
- **Visual Resources:** The visual resources of the landscape are the stimuli upon which actual visual experience is based. They are a combination of visual character and visual quality;
- **Visual Quality:** Although the interpretation of viewers' experience can have preferential and subjective components, there is generally clear public agreement that the visual resources of certain landscapes have high visual quality. The visual quality of a landscape will reflect the physical state of individual features or elements. Due to the subjective value of the evaluation there is no comprehensive official process for identifying visual quality. The visual quality of this evaluation has been carried out by one Chartered Landscape Architect and verified by another; and
- **Zone of Theoretical Visibility (ZTV):** This represents the area over which a development could theoretically be seen. The ZTV usually presents a 'bare ground' scenario – i.e. a landscape without screening structures or vegetation.

16.3 RECEIVING ENVIRONMENT

16.3.1 Scale and Character

The proposed M28 Road Project extends from the Douglas area southeast of Cork City to immediately east of the village of Ringaskiddy and follows the corridor of the existing N28.

To the east lies Ringaskiddy that is a designated Strategic Employment Area under the Cork CDP, 2014-2020 which is reflected by the quantity and frequency of industrial plants in the landscape around the village. The Port of Cork terminal is also located in Ringaskiddy which operates as a cargo and ferry port linking Ireland to the UK and France. The character of Ringaskiddy is strongly influenced by the industrial uses including a number of tall wind turbines. The scale of this landscape is broad as the harbour is wide and opens up the landscape between adjacent hills.

To the west lies Cork City with the urban areas of Douglas, Rochestown and Donnybrook on the south side of the River Lee. These urban areas are predominantly residential in character with the majority of houses being two storey. The scale of this landscape is enclosed due to the proximity of built form and trees and vegetation.

The majority of the proposed M28 Road Project crosses a landscape that comprises undulating agricultural land which is predominantly open grasslands with frequent rounded and small hills. The undulating nature of this landscape results in lower parts of the landscape being enclosed but with wider views available from taller hilltops.

The existing N28 is a busy road for commuters travelling to and from Cork City as well as for port and industrial traffic travelling to and from the Ringaskiddy area. The existing road broadly follows the contours of the landscape as it meanders from the City to Ringaskiddy. The existing road is not prominent in views from the wider landscape as it appears to quickly merge with either adjacent urban development or with trees, hedgerows and hillsides in the undulating agricultural landscape.

Given the context of the scale and character of the landscapes within the study area of this proposal it is anticipated that there will be potential views available from a range of locations within the ZTV including:-

- Douglas and Rochestown areas;
- Cobh to the northeast;
- Monkstown to the north;
- Haulbowline to the northeast;
- Carrigaline from properties on its northern most parts adjacent to the R611;
- Shannonpark and Shanbally areas;
- Scattered dwellings along the adjacent road network; and
- Ringaskiddy village from southern and eastern parts.

A series of viewpoint locations have been chosen to represent the potential views listed above as illustrated in **Figure 16.2** in **Volume 5.**

16.3.2 Landscape Character

The proposed M28 Road project extends from the Douglas area of Cork City to immediately east of the village of Ringaskiddy and follows the corridor of the existing N28. With reference to the Cork CDP 2014-2020 - Appendix E: Landscape Character Assessment of County Cork, the proposed road project is located directly within the City Harbour and Estuary Landscape Character Type. As this LCT is based on a general categorisation of Cork County landscapes as part of the landscape and visual impact assessment of the proposed M28 Cork to Ringaskiddy Motorway Project a landscape character assessment has been completed to further refine the broad City Harbour and Estuary LCT and the the landscape character of the study area can be described by use of the following distinctive landscape character areas (which are illustrated in **Figure 16.3** in **Volume 5**).

Estuarine Harbour-Based Industrial and Maritime Landscape

This landscape character area is concentrated mainly on low-lying parts of the landscape at the edge of Cork Harbour, but also expands to the adjacent hillsides. Many of the industrial sites are located historically at the water's edge for operational purposes but many modern industrial sites have been constructed around the village of Ringaskiddy. The industrial sites are located at Ringaskiddy are mainly pharmaceutical plants. Haulbowline Island has its naval activities and former Irish Steel East Tip site (under remediation). The Rushbrooke (Cork Dockyard) with its tall cranes at the entrance to Passage West are prominent feature of the harbour. Aghada and Whitegate (electricity generating station, and oil refinery are located further to the east in the harbour. Spike Island with its star fort is located just east of Ringaskiddy and is promoted as a tourist destination.

The value of this landscape is mainly economic, due to its industrial nature. This is a generally robust changing landscape. The industrial landscapes around the existing Cork Harbour and reclaimed lands are generally of low visual quality with frequent industrial type buildings and equipment and vacant lands. Recently the erection of wind turbines has altered the landscape character of the Cork Harbour at Ringaskiddy and the wind turbines are visible over a wide area and are the tallest features in the landscape.

Haulbowline Island is located to the north and the topography of the island site is generally flat in the centre with undulations to the western and eastern most edges. The naval base buildings offer screening in views to the west but the east side of the island is open to views to the northeast and south. The eastern side of the island is known as East Tip and consists of the brownfield site of the former Irish Steel plant. Views from the island are available towards Ringaskiddy and to the proposed M28 Road Project.

Spike Island is located to the east and consists of a rounded hill topography dominated by the former star fort. The buildings offer screening in views to the east but the west side of the island is open to views to the west towards Ringaskiddy and the proposed M28 Road Project.

Overall this landscape character area has a low sensitivity to change.

Harbour Edge Town Centre and Undulating Residential Townscape

Town centres such as Ringaskiddy, Monkstown, Cobh and Passage West are all located at the waterside of Cork Harbour. The residential areas of these towns have spread outwards along the harbour. Monkstown, Cobh and Passage West have also extensively spread onto the surrounding hillsides, with Cobh continuing to expand on to the higher parts of the hill on which it is located. The towns have a scenic value due to their location on the harbour. This value is expressed by the designations of scenic landscapes and scenic routes. These towns also have recreational value in the form of town parks or walking trails.

Cobh is located to the north of the proposed site and is a significantly larger settlement than Ringaskiddy and has an important tourist industry and acts as a satellite town for Cork City. Cobh has a number of structures recorded for protection. These structures give Cobh a high scenic value. Due to Cobh's history it attracts many visitors and has a high recreational value. Large cruise liners regularly berth at Cobh from where tourists can explore Cobh and the wider Cork City area. The topography at Cobh rises steeply from the shoreline with stepped terraces of houses that broadly follow the contours with direct views across the harbour. Cobh harbour provides ferries to Spike Island. There are potential views southwest from Cobh towards the proposed M28 Road Project.

Monkstown is located to the northwest of Ringaskiddy and like Cobh has grown up the steep hillsides that surround Cork Harbour with distinctive terraces and occasional church spire breaking the skyline. Due to the terraced nature of the settlement there are potential views across to Monkstown Creek and the harbour towards the proposed M28 Road Project.

Shanbally is a smaller settlement immediately west of Ringaskiddy and south of Monkstown Creek and located at a cross road on the existing N28. The village consists of mostly rendered two storey dwellings but also has a school and church that face onto the existing N28 road. The settlement is enclosed by adjacent topography and trees with few views out to the surrounding landscape.

Rochestown lies east of the existing N28 and is defined to the north by the R610 coast road that follows the shore line of the River Lee. Built urban form extends south on rising topography that affords properties views across the river to the north. In recent times more extensive housing estates have been developed further south and along the existing N28 road corridor. Houses are predominantly two storey in height and of mixed construction types and architectural design.

Douglas lies west of the existing N28 and like Rochestown also follows the R610 road on lower lying topography but rises to the south with longer range view to the north available from properties towards the River Lee. Houses are predominantly two storey in height and of mixed construction types and architectural design.

Carrigaline lies south of the existing N28 and extends to the shoreline of Cork Harbour. The town acts as a commuter town for Cork but has a thriving commercial centre and extensive housing estates particularly on the north side of the town. Housing is predominantly two storey in height and modern in style.

Ringaskiddy Village sits on the existing N28 and is now positioned in a landscape that has become industrialised through the growth of the port and surrounding pharmaceutical industries. The village essentially consists of housing with limited commercial premises. The housing spreads across steep slopes that offer views towards the harbour.

This landscape character area has a medium sensitivity to change.

Undulating Agricultural Patchwork Landscape

The undulating agricultural landscape is a landscape found over a wide area south and southeast of Cork City and comprises agricultural fields, and meadows, hedgerows as field boundaries, rural houses, farm complexes etc. It also comprises protected structures scattered across the landscape. This landscape extends inland from the River Lee and Harbour's edge and is strongly undulating in nature. This landscape is frequently heavily influenced by adjacent urban and industrial land uses in proximity to the settlements but also along the existing N28 corridor that crosses the landscape largely located in hollows between the hills as it meanders from Cork to Ringaskiddy. A large hard rock quarry, golf course and a dismantled railway line are all located within this landscape between Shannonpark and Shanbally. Tall electricity towers cross this landscape west of Shanbally and towards Monkstown. At Barnahely south of Ringaskiddy and east of the R613 lies the site of a castle in ruins known as Castle Warren (full details are provided in Cultural Heritage **Chapter 15** of the EIS).

This landscape character area has a medium sensitivity to change.

16.3.3 Planning Designations

County Cork Development Plan (CDP) 2014- 2020

A review took place of the landscape policies and objectives of the Cork CDP 2014-2020. The Cork CDP 2014-2020 states the following objectives regarding landscape, scenic amenity views and prospects:

County Development Plan Objective GI 6-1: Landscape

a) Protect the visual and scenic amenities of County Cork's built and natural environment;
b) Landscape issues will be an important factor in all land use proposals, ensuring that a proactive view of development is undertaken while maintaining respect for the environment and heritage generally in line with the principle of sustainability;
c) Ensure that new development meets high standards of siting and design;
d) Protect skylines and ridgelines from development; and
e) Discourage proposals necessitating the removal of extensive amounts of trees, hedgerows and historic walls or other distinctive boundary treatments.

County Development Plan Objective GI 7-1: General Views and Prospects: preserve the character of all important views and prospects, particularly sea views, river or lake views, views of unspoilt mountains, upland or coastal landscapes, views of historical or cultural significance (including buildings and townscapes) and views of natural beauty as recognized in the Draft Landscape Strategy.

County Development Plan Objective GI 7-2: Scenic Routes: Protect the character of those views and prospects obtainable from scenic routes and in particular stretches of scenic routes that have very special views and prospects identified in this plan. The scenic routes identified in this plan are shown on the scenic amenity maps listed in Volume 2 Chapter 5 Scenic Routes of the plan.

County Development Plan Objective GI 7-3: Development on Scenic Routes

a) Require those seeking to carry out development in the environs of a scenic route and/or an area with important views and prospects, to demonstrate that there will be no adverse obstruction or degradation of the views towards and from vulnerable landscape features. In such areas, the appropriateness of the design, site layout, and landscaping of the proposed development must be demonstrated along with mitigation measures to prevent significant alterations to the appearance or character of the area.

b) Encourage appropriate landscaping and screen planting of developments along scenic routes.

County Development Plan Objective GI 7-4: Development on the Approaches to Towns and Villages: Ensure that the approach roads to towns and villages are protected from inappropriate development, which would detract from the setting and historic character of these settlements.

County Development Plan Objective GI 8-1: Prominent and Strategic Metropolitan Greenbelt Areas Requiring Special Protection: Protect those prominent open hilltops, valley sides and ridges that define the character of the Metropolitan Cork Greenbelt and those areas which form strategic, largely undeveloped gaps between the main Greenbelt settlements. These areas are labelled MGB1 in the Metropolitan Greenbelt map and it is an objective to preserve them from development.

Table 16.6: Designated Scenic Landscapes and Scenic Routes in Study Area

Designation	Location
High Value Landscape	Monkstown
High Value Landscape	Great Island
High Value Landscape	Spike Island
High Value Landscape	Haulbowline Island
High Value Landscape	Barnahely
Scenic Route S53	R624 Regional Road, between Cobh and Belvelly - Views of the Upper Harbour and coastal environment.
Scenic Route S54	R610 Regional Road, Local Road & N28 National Primary Route between Passage West and Ringaskiddy - Views of the Harbour.
Scenic Route S59	R612 Regional Road & Local Roads between Crosshaven and Myrtleville, Church Bay, Camden, Weavers Point and Fountainstown - Views of the sea & coastal landscape.
City Harbour and Estuary Landscape Character Type- Very High Value & Sensitivity	Entire Cork City, Harbour and Estuary.

Other Designations

Other designations include proposed NHAs, SPAs, and SACs. Potential impacts of the proposed road project on these designated sites in the Study Area are discussed in **Chapter 12: Terrestrial Ecology** of this **EIS** and not in this Landscape and Visual Chapter**.** Potential impacts of the proposed road project on designations for cultural heritage features are discussed in **Chapter 15: Cultural Heritage.**

Trees

The CDP 2014-2020, Objective HE 2-5: Trees and Woodlands seeks to protect trees and groups of trees. It is an objective to preserve and enhance the general level of tree cover in both town and country, to ensure that development proposals do not compromise important trees and include an appropriate level of new tree planting and where appropriate to make use of tree preservation orders to protect important trees or groups of trees which may be at risk or any tree(s) that warrants an order given its important amenity or historic value. See also Objective GI 6-1: Landscape (e) above - Discourage proposals necessitating the removal of extensive amounts of trees, hedgerows and historic walls or other distinctive boundary treatments.

Landscape Character

A landscape character assessment of County Cork was undertaken in 2003 using a methodology that followed the Landscape Assessment Guidelines issued by the Department of the Environment and Local Government. The process involved the identification and integration of physical units and visual units, utilising photography, GIS, contour mapping, etc. The Landscape Character Areas were identified and refined to 16 Landscape character types (LCT), where the primary elements of landform and land cover were similar. Mapping, panoramic photography and an outline description of the 16 landscape character types were provided within the assessment. Key diagrams from the document are illustrated on the following pages: Landscape Character Assessment Strategy; Landscape Character Areas for County Cork; and Landscape Character Types for County Cork. The CDP states that the 16 LCT's provide a general categorisation of Cork County landscape character.

The Landscape Character Area (LCA) identified for Cork City environs was Cork City and Harbour LCA. This LCA was refined as City Harbour & Estuary landscape character type. It is bounded to the south by indented Estuarine Coast of Crosshaven and Roberts Head; to the south-west by Rolling Patchwork Farmland of Belgooly. To the west lies Broad Fertile Lowland Valleys of Enniskeane, Bandon, Ballinhassig and the River Bride. Fissured Fertile Middleground lies to the north, comprising of Donoughmore and Watergrass Hill. Broad Fertile Lowland Valleys of Castlemartyr and Cloyne lie to the east of the City Harbour and Estuary. The south-eastern edge is identified as Broad Bay Coast. The key characteristics of the City Harbour and Estuary Character Type are:-

- Mouth of the River Lee;
- Extensive natural harbour
- Urban, industrial and commercial developments;
- Large islands; and
- Estuarine River.

The overall City Harbour & Estuary landscape is described as a balance of intensive urban form, rural character and seascape. It has been stated as having a high landscape value and as having a very high landscape sensitivity. The CDP states that large scale development must be carefully located to avoid being highly obtrusive.

16.4 POTENTIAL IMPACTS

16.4.1 Construction Phase

During the construction phase potential impacts include:-

- Site preparation/enabling works and operations including temporary stockpiles;
- Compound location;
- Removal of existing trees and woodlands;
- Site infrastructure and access for construction traffic;
- Haul route traffic;
- Vehicular and plant movements including earthworks;
- Use of crushing and screening plant at the existing quarry site. Any quarrying of material will be done in accordance with the existing planning permission; and
- Dust emissions.

Chapter 3: Description of Proposed Road Development of the EIS describes the construction methods proposed in detail. The works are anticipated to be 30 – 36 months in duration. Works will be potentially visible from within the ZTV during this phase to a varied extent that will be related to the individual construction activity at any given time. It is anticipated that the majority of the material deficit will be obtained from Raffeen Quarry. The route of the proposed road passes through the southern part of the quarry. The quarry has planning permission to resume material extraction, obtained on 16th July 2008 under Reg. Ref. 06/10037 and PL. 04.225610. This planning permission is valid for a 30 year period. This quarry is well screened from surrounding properties and existing roads and no significant landscape or visual impacts are predicted for its use during the construction stage.

Elsewhere ground level views of the site activities will be restricted by extensive built form at Douglas and Rochestown and intervening strong topography and vegetation in rural areas that will limit the extent of potential impacts to localised areas in close proximity. However due to the existing topographical characteristics of the undulating agricultural landscape the proposed construction site will have potential to be more visible to the wider surrounding landscape from elevated properties and roads.

As described in **Chapter 3: Description of the Proposed Road Development** of this EIS a site for the construction stage compound have been identified has been identified at the proposed Shanbally Interchange within the footprint of the proposed road development.

During the construction stage, the main visual receptors to be impacted will be the residents located directly adjacent to the construction works from Ch. 0 - 1,600 West Side; Ch. 250 - 2,000 East Side; residents in properties either side of Shannonpark roundabout from Ch. 6,000 - 6,500 both sides; residents in properties on the southern side of Shanbally between Ch. 9,000 - 10,000; residents in properties on the southern and eastern side of Ringaskiddy village. Associated activities include the increase in construction traffic (mainly HGV) on local roads and loss of screening vegetation. Properties at close proximity to the proposed road development will have Moderate to Major visual impact when construction activities are in close proximity and short term in duration.

Other identified wider sensitive visual receptors will be less impacted, due to a combination of the large distance between proposed construction works and receptors and/or the intervening built form and topography of the landscape.

Within the wider landscape impacts during the construction phase will be Minor to Moderate negative due to limited influence the construction works will have on the landscape, its phased/sequenced construction and the duration of the works at any given location.

The construction stage of the proposed Service Area will be located within an existing harbour industrial area that is in a constant state of flux with large HGVs coming and going from the harbour. The proposed site is set back from the existing N28 road in a flat landscape and these factors will prevent significant landscape or visual impacts In the Ringaskiddy area. The predicted visual effect for elevated properties in Ringaskiddy with a view north towards the construction site will be Minor to Moderate. No significant landscape effects are predicted for the proposed Service Area during the construction stage.

16.4.2 Operational Phase

The proposed M28 Road Project will result in new built elements in the local landscape albeit partly directly along an existing road corridor. The principal sources of impact of such a development include:-

i. Disturbance from traffic during operation.
ii. Imposition of new features in the landscape.

The following features have been taken into account during the prediction of impacts; the level of new roads, side roads; junctions or structures; road signs; lighting; traffic on road including headlight glare, loss of trees and relocation of pylons at Shanbally.

Landscape Character Area Impacts

With reference to the Cork CDP 2014-2020 - Appendix E: Landscape Character Assessment of County Cork, the proposed road project is located directly within the City Harbour and Estuary Landscape Character Type. As this LCT is based on a general categorisation of Cork County landscapes as part of the landscape and visual impact assessment of the proposed M28 Cork to Ringaskiddy Motorway Project a landscape character assessment has been completed to further refine the broad City Harbour and Estuary LCT and the following landscape/townscapes have been identified and are located directly within the proposed road project; Undulating Agricultural Patchwork Landscape; the Harbour Edge Town Centre & Undulating Residential Townscape; and Estuarine Harbour Based Industrial & Maritime Landscape.

Undulating Agricultural Patchwork Landscape

This landscape character area extends inland from the harbour's edge and is of an undulating nature. The proposed road project is directly located within this landscape character and there will be direct impacts as result. The proposals will result in a new road with embankments, cuttings and structures that will alter this landscape permanently. While the proposed road project does follow a similar corridor to the existing N28 it will result in a new feature in this landscape. The existing N28 is noticeable but not a prominent feature in the wider context of this landscape, but locally it is

prominent. It is predicted that the proposed M28 Road Project will not be prominent widely across this landscape as this landscape, due to its undulating nature, has potential to quickly absorb changes with distance. The proposed M28 Road Project follows the local contours of the topography through large parts of this landscape. Locally however, the proposed road project will be prominent in the landscape where the profile of the new road is raised above local topography to form embankments for overbridges for example at Shannonpark; Shanbally; Warrens Cross Roads; and Old Post Office Road. A steep sided cutting across the local topography is also required between Ringaskiddy and the Martello Tower to the rear of properties at Martello Park. At Barnahely south of Ringaskiddy and east of the R613 lies the site of a castle in ruins known as Castle Warren. There is no public access to the castle and therefore no potential for visitor amenity impacts. The adjacent graveyard will not be directly affected and remaining walls and vegetation provides a buffer from the proposed road project. The former demesne at this location is now broken up and doesn't form a distinctive landscape feature. Effects on this protected structure are assessed in the Cultural Heritage **Chapter 15** of this EIS.

This landscape character area has a medium sensitivity to change.

The predicted change in landscape resource is large in proximity to the proposed route within 1km. Beyond this distance the landscape resource change will be Negligible.

When landscape impacts are assessed during the operational stage they will be Moderate to Major in proximity to the proposed M28 Road Project and Negligible to Minor adverse beyond 1km.

Harbour Edge Town Centre & Undulating Residential Townscape

This landscape character area is located around the edges of the Harbour and River Lee and its estuaries. The proposed road project is directly located within this landscape character at Douglas, Rochestown; Shanbally; and Ringaskiddy and there will be direct impacts as result. The existing N28 is a feature of the townscape at Douglas and Rochestown already and the proposed road project closely follows the alignment of the existing road. The proposed road project therefore modifies the appearance of an existing feature of the townscape in Douglas and Rochestown rather than introduces a completely new feature. Trees and woodland will however be lost along the boundaries of the existing N28 between Douglas and Rochestown with a large area of woodland lost at the area known locally as Mulcon Valley that will result in significant landscape effect at a local level. The proposed road project will introduce new roads to the Shanbally and Ringaskiddy townscapes on larger scale than adjacent local roads (with exception of the existing R613 and N28 crossed at Ringaskiddy). Roads are a feature in this wider townscape and the proposed road project is therefore in part consistent with this townscape area and this offsets the degree of landscape resource change. Local diversions to overhead electricity lines are required at Shanbally that will result in existing separate overhead lines on steel pylons and wooden poles being relocated. These features exist already in the landscape and as a result there will be no change in landscape resource. Both Monkstown and Cobh townscapes are not directly impacted and are both well separated from the proposed road project with no significant effects predicted. Carrigaline is similarly not directly impacted by the proposed road project and although the proposals will be visible from the northern edge of the settlement there will be alteration of the townscape character of the settlement and no significant effects are predicted.

This landscape character area has a medium sensitivity to change.

The predicted change in landscape resource is medium.

When landscape impacts are assessed during the operational stage will be Moderate adverse.

Estuarine Harbour Based Industrial & Maritime Landscape

This landscape character area is located at Ringaskiddy and the proposal is directly located within this landscape character. This landscape is robust and in a continual state of flux and change. This landscape has frequent large buildings and traffic coming and going from the port related industries and pharmaceutical factories in the Ringaskiddy area. The proposed road project crosses the existing N28. The existing N28 is a feature of this landscape. The proposed Service Area is located directly within this landscape. The proposed Service Area will be a new feature in this landscape but similar in scale and appearance to adjacent buildings. Traffic accessing the proposed Service Area will be similar to the traffic currently accessing the port area. Low levels of landscape resource change will therefore occur.

This landscape character area has a low sensitivity to change.

The predicted change in landscape resource is small.

When landscape impacts are assessed during the operational stage will be Negligible to Minor adverse.

Table 16.7: Summary of Landscape Character Impact Assessment

Landscape Character Area	Impact Assessment
Undulating Agricultural Patchwork Landscape	Moderate/Major to Moderate adverse (within 1km of proposed road project)
Harbour Edge Town Centre & Undulating Residential Townscape	Moderate adverse
Estuarine Harbour Based Industrial & Maritime Landscape	Negligible to Minor adverse

16.4.3 Planning Policy Designation Impacts

Cork County Development Plan (CDP) 2014-2020

Impacts on relevant designations contained within the Cork CDP2014-2020 are assessed below.

Scenic Route S53: The majority of this route (on the R624) is located on the west side of Great Island and therefore visually separated from proposed road project. On approaching Cobh the road does offer glimpse and direct views across the harbour to the proposed M28 Road Project at Ringaskiddy. The views from the R624 are from low lying positions. The proposals will be difficult to discern at this distance and with Haulbowline Island the main focal point in the foreground of views. The predicted significance of visual impact is no change.

Scenic Route S54: People driving the scenic route (on the R610) in the direction from Passage West to Monkstown will be looking in the direction of the proposed M28 Road Project but no views will be available due to intervening topography and built form at Shanbally, Ballintaggart and Ringaskiddy. The prominent tall electricity pylons and cranes at Rushbrooke and the existing port facilities and wind turbines will remain notable in the view from the R610 at these locations.

Drivers on the scenic route beyond Monkstown and at Monkstown Creek views will be completely screened.

From Monkstown Creek to Ringaskiddy the existing port facilities and adjacent industrial development is prominent in views and the scenic views are directed towards the harbour and Cobh and away from the proposed road project that is well screened by topography/vegetation apart from the short section to the rear of Martello Park. The proposed Service Area will be well screened in views. The predicted visual impact for the Scenic Route 54 is Negligible to Minor.

Scenic Route S59: People driving the scenic route from the R612 will not have views of the proposed road project due to intervening topography and the distance of view. The predicted visual impact for the Scenic Route 59 is no change.

Designated Scenic Landscapes: a series of scenic landscapes have been identified for protection by the Cork CDP 2014-2020 as listed in **Table 16.6** above. The proposed route does not directly or indirectly affect any of the designated scenic landscapes due to the separation distance of the proposed route from the scenic landscapes.

16.4.4 Visual Impacts on Residential Properties and Other Visual Receptors

An assessment has occurred within the ZTV to determine the magnitude of visual impact of the proposed road project during the operational stage on potential views from sensitive visual receptors including residential properties.

Ringaskiddy Residential Properties: A detailed visual impact assessment has been completed for properties at Ringaskiddy in proximity to the proposed M28 Road Project (see **Figures 16.4a** to **16.4p**). Due to the location of the proposed road project on higher ground and south of Ringaskiddy the majority of the village will not have a potential view of the new road. The Service Area is located on lower lying ground between the village and the harbour and will be potentially visible from elevated properties in Ringaskiddy with views towards the harbour. In such views the Service Area will be noticeable but not prominent as it is well separated from the village and located within an area with similar built form and features that will offset its potential prominence. There will be some beneficial effects from the reduction in port traffic using the proposed M28 instead of the existing N28 through the village. Overall the predicted significance of visual impact is predicted as Minor to Moderate for the residential properties at Ringaskiddy (not covered by the detailed visual impact assessment in **Figure 16.4a** to **16.4p**) with a view in the direction of the proposed road project.

Monkstown Residential Properties: The site of the proposed road project will not be visible from Monkstown. The new Service Area will be located in the view direction of elevated properties at Monkstown but the new facilities will be difficult to discern from existing visual clutter and buildings in the port area. Overall the predicted significance of visual impact is predicted as Minor for the residential properties at Monkstown with a view in the direction of the proposed M28 Road Project.

Cobh Residential Properties: The majority of the site of the proposed M28 road will not be visible from Cobh. Only the short section to the rear of Martello Park at Ringaskiddy will potentially be visible but at such long distances (>2km) the proposed cutting at this location will be very difficult to discern. The new Service Area will be located in the view direction of elevated properties at Cobh and from Whitepoint and Blackpoint at lower levels but the new facility will be difficult to discern from existing visual clutter and buildings in the port area. Overall the predicted significance of visual impact is predicted as Minor for the residential properties at Cobh with a view in the direction of the proposed M28 Road Project.

Douglas Residential Properties: A detailed visual impact assessment has been completed for properties at Douglas in proximity to the proposed M28 Road Project (see **Figures 16.4a** to **16.4p**). Due to the location of the proposed M28 road within the urban built up form of Douglas the majority of the settlement will not have a potential view of the new road as views will be obstructed by neighbouring properties. To the south of Douglas the topography rises and some houses have glimpse views across rooftops towards the existing N28. In such views the proposed road project will be visible but there will be no significant change in visual resource for middle to long distance glimpse views. Full details of the visual impact assessment for Douglas is provided in **Figure 16.4a** to **16.4p**) for those properties with a view in the direction of the proposed road project.

Rochestown Residential Properties: A detailed visual impact assessment has been completed for properties at Rochestown in proximity to the proposed road project (see **Figures 16.4a** to **16.4p**). Due to the location of the proposed road project within the urban built up form of Rochestown the majority of the settlement will not have a potential view of the proposed M28 as views will be obstructed by neighbouring properties. As with Douglas to the south of Rochestown the topography rises and some houses have glimpse views across rooftops towards the existing N28. In such views the proposed M28 will be visible but there will be no significant change in visual resource for middle to long distance glimpse views. Full details of the visual impact assessment for Douglas is provided in **Figure 16.4a** to **16.4p**) for those properties with a view in the direction of the proposed M28 Road Project.

Passage West Residential Properties: Properties at Passage West will have no direct views of the proposed road project due to the separation distance and topography and harbour side development located between the settlement and the proposed road project.

Shannonpark Residential Properties: Full details of the visual impact assessment for Shannonpark is provided in **Figure 16.4a** to **16.4p**) for those properties with a view in the direction of the proposed road project.

Shanbally Residential Properties: Full details of the visual impact assessment for Shanbally is provided in **Figure 16.4a** to **16.4p**) for those properties with a view in the direction of the proposed road project.

The location of all individual residential properties affected in close proximity to the proposed road project is illustrated in **Figure 16.4a** to **16.4p** and details on impacts on individual properties in the absence of mitigation are summarised in **Table 16.8**. Specific Landscape Mitigation (SLM) has been identified in **Section 16.5** to address the significant impacts established.

Table 16.8: Visual Impact (Without Mitigation)

Degree of Visual Impact	Number of Properties Before Mitigation
Major to Substantial Negative Visual Impact	67
Moderate to Major Negative Visual Impact	193
Minor to Moderate Negative Visual Impact	364
Minor	294
None	100

Recreation and Amenity: there are two golf courses in close proximity to the proposed road project namely; Douglas Golf Club and Fernhill Golf Club and Country Club. Douglas Golf Club is located immediately west of the existing N28 and will have views towards the proposed road project opened through disturbance of existing roadside vegetation for a very small part of the extensive golfing facility. The predicted visual effect is moderate and not significant for users.

Fernhill Golf Club currently has no direct views of the existing N28 and will be located immediately south of the proposed road project where it crosses the existing quarry at Raffeen. The proposed road project will be a new but not overly prominent feature in the landscape immediately north of the golf course and the predicted visual effect is moderate and not significant for users.

There are two sport pitch facilities in proximity to the proposed road project namely; Shamrocks GAA Club, Shanbally and football pitches at Coolmore Close Shanbally. The GAA club pitches will be located north of the proposed road project with strong hedgerow and tree cover and separation distance in the land in between. The focus of users is on the pitch facility. The predicted visual effect is Minor and not significant.

The football pitches at Coolmore Close Shanbally are directly impacted by the proposed road project with one of two pitches to be acquired for the construction of the road. Alternative access will be provided to the retained pitch, car park and club house. The predicted visual effect is Moderate to Major and not significant as the main focus of users is on the pitch facility.

The Martello Tower at Ringaskiddy has accessed by a short footpath and overs elevated views over Cork Harbour and Estuary. Although the proposed road project is located immediately north of the Martello Tower and footpath it is located with a cutting and views to Cork Harbour and Estuary will remain uninterrupted with only road lighting and distant glimpse view of the Service Area available. The predicted visual effect is Minor to Moderate and not significant.

There is a graveyard immediately adjacent to the R613 at Ringaskiddy that will be located north of the proposed road project. The graveyard will not be directly affected and existing walls, fences and vegetation will provide a buffer from the proposed road project where it is closest to the graveyard and offset medium distance visibility to the east. The predicted visual effect is Minor to Moderate and not significant.

Rochestown Park Hotel is located immediately south of the existing N28 and the proposed road project. While alterations to the existing road will be visible from some locations within the hotel and grounds there is limited change in visual resource and the predicted visual effect is Minor to Moderate and not significant.

16.4.5 Viewpoint Assessment

A series of representative viewpoints have been selected from locations throughout the study area and photomontages prepared of the proposals and subjected to specific assessment below. The location of all viewpoints can be found on **Figure 16.2 (Volume 5)** and Photomontages are also included in **Volume 5**. A summary of the viewpoint assessment in the absence of mitigation is presented in **Table 16.9** below.

Viewpoint 1: View South-west from Rocky Island, Cork Harbour.

Viewpoint Description and Sensitivity

This viewpoint is located on the gravelled access pathway on the south-western corner of Rocky Island accessed from the L252. The viewpoint is located approximately 800m northeast of the route at its proposed junction with the L2545. The view is considered to be representative of views experienced by visitors to Rocky Island and oblique views from the adjacent L252 when travelling south.

The viewer sensitivity is considered to be high.

Existing View

The existing panoramic view available from this location is heavily influenced by large scale buildings and development associated with Cork Harbour. The majority of the visible built form is viewed below the well vegetated elevated land to the rear which forms a middle distance horizon. The National Maritime College of Ireland (NMCI) and Beaufort Research Buildings are visible to the left of the view, whilst cranes and industrial buildings associated with Cork Harbour are visible to the right of the view. The jetty and lifeboat training facility associated with the NMCI forms a point of interest within the foreground centre of the view. Martello Tower, visible to the centre left, buildings associated with Janssen Biological and the Beaufort Research Building punctuate the middle distance horizon, whilst pylons carrying high voltage cables and large scale lighting columns associated with the Port of Cork facility add further verticality within the view.

Predicted View

It is predicted that the route of the proposed road project will not be visible within the view due to screening effects provided by intervening built form and vegetation cover. The proposed Service Area will be partially visible at lower elevation beyond the jetty, though it will be read as part of the overall existing shoreline development. Proposed embankment cutting will be visible within a small portion of the view due to loss of existing vegetation and will be perceived as an alteration to the existing vegetated slopes forming the mid distance horizon.

Magnitude of Impact

The magnitude of impact on the visual resource is considered to be small, as the majority of the overall view available from this location will remain unaltered.

Significance of Visual Impact

The significance of visual impact is considered to be Minor to Moderate and not significant.

Viewpoint 2: View East from L2545 at Junction with N28.

Viewpoint Description and Sensitivity

This viewpoint is located on the footpath adjacent to the L2545 in proximity to its junction with the existing N28 and the access to Cork Ferry facility. The viewpoint is located approximately 500m west of the route at its proposed junction with the L2545. The view is considered to be representative of views currently experienced by road users on the L2545 and oblique views available to residential properties in the vicinity.

The viewer sensitivity is considered to be high for both road users and residential receptors.

Existing View

The existing, focused view is partially restricted by existing vegetation adjacent to the L2545. The existing tree line to the right of the view partially screens residential properties beyond, with canopies forming an elevated horizon line. Vegetation to the left of the view screens the adjacent port side development lands, whilst street lighting and lighting columns within adjacent port land add further verticality to the view. Existing industrial buildings are partially screened by vegetation at distance within the central portion of the view.

Predicted View

It is predicted that the proposed road project will be partially visible at distance only within the central portion of the view as a consequence of vegetation removal. Existing industrial buildings adjacent to the proposed route junction will become more visible within the view as a result of site clearance. It is considered that traffic utilising the proposed road project will be perceived within a minor portion of the view and will only be visible for a short duration.

Magnitude of Impact

The magnitude of impact on the visual resource is considered to be Negligible as the majority of the view will remain unaltered.

Significance of Visual Impact

The significance of visual impact is considered to be Minor and not significant for both road users and residential receptors.

Viewpoint 2a: View South from Old Post Office Road, Ringaskiddy.

Viewpoint Description and Sensitivity

This viewpoint is located adjacent to the access for the residential property ‘Martello’, which lies on the southern extent of Ringaskiddy. The viewpoint is located approximately 80m north of the proposed M28. The view is considered to be representative of views experienced by road users on the Old Post Office Road and residential properties in the immediate vicinity.

The viewer sensitivity is considered to be high for both road users and residential receptors.

Existing View

The existing view is enclosed by existing vegetation adjacent to the Old Post Office Road, field boundary hedgerows associated with adjacent arable land and woodland screen planting. Existing vegetation cover provides an elevated horizon, perceived at middle distance. Rendered garden boundary walls associated with residential properties form visual contrast with the generally rural landscape beyond. Timber poles and pylons carrying overhead cables are prominent within and add verticality to the view.

Predicted View

It is predicted that embankments, noise barriers and overbridge will be visible at close distance within the view, located within the foreground arable field. Embankments associated with the route will form a visual barrier to woodland and vegetation beyond, whilst the rear of the proposed 3m high noise barrier will be visible across the top of the embankment. Bridge parapets associated with the crossing over the Old Post Office Road will be partially screened within the view by intervening roadside vegetation. New public lighting will draw attention to the proposed road project at night time.

Magnitude of Impact

The magnitude of impact on the visual resource is considered to be large.

Significance of Visual Impact

The significance of visual impact is considered to be Major to Substantial, assessed as significant for both road users and residential receptors.

Viewpoint 3: View South from St. Carthage Place, Ringaskiddy

Viewpoint Description and Sensitivity

This viewpoint is located on the communal parking area at the western end of St. Carthage Place, which lies on the southern extent of Ringaskiddy. The viewpoint is located approximately 90m north of the proposed road project. The view is considered to be representative of views experienced by residential properties in the immediate vicinity.

The viewer sensitivity is considered to be high.

Existing View

The existing view is generally open in nature, though partially restricted by trees and hedgerows forming boundaries to arable fields within the immediate foreground. More elevated arable land set within a strong framework of woodland and hedgerows forms the distant backdrop. Distant horizons within the central portion of the view are elevated by existing tree lines and woodland, whilst distant views to the left are screened by intervening woodland. The ridgeline of Ringaskiddy Lower Harbour National School is partially screened by intervening vegetation within the centre of the view. Timber poles and pylon carrying overhead cables are visible within the foreground and together with the wind turbine add verticality to the view.

Predicted View

It is predicted that embankments and noise barriers will be visible at close distance within the view. Embankments associated with the route re-alignment will form a visual barrier to lower elevated land within the central portion of the view, whilst more elevated arable land forming the distant horizon will remain visible. The rear of the proposed 3m high noise barrier will be visible across the top of the embankment.

Magnitude of Impact

The magnitude of impact on the visual resource is considered to be medium, as whilst the view is partially obstructed by new embankments they do not substantially alter the scale or character of the wider setting.

Significance of Visual Impact

The significance of visual impact is considered to be Moderate to Major, assessed as significant.

Viewpoint 4: View South from Marian Terrace, Shanbally

Viewpoint Description and Sensitivity

This viewpoint is located on the footpath adjacent to Marian Terrace, within a gated access driveway to an incomplete residential property. The viewpoint is located approximately 90m north of the proposed route and is considered to be representative of views experienced by road users travelling south on Marian Terrace and residential properties in the immediate vicinity.

The viewer sensitivity is considered to be high.

Existing View

The representative view is restricted by the existing rendered wall associated with the driveway access to the incomplete residential property adjacent. Views south, along Marian Terrace, are available from this location, though are focused in nature by roadside vegetation and boundaries associated with residential properties to the south of this location. Arable land is visible above the gated access to the left of the view, though soon gives way to scrub vegetation on more elevated land which screens the Barnahely Electrical Substation beyond. Existing pylons and wooden poles carrying overhead cables are prominent within the view and together with the telecommunications mast add strong verticality to the view. New public lighting will draw attention to the proposed road project at night time.

Predicted View

It is predicted that embankments, noise barriers and bridge crossing will be visible at close distance within the view, located within the foreground arable field. Embankments associated with the route re-alignment will form a visual barrier to land beyond and will partially obscure wooden poles, pylons and telecommunication mast beyond. Local diversions to overhead lines on steel pylons and wooden poles will be required at this location but there will be little noticeable difference in the partial views available from this direction. The rear of the proposed 2m high noise barrier will be visible across the top of the embankment. Bridge parapets associated with the crossing over Marian Terrace will be partially screened within the view by intervening roadside vegetation.

Magnitude of Impact

The magnitude of impact on the visual resource is considered to be large.

Significance of Visual Impact

The significance of visual impact is considered to be Major to Substantial, assessed as significant.

Viewpoint 4b: View South-east from Marian Terrace, Shanbally

Viewpoint Description and Sensitivity

This viewpoint is located adjacent to the screen gate, visible to the left of the previous view from adjacent to Marian Terrace. The viewpoint located approximately 90m north of the proposed route, has been orientated southeast and is considered to be representative of views experienced by residential properties in the immediate vicinity.

The viewer sensitivity is considered to be high.

Existing View

The existing, whilst partially restricted by boundary access arrangements within the immediate foreground is comprised pastoral arable fields set at a slightly lower elevation within a strong framework of hedgerows, trees and scrub vegetation. Pastoral fields are visible at middle distance whilst the immediate foreground is comprised unmaintained private land associated with the incomplete residential property. Shanbally Health Centre is partially screened by existing intervening vegetation, whilst the rear of the Shanbally Grotto structure is visible above existing pastoral fields within the centre of the view. Existing pylons and timber poles carrying overhead cables are prominent within the view and together with the telecommunications mast add strong verticality to the view.

Predicted View

It is predicted that embankments and noise barriers will be visible at close distance within the view, located within the foreground arable field. Embankments associated with the proposed road project will form a visual barrier to land beyond and will partially obscure timber poles, pylons and telecommunication mast beyond. The rear of the proposed 2m high noise barrier will be visible across the top of the embankment. New public lighting will draw attention to the proposed road project at night time. The existing 110kv lines on wooden poles and steel pylons will be relocated at this location with the overhead line on wooden poles slightly closer to the viewer and the overhead line on steel pylons relocated further away from the viewer. Overall however the visibility of the overhead lines and supporting structures will be well screened by the proposed road embankments at this location with little noticeable difference in visibility of electricity infrastructure (see **Appendix 16A** in **Volume 5; Figure 1.5b**).

Magnitude of Impact

The magnitude of impact on the visual resource is considered to be large.

Significance of Visual Impact

The significance of visual impact is considered to be Major to Substantial, assessed as significant.

Viewpoint 5: View West from the existing N28

Viewpoint Description and Sensitivity

This viewpoint is located adjacent to the existing N28 corridor, east of the Shannonpark Roundabout junction with the R611 (Cork Road). The viewpoint is located approximately 90m east of the Shannonpark Roundabout and 120m north of the proposed M28 Road Project. The view is considered to be representative of views experienced by road users on the N28 and residential properties in the immediate vicinity.

The viewer sensitivity is considered to be high for the close residential receptor and medium for road users due to influences exerted by the existing N28 corridor.

Existing View

The existing, generally panoramic view is partially restricted by mature planting within the immediate foreground, which screens land beyond. Land to the left of the view, beyond the residential property is generally open, rising pastoral land which screens views of arable land beyond.

The existing N28 road corridor dominates and focuses the view in the direction of travel (west). Visible land beyond the Shannonpark Roundabout is well vegetated, with mature trees extending the perceived horizon line. Glimpses of arable land set within a strong enclosing framework of hedgerows and woodland are available to the right of the view. Scattered residential properties are glimpsed within a small portion of the view amongst the mature planting to the left of the Shannonpark Roundabout. Lighting columns and road signage add verticality to the overall view, though are limited to the existing road corridor, whilst timber poles and pylons carrying overhead lines are largely absent from the view.

Predicted View

It is predicted that embankments and noise barriers will be visible at a variety of distances within the view. Embankments associated with the proposed road project will form a visual barrier to land beyond. Proposed 2.5m high noise barrier will be visible at higher elevation within the same portion of view, increasing screening of land beyond.

Magnitude of Impact

The magnitude of impact on the visual resource is considered to be high, as whilst the proposals are prominent they do not substantially alter the scale or character of the surroundings.

Significance of Visual Impact

The significance of visual impact is considered to be Major to Substantial, assessed as significant for residential receptors and considered to be Moderate to Major and not significant for road users on the current N28 route.

Viewpoint 6: View South-west from existing N28 at junction with L6469

Viewpoint Description and Sensitivity

This viewpoint is located on the grassed verge adjacent to the existing N28 corridor at its junction with the L6469, north of the Shannonpark Roundabout. The viewpoint is located approximately 200m north of the Shannonpark Roundabout and 220m northeast of the proposed road project. The view is considered to be representative of views experienced by road users on the existing N28 and residential properties in the immediate vicinity.

The viewer sensitivity is considered to be high for residential receptors within the immediate vicinity and medium for road users due to influences exerted by the existing N28 corridor.

Existing View

The existing view is generally panoramic in nature, though is partially restricted by mature tree planting throughout. The left portion of the view is dominated by the existing N28 corridor and associated signage. Pastoral land is visible within the central portion of the view though is partially screened by existing hedgerows and roadside vegetation. A line of mature poplars, within the central portion of the view, marks the northern edge of the R611 and forms a strong visual draw within the view. The woodland copse and well maintained garden boundary hedgerows to the right of the view screens existing large scale residential properties.

Residential properties associated with the northern extent of Carrigaline, to the south are partially visible above and within intervening vegetation cover, whilst more elevated mixed arable and pastoral land beyond forms the distant horizon. Street lighting columns associated with the existing N28 and R611 corridors are perceived above the distant horizon line, adding verticality and scale to the view. Timber poles carrying overhead cables are visible within the view, though are partially screened by existing vegetation cover.

Predicted View

Existing vegetation associated with field boundaries within the central portion of the view along with the line of existing poplars along the R611 will be removed as part of the proposed road project. New embankments, noise barriers and bridge parapets will be visible across the central portion of the view at a variety of distances.

The 2m high noise barrier associated with the Shannonpark off slip will be visible at a lower elevation than the proposed road level, whilst 2m and 2.5m high noise barriers to the east and west of the new bridge over the R611 will be visible above the embankments. Embankments and associated noise barriers will obscure visibility of lower lying land beyond, whilst residential properties on the northern edge of Carrigaline will remain partially screened within the centre left of the view. The large residential properties, to the right of the view will become fully obscured by the proposed road project works. New public lighting will draw attention to the proposed development at night time

Magnitude of Impact

The magnitude of impact on the visual resource is considered to be large.

Significance of Visual Impact

The significance of visual impact is considered to be Major to Substantial, assessed as significant for residential receptors in the vicinity and Moderate to Major, assessed as significant for road users on the current N28 route.

Viewpoint 7: View South-east from R609

Viewpoint Description and Sensitivity

This viewpoint is located on the R609 adjacent to the cluster of residential dwellings to the northwest of the proposed road project. The viewpoint is located approximately 160m northwest of the route at its bridged overpass with the R609. The view is considered to be representative of views experienced by users on the R609 and oblique views available to residential receptors in the vicinity.

The viewer sensitivity is considered to be high for the close residential receptor and medium for road users on the R609.

Existing View

The existing view is constrained by garden boundary vegetation, to the left of the view and tall field boundary vegetation to the right of the view, such that views are directed east along the R609. The existing bridge, carrying the existing N28 over the R609 is partially visible to the centre of the view, screened by existing garden boundary and field boundary vegetation. Timber poles carrying overhead lines are present within the view, though screened by vegetation to the left of the view. Rising agricultural land forms the back drop and horizon to the view, whilst existing embankment planting forms a well vegetated backdrop to the existing N28 route. Existing road network connections and associated directional signage is visible from this location.

Predicted View

It is predicted that the upgraded bridge carrying the M28 will be fully visible within the view, together with new road linkages and roundabouts associated with the junction improvements. The proposals includes for re-alignment of the R609 which will result in the removal of the field boundary vegetation to the right of the view. Such improvements will be visible from the cluster of residential properties adjacent to the viewpoint location. Proposed embankments beyond the N28 will be visible in forward views when travelling east due to removal of existing vegetation, with rising agricultural lands modified as part of the works. Upper portions of the existing agricultural land will remain intact, together with the open horizon-line. The proposed 3m high noise barrier will be partially screened by retained field boundary vegetation in eastern views. New public lighting will draw attention to the proposed road project at night time.

Magnitude of Impact

The magnitude of impact on the visual resource is considered to be large.

Significance of Visual Impact

The significance of visual impact is considered to be Major to Substantial, assessed as significant for residential receptors and Moderate to Major, assessed as not significant for road users.

Viewpoint 8: View from Route of Existing N28.

Viewpoint Description and Sensitivity

This viewpoint has been located on the existing N28, within close proximity to the existing off slip to the R609. The viewpoint is located approximately 10m east of the proposed road project. This view is considered to be representative of views experienced by road users travelling north on the existing N28 route.

The viewer sensitivity is considered to be medium due to travel speeds.

Existing View

The existing view is constrained and restricted by the combination of embankments and existing vegetation cover, such that views are directed along the direction of travel. Peripheral and forward views are restricted by existing field boundary and embankment vegetation which restricts views of the wider landscape and the distant horizon. Arable land is glimpsed beyond the foreground, which is comprised of the N28 and associated signage. Timber poles carrying overhead lines are fully visible either side of the carriageway, though are not generally perceived as duration of view is short lived due to speed of travel.

Predicted View

It is predicted that the view available from this location will become more open in nature due to the removal of roadside vegetation associated with new embankment works related to the re-alignment of the N28 and the R609 junction. Vegetation cover on lower portions of the existing embankment to the right of the view will be reduced as part of the proposed road project, with land beyond becoming more visible in the view. Arable land visible within the centre of the view will become part of the proposed road project with associated embankments and 3m high noise barrier. New public lighting will draw attention to the proposed road project at night time.

Magnitude of Impact

The magnitude of impact on the visual resource is considered to be large.

Significance of Visual Impact

The significance of visual impact is considered to be Moderate to Major, assessed as significant.

Viewpoint 9: View South-west from Ard Keale, Mount Oval Village

Viewpoint Description and Sensitivity

This viewpoint is located on the footpath adjacent to local access within the Rowan Hill residential Estate to the east of the N28. The viewpoint is located approximately 260m east of the existing N28 and the view is considered to be representative of views experienced by residential receptors in the vicinity.

The viewer sensitivity is considered to be high for both road users and residential receptors.

Existing View

The existing view is partially restricted by maturing vegetation along the main access route into the residential development. The elevated location of the viewpoint offers panoramic views west over Cork, with town centre buildings forming minor visual draws on the distant horizon. Roof lines of residential properties that lie to the west of the N28 are visible amongst the existing vegetation cover, though are viewed below and amongst existing tree canopies. The existing N28 route is not visible within the view to screening by intervening vegetation.

Predicted View

It is predicted that the route of the proposed road will not be visible within the view due to screening effects provided by intervening vegetation cover.

Magnitude of Impact

The magnitude of impact on the visual resource is considered to be no change as the proposed road project is screened in the view.

Significance of Visual Impact

The significance of visual impact is considered to be None.

Viewpoint 10: View West from R610 (Rochestown Road)

Viewpoint Description and Sensitivity

This viewpoint is located on the footpath adjacent to the R610 (Rochestown Road) in proximity to its junction with the residential development The Ovals. The viewpoint is located approximately 140m east of the existing N28 overpass. The view is considered to be representative of views experienced by road users travelling west and residential receptors within the immediate vicinity.

The viewer sensitivity is considered to be high for both road users and residential receptors.

Existing View

The existing view is generally urban in character; comprised of residential housing, formal garden boundary treatments, road corridors, footpaths and mixed vegetation types. The existing N28 overpass forms a distinct horizontal visual draw above the R610 corridor in the central portion of the view. The existing N28 overpass and associated barriers are set against a strongly vegetated back drop and are perceived below the elevated horizon formed by elevated tree canopies beyond. Street lighting columns are visible throughout the central portion of the view, adding verticality and scale to the view.

Predicted View

It is predicted that the proposed road to the overbridge will be fully visible within the view, whilst works associated with the route alignment to the north and south will be screened by intervening vegetation and built form. Vegetation clearance proposed as part of the north-bound carriageway alignment works will be perceived above the new bridge works.

Magnitude of Impact

The magnitude of impact on the visual resource is considered to be medium.

Significance of Visual Impact

The significance of visual impact is considered to be Moderate to Major, assessed as significant for both road users and residential receptors.

Viewpoint 11: View East from Newlyn Vale

Viewpoint Description and Sensitivity

This viewpoint is located on the local access road at Newlyn Vale to the west of the existing N28 corridor. The viewpoint is located approximately 100m west of the proposed northbound route and is considered to be representative of oblique views experienced by residential receptors and views experienced from the R610 (Rochestown Road).

The viewer sensitivity is considered to be high.

Existing View

The existing view is restricted in nature by adjacent residential properties and street trees along the edge of Rochestown Road. Garden boundary walls and mixed shrub planting provides variety and interest to the left of the view, whilst close street trees screen views to the right. The existing overpass structure associated with the existing N28 is partially screened by intervening tree canopies within the central portion of the view, though forms a minor element of the view. Existing street lighting is visible within the left portion of the view, adding verticality and scale within the view though are generally perceived at a lower elevation than the horizon lines formed by tree canopies and ridge lines.

Predicted View

It is predicted that the proposed alterations to the overpass will be visible within the left hand portion of the view. The 3m high noise barrier and parapet for the bridge will be visible above the overbridge to the left of the view though will become screened to the right by existing street trees. Visibility of the proposed overpass structure and associated barriers will increase during winter months only as tree canopies become devoid of leaves.

Magnitude of Impact

The magnitude of impact on the visual resource is considered to be medium.

Significance of Visual Impact

The significance of visual impact is considered to be Moderate to Major, assessed as significant.

Viewpoint 11a: View East from Rochestown Rise

Viewpoint Description and Sensitivity

This viewpoint is located on the local access road, Rochestown Rise, approximately 100m to the west of the proposed road project. The viewpoint is considered to be representative of views experienced by residential receptors.

The viewer sensitivity is considered to be high.

Existing View

The existing view is restricted by garden boundary walls and mixed species boundary screen planting. The existing N28 corridor is not visible within the view due to screening provided by intervening vegetation. Street lighting column, whilst visible within the view is not perceived against the existing vegetated boundary.

Predicted View

It is predicted that new embankment works, noise barrier and security fencing associated with the proposed development will be visible within the view. Existing vegetation clearance will result in the view becoming more open, though the proposed embankment and 3m high noise barrier will screen views of the M28.

Magnitude of Impact

The magnitude of impact on the visual resource is considered to be medium, as adjacent residential properties are predicted to experience a greater magnitude.

Significance of Visual Impact

The significance of visual impact is considered to be Moderate to Major, assessed as significant to residential receptors in the absence of mitigation.

Viewpoint 12: View North from Delford Drive, Cork

Viewpoint Description and Sensitivity

This viewpoint is located on the edge of unmanaged open space to the north of Delford Drive. The viewpoint located approximately 150m west of the existing N28 corridor north and is considered to be representative of views experienced by residential properties in the immediate vicinity.

The viewer sensitivity is considered to be high.

Existing View

The existing view is restricted in nature by mature tree and shrub planting within the foreground and at middle distance where such woodland planting is associated with the southern boundary of the existing N28 corridor. The immediate foreground is comprised of unmanaged tall grassland with scattered shrub and tree species, edged by footpath and maintained grassed verge. Perceived horizon lines are elevated by existing tree canopies.

Predicted View

It is predicted that proposed road project north of this viewpoint will be fully screened in views. Proposed vegetation removal required as part of the proposed alignment will be difficult to distinguish and will be viewed as a minor alteration to the elevated horizon.

Magnitude of Impact

The magnitude of impact on the visual resource is considered to be no change as impacts resulting from vegetation clearance will be difficult to distinguish within the view.

Significance of Visual Impact

The significance of visual impact is considered to be None**.**

Viewpoint 12a: View West from St Patrick's Church, Rochestown

Viewpoint Description and Sensitivity

This viewpoint is located in the car park of St. Patrick's Church, Rochestown. The viewpoint is located approximately 80m east of the existing N28 and is considered to be representative of views experienced by residential receptors in the vicinity and visitors to the church.

The viewer sensitivity is considered to be high.

Existing View

The existing view from this location is restricted and heavily influenced by mature tree planting associated with the N28 and within the streetscape within the immediate foreground. The mixed species conifer and broadleaved planting to the rear of the block walling and hedge within the centre of the view screens the existing N28 from receptors at this location. Upper canopy levels are perceived as an elevated horizon. Existing lighting columns associated with the N28 are visible above the canopies of trees.

Predicted View

Vegetation clearance associated with the proposed road project will alter the available view from this location. It is predicted that the 3m high noise barrier, associated with the off slip will be visible at a lower elevation in the view and will screen the off slip route within the view. The proposed road project will become visible above this, forming a strong horizontal feature within the view, further extended by street lighting columns.

Magnitude of Impact

The magnitude of Impact on the visual resource is considered to be large.

Significance of Visual Impact

The significance of visual impact is considered to be Major to Substantial assessed as significan**t** to residential receptors.

Table 16.9: Summary of Viewpoint Assessment

Viewpoint No.	Viewpoint Name	Predicted Effect (Without Mitigation)
1	View South-west from Rocky Island, Cork Harbour.	Minor to Moderate and not significant
2	View East from L2545 at Junction with N28	Minor and not significant
2a	View south from Old Post Office Road	Major to Substantial, assessed as significant.
3	View South from St. Carthage Place, Ringaskiddy	Moderate to Major, assessed as significant.
4	View South from Marian Terrace, Shanbally	Major to Substantial, assessed as significant.
4b	View South-east from Marian Terrace, Shanbally	Major to Substantial, assessed as significant.
5	View West from N28	Major to Substantial, assessed as significant for residential receptors and Moderate, assessed as not significant for road users.
6	View South-west from N28 at junction with L6469	Major to Substantial, assessed as significant for residential receptors and Moderate to major, assessed as significant for road users.
7	View South-east from R609	Major to Substantial, assessed as significant.
8	View from Route of Existing N28.	Moderate to Major, assessed as not significant.
9	View South-west from Ard Keale.	None
10	View West from R610 (Rochestown Road)	Moderate to Major, assessed as significant
11	View East from Newlyn Vale	Moderate to Major, assessed as significant.
11a	View East from Rochestown Rise	Moderate to Major, assessed as significant.
12	View North from Delford Drive,	None
12a	View West from St Patrick's Church, Rochestown	Major to Substantial, assessed as significant.

16.5 MITIGATION MEASURES

16.5.1 Landscape Mitigations Measures

Project Level Objectives

The relevant project level objectives as set out in **Chapter 1: Introduction and Need for the Proposed Road Development** to this LVIA Chapter are *to minimise the impact of any improvement works on nearby environmentally sensitive sites*.

Aims of Landscape Mitigation

To provide mitigation measures to help avoid, reduce or remedy any significant landscape and visual impacts arising from any elements within the proposed M28 Road Project.

To ensure the physical and visual integration of the proposed road project and associated features into surrounding landscape.

To provide screening to avoid, reduce or remedy visual intrusion at residential properties to address any negative aspects regarding the visual impact of the proposed road project.

To provide replacement planting for visually significant woodland and hedgerows lost due to widening.

General Objectives of Landscape Mitigation

Mitigation shall be in keeping with the existing landscape character. Therefore, small copses of woodland using plant species present in the local landscape will be acceptable and beneficial to the landscape. In instances where small corners of fields are disrupted it is proposed to plant them with hedgerows and provide small wooded clumps to break up the visible mass of the road where appropriate. Plant mixes of native trees and shrubs and wild meadow grass mix will be planted where appropriate.

In line with the NRA *Guide to Landscape Treatments of National Road Schemes in Ireland* it is a core objective of the landscape mitigation to use native plants and seed from indigenous sources. The implementation of the landscape mitigation measures must be in accordance with the NRA *Guide to Landscape Treatments*.

Specific Landscape Measures (SLM)

The location and details of where SLM will be implemented are set out in **Table 16.10** and illustrated on **Figure 16.5**. Where cuttings and embankments are not present the SLM will require a minimum width of 5m planting as illustrated **on Figure 16.5.**

Table 16.10: Specific Landscape Measures (SLM)

Location	Description of SLM
SLM 01:- minus 300 -Ch. 0.00 west	Screening Woodland Mix planting
SLM 02:- Ch. 100 - 550 both sides	Screening Woodland Mix planting (Individual trees Ch.400-550 east)
SLM 03:- Ch. 550 - 800 both sides	Screening Woodland Mix planting (Individual trees Ch. 550 – 800 west)
SLM 04:- Ch. 800 - 1,300 both sides	New trees to replace roadside trees lost due to construction in are known locally as Mulcon Valley (Individual trees Ch. 1050 – 1300 west and Ch. 1000 – 1200 east)
SLM 05:- Ch. 1,300 - 1,550 east	Screening Woodland Mix planting (Individual trees Ch. 1300 – 1550 east)
SLM 06:- Ch. 1,400 - 1,650 west	Screening Woodland Mix planting (Individual trees Ch. 1400 – 1650 west)
SLM 07:- Ch. 2,200 Carrigaline Road West on and off slip roads	Screening Woodland Mix planting (Individual trees)
SLM 08:- Ch. 3,350 - 4,000 east	Screening Woodland Mix planting
SLM 09:- Ch. 3,900 - 4,450 west	Screening Woodland Mix planting
SLM 10:- Ch. 5,300 - 6,250 both sides	Screening Woodland Mix planting (Individual trees Ch. 5450 – 6100 east and Ch. 6000 – 6250 west)
SLM 11:- Ch. 6,250 -6,600 both sides	Screening Woodland Mix planting (Individual trees Ch. 6250 –

Location	Description of SLM
	6500 east)
SLM 12:- Ch. 6,750 - 7,300 both sides	Screening Woodland Mix planting (Individual trees Ch. 6850 – 7100 east and Ch. 6850 – 7200 west)
SLM 13:- Ch. 8,100 - 8,800 east	Screening Woodland Mix planting
SLM 14:- Ch. 9,000 - 9,500 both sides and slip roads	Screening Woodland Mix planting (Individual trees both sides)
SLM 15:- Ch. 11,000 - 11,950 both sides	Screening Woodland Mix planting (Individual trees Ch. 11400 – 11800 and 11850 – 11950 east and Ch. 11550 – 11750 west)
SLM 16:- Ch. 1200 - 12,300 both sides	Screening Woodland Mix planting to cutting (Individual trees Ch. 12000 –12150 east to top of cutting)

Chapter 12: Terrestrial Ecology proposes ecological mitigation measures (See **Figure 12.6**) on the proposed road project where it crosses Raffeen Quarry that have been considered as part of the landscape and visual impact assessment and are consistent with the proposed landscape mitigation measure set out in this chapter.

16.5.2 Mitigation Specifications

Tree, Hedge and Shrub Planting

All trees, shrubs, transplants/whips, hedging material and ground cover planting shall conform fully to the specification, prepared by the landscape consultant, in respect of species, size and quality. All plants shall be well grown, sturdy and bushy according to type and free from all diseases and defects. The plants shall be available for inspection prior to planting works. Any plant material that does not conform to the specification will be automatically rejected and must be removed from site. All trees, shrubs and other plant material shall comply with the standards set out in National Plant Specification (NPS) prepared by the Committee on Plant Supply and Establishment and published with the backing of the Joint Council of Landscape Industries (JCLI, 1989).

Defective Plant Material

All trees, shrubs, transplants, hedging material and ground cover planting shall be maintained and guaranteed for a period against death, deformation, die-back, or disease other than that caused by malicious damage.

Plant Mixes

Essentially road verge or bank planting will consist of ‘bare root transplants’, ‘whips’ and ‘feathered trees’ which, due to their smaller stock size at time of planting, will adapt more easily to the disturbed ground and exposed site conditions. All plants are to be positioned in the locations and in the required numbers and centres indicated on the agreed planting plan.

Screening Woodland Mix

Landscape mitigation planting of road verges and slopes and as compensation for loss of existing screening and loss of woodland, individual trees and hedgerows along the proposed M28 Road Project will exclusively use Irish native species that reflect the existing vegetation of the area. Core species will include; Hybrid Oak, Scots Pine, Hawthorn, Hazel, Holly, Blackthorn, Goat Willow, Alder, Rowan and Birch. Additional species at certain locations will include; Blackthorn, Broom, Elder, and Grey Willow.

Woodland Mix areas will be planted as whips and feathered transplants at a standard size of 60-90cm or 90-120cm augmented by semi-mature individual trees. Species shall be randomly planted in groups. The majority of species used will be quickly maturing species and will have formed dense woodland within ten years. The canopy will reach at least 7 to 10m, in places where groups of trees are planted. In addition to whip and feathered transplants individual semi-mature trees shall be used to provide screening at SLM locations where limited roadside space is available or where early effect is required as set out in **Table 16.10**.

Individual Tree Planting

Individual semi-mature tree planting using the core native species (Hybrid Oak and Scots Pine) shall include standard (2.5-3.0 m) and heavy standard (3.5-4.25 m) trees located in locations to provide specific screening and early effect as per **Table 16.10**.

Native Shrub Planting

Shrub planting shall consist of native species from the core and additional species listed above to provide woodland understorey, woodland edge and scrub areas. Shrub planting mixes shall complement areas of woodland and be used at locations consistent with the ecological assessment mitigation measures (see **Figure 12.6**). Hedgerows shall be reinstated at interrupted field boundaries or where new boundaries with fields are created using native hawthorn, blackthorn and holly that shall be the predominant species used. Shrub planting shall also be planted to soften the appearance of noise barriers.

Grass and Wildflower Mixes

The road verges will be seeded with a general (Grade II) grass seed mix. Areas away from designated sight lines where mowing regimes are not required to be of a regular nature will be seeded with wild grasses and meadow flowers. Grass and wildflower mixes using seed from Irish native sources shall be employed to provide quality areas of low maintenance, rapid establishment, and visual appearance.

The construction Contractor will adhere to the NRA's *Draft Guidelines on the Implementation of Landscape Treatment on National Road Schemes in Ireland*, 2011. Storage areas will be located so 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.

Lighting

Mitigation measures have the potential to reduce construction and operational night time impacts, which will mitigate potential visual impacts by night. These include:-

- Use of directional down light style cut-off luminaries to prevent up lighting and reduce glare and sky glow;
- Use of baffles were street lights are located in close proximity to properties to reduce light spill on to properties and to reduce glare and sky glow; and
- Use of lighting control systems to reduce amount of light spill, sky glow, and visual appearance during the construction phase where works take place in proximity to properties.

16.6 RESIDUAL IMPACTS

16.6.1 Residual Impacts

This section of the chapter assesses the residual impact on the landscape character and visual receptors (previously identified in **Section 16.4**), after the mitigation (described above in **Section 16.5**) has attained 10 years of growth. After 10 years of growth the proposed planting will help to integrate the proposal into the existing landscape. The proposed mitigation planting will limit the extent of the influence of the proposed road project on the adjacent Landscape Character Areas with a resultant reduction in landscape impact. The planting at the Service Area will assist in blending the new development within its industrial landscape setting.

As the vegetation re-establishes at area known locally as Mulcon Valley and above Martello Park in Ringaskiddy (on high side slopes) the significant landscape impacts predicted at the construction stage will decrease and the proposed road project will become an integrated component of this urban landscape.

With regards to visual impact on sensitive receptors in general the visual impacts are slightly reduced by the establishment of replacement or new screening woodland that will offset views towards the proposed M28 and its infrastructure and traffic on the road. The predicted residual visual impacts for all properties are provided in detail in **Figure 16.4a-16.4p** and summarised below in **Table 16.11**.

Table 16.11: Residual Visual Impacts (After Mitigation)

Degree of Visual Impact	Number of Properties Before Mitigation	Number of Properties After Mitigation
Major to Substantial Negative Visual Impact	67	0
Moderate to Major Negative Visual Impact	193	67
Minor to Moderate Negative Visual Impact	364	192
Minor	294	365
None	100	394

Table 16.12: Residual Viewpoint Impacts (After Mitigation)

Viewpoint No.	Viewpoint Name	Predicted Effect (Without Mitigation)	Predicted Effect (With Mitigation)
1	View South-west from Rocky Island, Cork Harbour.	Minor to Moderate and not significant	Minor and not significant
2	View East from L2545 at Junction with N28	Minor and not significant	Negligible to Minor and not significant
2a	View south from Old Post Office Road	Major to Substantial, assessed as significant.	Moderate to Major, assessed as not significant (See Appendix 16A for photomontage with mitigation in place).
3	View South from St. Carthage Place, Ringaskiddy	Moderate to Major, assessed as significant.	Minor to Moderate, assessed as not significant.
4	View South from Marian Terrace, Shanbally	Major to Substantial, assessed as significant.	Moderate to Major, assessed as significant.
4b	View South-east from Marian Terrace, Shanbally	Major to Substantial, assessed as significant.	Moderate to Major, assessed as significant.
5	View West from N28	Major to Substantial, assessed as significant for residential receptors and Moderate, assessed as not significant for road users.	Moderate to Major for residential receptors assessed as significant and Minor to Moderate, assessed as not significant for road users (See Appendix 16A for photomontage with mitigation in place)
6	View South-west from N28 at junction with L6469	Major to Substantial, assessed as significant for residential receptors and Moderate to major, assessed as significant for road users.	Moderate to Major for residential receptors assessed as not significant and Moderate, assessed as not significant for road users
7	View South-east from R609	Major to Substantial, assessed as significant.	Moderate to Major, assessed as significant.
8	View from Route of Existing N28.	Moderate to Major, assessed as not significant.	Minor to Moderate, assessed as not significant.
9	View South-west from Ard Keale.	None	None
10	View West from R610 (Rochestown Road)	Moderate to Major, assessed as significant	Minor to Moderate, assessed as not significant
11	View East from Newlyn Vale	Moderate to Major, assessed as significant.	Minor to Moderate, assessed as not significant (See Appendix 16A for photomontage with mitigation in place).
11a	View East from Rochestown Rise	Moderate to Major, assessed as significant.	Minor to Moderate, assessed as not significant.
12	View North from Delford Drive	None	None
12a	View West from St Patrick's Church, Rochestown	Major to Substantial, assessed as significant.	Moderate to Major, assessed as not significant.

The proposed M28 Road Project is located within a number of landscape character areas identified as Undulating Agricultural Patchwork Landscape; the Harbour Edge Town Centre & Undulating Residential Townscape; and Estuarine Harbour Based Industrial & Maritime Landscape. The proposed road project has been predicted to have the following landscape effects; Undulating Agricultural Patchwork Landscape Moderate to Major and significant within 1km and Negligible to Minor and not significant beyond 1km; the Harbour Edge Town Centre & Undulating Residential Townscape Moderate and not significant; and Estuarine Harbour Based Industrial & Maritime Landscape Negligible to Minor and not significant. During construction of the proposed M28 Road Project, the predicted magnitude of landscape resource change will be low and the significance of landscape impact will be Minor to Moderate adverse. On completion of the proposed SLM measures the predicted landscape effects will be reduced during the operation stage.

The ZTV has been established for the proposed M28 Road Project to allow any potential areas of significant visual impact to be identified. Actual visual impacts from within the ZTV have been predicted by site survey and assessment.

A total of 16 viewpoints have been assessed and 11 viewpoints have been predicted to have significant visual impacts largely due to the proximity of the viewpoints to the proposals. Following implementation of the SLM measures the predicted visual effects on viewpoints will be reduced for all views but remain significant for 4 viewpoints due to the proximity of views.

An assessment of Cork County Development Plan has predicted that there will be no significant landscape or visual effects for any relevant landscape policy and designations in the Plan.

A detailed visual impact assessment for residential properties in proximity to the proposed M28 Road Project has been completed. Before mitigation a total of 67 properties are predicted to have Major to Substantial impact; 193 properties are predicted to have a Moderate to Major impact; 364 properties are predicted to have a Minor to Moderate impact; 294 properties are predicted to have a Minor impact; and 100 properties are predicted to have No impact. Following completion of the proposed SLM measures the visual impacts are reduced as follows; 0 properties are predicted to have a Major to Substantial impact; 67 properties are predicted to have a Moderate to Major impact; 192 properties are predicted to have a Minor to Moderate impact; 365 properties are predicted to have a Minor impact; and 394 properties are predicted to have no impact. Significant visual impacts will remain for some properties that are located in close proximity.

17 MATERIAL ASSETS

17.1 INTRODUCTION

This chapter considers and assesses the potential impacts on the material assets of the surrounding area during the construction and operational phases of the proposed road project. The material assets that are considered include:-

- Major utilities; and
- Waste.

Potential impacts to land use and properties are addressed in **Chapter 7: Socio Economic and Community** and potential impacts to agricultural assets are addressed in **Chapter 8: Agriculture Land Uses**.

17.2 METHODOLOGY

17.2.1 Utilities

A number of utility providers have installations within the study area and these are summarised in **Table 17.1** below.

Table 17.1: Data Sources for Material Assets

Utility Provider	Data Source
Gas Network Ireland (GNI)	Consultations between Design Team and GNI
Electricity Supply – EirGrid, ESBI and ESB Networks	Consultations between Design Team and ESBI, EirGrid and ESB Networks
Water Supply/ Waste Water	Consultations between Design Team and Irish Water & Cork County Council
Eir	Consultations between Design Team and Eir
Vodafone	Consultations between Design Team and Vodafone
Meteor	Consultations between Design Team and Meteor
3	Consultations between Design Team and 3
Virgin Media	Consultations between Design Team and Virgin Media (formerly UPC)
enet	Consultations between Design Team and enet
Eir	Consultations between Design Team and Eir

Chapter 6: Non-Statutory Consultation outlines the level of consultation that was undertaken with the various service providers.

17.2.2 Waste

The assessment of the potential impact of the proposed M28 Road Project on the waste management environment has been undertaken in accordance with the general requirements of the "*Guidelines on the information to be Contained in the Environmental Impact Statement* (Draft September 2015), *Advice Notes for preparing Environmental Impact Statements* (Draft September 2015, and the *Guidelines for the management of waste From National Roads Construction Projects* (Revision 1, 12 November 2014). The characteristics of the impact which will be defined are the quality, significance and duration of the impact.

17.3 RECEIVING ENVIRONMENT

17.3.1 Existing Utilities

Utility providers that are known to have services within, or adjacent to, the footprint of the proposed road project include:-

- Gas – Gas Networks Ireland (Transmission and Distribution mains);
- Electricity Supply – EirGrid, ESBI and ESB Networks;
- Mains Water, Surface Water and Foul Sewers – Irish Water and Cork County Council; and
- Telecommunications – Eir, Vodafone, Meteor, 3, Virgin Media (formerly UPC); and enet.

Drawing Nos. UT0201-UT0207 in **Volume 5,** show approximate locations of known services. These drawings were prepared following liaison and meetings with the various service providers. In some instances topographical survey and site investigation data (slit trenches etc.) has been used to verify these locations.

17.3.2 Waste

The proposed M28 Road Project will require a variety of construction methodologies resulting in the generation of various waste streams. As outlined in **Chapter 3: Description of the Proposed Road Development**, the proposed M28 Road Project will run above and below current ground level and as a result cutting and filling will be required along the length of the route. The majority of the waste will be generated from the demolition works, excavation arisings and at the construction compound and Service Area. The potential wastes to be generated by the project and their potential for significant environmental impacts are discussed below in **Section 17.4.2.**

17.4 POTENTIAL IMPACTS

17.4.1 Utilities

17.4.1.1 Gas

Gas Networks Ireland (GNI) owns and operates distribution and transmission mains in the vicinity of the proposed M28 Road Project and has been discussed in detail with Gas Networks Ireland.

Distribution Mains

Table 17.2 below gives details of conflict locations between the proposed M28 Road Project and existing Gas Distribution mains.

Table 17.2: Conflicts with Gas Distribution Mains

Location	Chainage	Existing Apparatus
R610 Rochestown Road	0+550 (Mainline)	180mm 4bar
Maryborough Overbridge	1+560 (Mainline)	125mm 4bar
M28 mainline	9+230 (Mainline)	125mm 4bar
Proposed L6472 Shanbally to Raffeen Link Road	0+080 to 0+180	125mm 4bar
Proposed L2492 Shanbally Southern Link Road	0+000 to 0+080	125mm 4bar
Proposed IDA Link Road	0+080 to 0+270	180mm 4bar
Proposed R613 South Link Road	0+000 to 0+150	180mm 4bar
Barnahely Roundabout	N/A	180mm 4bar
Proposed R613 North Link Road	0+000 to 0+150	180mm 4bar
Proposed L6517 Loughbeg Road (North)	0+000 to 0+040	180mm PE-80 4bar
Proposed Loughbeg Roundabout	N/A	180mm PE-80 4bar
Proposed L6517 Loughbeg Road (South)	0+000 to 0+280	180mm PE-80 4bar
Proposed L2545 West Ringaskiddy Village Link Road	0+000 to 0+070	180mm PE-80 4bar
Proposed Ringaskiddy Roundabout	N/A	180mm PE-80 4bar
Proposed L2545 East Haulbowline Island Link Road	0+000 to 0+090	180mm PE-80 4bar

Transmission Mains

The Gas Transmission main is a 300 mm diameter pipe that supplies a number of pharmaceutical plants in Ringaskiddy. The proposed road project will be in conflict with this transmission main at a number of locations as listed in **Table 17.3** below.

Table 17.3: Conflicts with Gas Transmission Lines

Location	Chainage	Existing Apparatus
M28 Mainline	8+000	300mm ST 19bar
Proposed L6472 Shanbally to Raffeen Link Road	1+480	300mm ST 19bar
M28 Mainline (Barnahely to Loughbeg)	11+020	300mm ST 19bar
M28 Mainline (Barnahely to Loughbeg)	11+610 to 11+720	300mm ST 19bar
Proposed Loughbeg Roundabout	N/A	300mm ST 19bar
Proposed L6517 Loughbeg Road (South)	0+000 to 0+180	300mm ST 19bar

There are no utility services currently traversing the Service Area site. There is a gas pipeline along the southern boundary of the Port of Cork lands and the L-2545 (which also runs along the eastern side of the adjacent disused Ringaskiddy Logistics Centre).

17.4.1.2 Electricity Supply

The proposed road project will be in conflict with a number of overhead and underground ESB cables including LV, 10kV, 20kV, 38kV, 110kV and 220kV.

Extensive liaison has taken place with ESB Networks (LV, 10kV, 20kV and 38kV), EirGrid and ESBI (110kV & 220kV) during the course of the project, regarding existing services and future plans for the area.

Table 17.4 below lists locations of where LV & MV (excl. 38kV) overhead and underground cables are in conflict with the proposed M28 Road Project.

Table 17.4: Networks LV/MV Overhead and Underground Cables

Location on M28	Chainage	Existing Apparatus
N40 Northbound Merge	0+130	MV/LV UG Cable Network
Mainline	0+215	MV/LV UG Cable Network
Mainline (east)	0+250 to 0+350	MV/LV UG Cable Network
Mainline (west)	0+350 to 0+550	MV/LV UG Cable Network
Mainline and proposed Northbound M28 (West) Diverge	0+575 to 0+635	MV/LV UG Cable Network
Rochestown Road	N/A	MV/LV UG Cable Network
Mainline	1+380	MV Overhead Single & 3 Phase
Proposed Maryborough Hill Link Road	0+550 to 0+600	MV Overhead Single & 3 Phase
Proposed Maryborough Hill Link Road	0+460	MV/LV UG Cable Network
Proposed Maryborough Hill Link Road	0+052	MV Overhead Single & 3 Phase
Maryborough Hill	0+160	MV Overhead Single & 3 Phase
Maryborough Hill	0+000	MV Overhead Single & 3 Phase
Mainline	1+670	MV/LV UG Cable Network
Mainline	1+970 to 2+010	MV/LV UG Cable Network
Carr's Hill Northbound Merge	0+120	MV/LV UG Cable Network

Location on M28	Chainage	Existing Apparatus
Carr's Hill Northbound Merge	0+050 to 0+100	MV Overhead Single & 3 Phase
Stream Realignment, R609 tie-in (North South)	0+000 to 0+070	MV Overhead Single & 3 Phase
Stream Realignment, R609 tie-in (North South)	0+025, 0+050	MV Overhead Single & 3 Phase
Proposed Carr's Hill West Roundabout	N/A	MV Overhead Single & 3 Phase
Proposed Carr's Hill Southbound Diverge	0+130	MV/LV UG Cable Network
Proposed Carr's Hill Southbound Merge	0+050 to 0.100	MV Overhead Single & 3 Phase
Mainline	2+670	MV Overhead Single & 3 Phase
Mainline	4+650	MV Overhead Single & 3 Phase
Proposed Shannonpark Northbound Merge (East-West)	0+140 to 0+160 and 0+190	LV Overhead Single & 3 Phase
Proposed Shannonpark Northbound Merge (North-South)	0+190	LV Overhead Single & 3 Phase
Mainline	6+025 to 6+050	LV Overhead Single & 3 Phase
Proposed Shannonpark Southbound Diverge	0+280	LV Overhead Single & 3 Phase
Proposed Ballinrea Access Road	0+025 to 0.060	LV Overhead Single & 3 Phase
Proposed Shannonpark South Link Road	0+025 to 0+175	MV/LV UG Cable Network
Mainline	6+575	MV Overhead Single & 3 Phase
Mainline	7+150 to 7+180	MV Overhead Single & 3 Phase
Mainline	7+800	MV Overhead Single & 3 Phase
Mainline	9+225	LV Overhead Single & 3 Phase
Proposed Shanbally Southbound diverge	0+075	LV Overhead Single & 3 Phase
Proposed L6472 Shanbally to Raffeen Link Road	0+220	LV Overhead Single & 3 Phase
Proposed Shanbally Southbound diverge	0+225	MV Overhead Single & 3 Phase
Mainline	9+375	MV Overhead Single & 3 Phase
Proposed Shanbally Northbound merge	0+200	MV Overhead Single & 3 Phase
Proposed Shanbally North Link Road	0+275	LV Overhead Single & 3 Phase
Proposed IDA Link Road	0+150	MV/LV UG Cable Network
Proposed IDA Link Road	0+250	MV/LV UG Cable Network
Mainline	9+600 to 9+725	MV/LV UG Cable Network
Mainline	9+730	MV/LV UG Cable Network
Mainline	9+890	MV/LV UG Cable Network
Mainline	10+200 to 10+250	MV Overhead Single & 3 Phase
Mainline	10+250 to 10+300	MV Overhead Single & 3 Phase
Proposed Janssen Access Spur	0+000 to 0+060	MV/LV UG Cable Network
Proposed R613 North Link Road	0+50 to 0+100	MV/LV UG Cable Network
Proposed R613 North Link Road	0+040	MV Overhead Single & 3 Phase
Mainline	10+675 to 10+850	MV/LV UG Cable Network
Mainline	10+910	LV Overhead Single & 3 Phase
Mainline	10+910	MV Overhead Single & 3 Phase
Barnahely Roundabout	N/A	MV/LV UG Cable Network
Mainline (Barnahely to Loughbeg)	11+660	MV Overhead Single & 3 Phase
Mainline (Barnahely to Loughbeg)	11+880	MV/LV UG Cable Network
Mainline (Barnahely to Loughbeg)	11+750 to 11+770	MV Overhead Single & 3 Phase

Location on M28	Chainage	Existing Apparatus
Mainline (Barnahely to Loughbeg)	11+770 to 11+980	MV/LV UG Cable Network
Loughbeg Roundabout	N/A	MV Overhead Single & 3 Phase
Loughbeg Roundabout and Entrance to Ringport Business Park	N/A	MV/LV UG Cable Network
Upgrade of Local Road at Loughbeg	0+110	MV/LV UG Cable Network
Upgrade of Local Road at Loughbeg	0+110	MV/LV UG Overhead Single & 3 Phase
Mainline (Loughbeg to East of Ringaskiddy)	12+400	MV Overhead Single & 3 Phase
Proposed L2545 West Ringaskiddy Village Link Road	0+000 to 0+070	MV Overhead Single & 3 Phase
Ringaskiddy Roundabout	N/A	MV Overhead Single & 3 Phase
Proposed L2545 East Haulbowline Island Link Road	0+000 to 0+080	MV Overhead Single & 3 Phase

The proposed M28 Road Project is in conflict with 38kV overhead and underground cables at the locations listed in **Table 17.5** below.

Table 17.5: ESB OH/UG 38kV Cables

Location on M28	Chainage	Existing Apparatus
Mainline	9+600 to 9+650	UG 38kV
Proposed IDA Link Road	0+125	UG 38kV
Mainline	10+350 to 10+400	OH 38kV
Proposed R613 North Link Road	0+060	OH 38kV
Mainline	11+530 to 11+580	OH 38kV
Proposed Loughbeg Roundabout	N/A	OH 38kV

The proposed M28 Road Project is in conflict with 110kV overhead and underground cables at the locations listed in **Table 17.6** below.

Table 17.6: ESBI OH/UG 110kV Cables

Location on M28	Chainage	Existing Apparatus
M28 Mainline	4+450 to 4+500	OH 110kV
Proposed R611 Carrigaline Link Road	0+140	OH 110kV
M28 Mainline	7+220	OH 110kV
M28 Mainline	8+060	OH 110kV
Proposed L6472 Shanbally to Raffeen Link Road	1+380	OH 110kV
M28 Mainline	8+600 to 8+700	OH 110kV
M28 Mainline	8+700 to 8+750	OH 110kV (2 lines)
M28 Mainline	9+200 to 9+350	OH 110kV (2 lines)
M28 Mainline	9+400 to 9+500	OH 110kV
M28 Mainline	9+575	OH 110kV
Proposed Shanbally Northbound Merge	0+100 to 0+280	OH 110kV (2 lines)
Proposed Shanbally Northbound Merge	0+400	OH 110kV

Location on M28	Chainage	Existing Apparatus
Proposed Shanbally Southbound Diverge	0+100 to 0+170	OH 110kV
Proposed IDA Link Road	0+120	OH 110kV
M28 Mainline	10+300 to 10+350	OH 110kV (2 lines)
R613 North Link Road	0+080	OH 110kV (2 lines)
M28 Mainline	11+550 to 11+650	OH 110kV (2 lines)
L6517 Loughbeg Road (South)	0+040	OH 110kV (2 lines)

The proposed M28 Road Project is in conflict with 220kV overhead and underground cables at the locations listed in **Table 17.7** below.

Table 17.7: ESBI 220kV Cables

Location on N28	Chainage	Existing Apparatus
M28 Mainline	7+900	OH 220kV (double line)
M28 Mainline	7+950	UG 220kV
Proposed L2545 West Ringaskiddy Village Link Road	0+000 to 0+070	UG 220kV
Ringaskiddy Roundabout	N/A	UG 220kV
Proposed L2545 East Haulbowline Island Link Road	0+000 to 0+080	UG 220kV

There are no utility services currently traversing the Service Area site. There is a 220Kv underground cable running along the southern boundary of the Port of Cork lands with the L-2545 (which also runs along the eastern side of the adjacent disused Ringaskiddy Logistics Centre). There is also an underground ESB connection servicing the adjacent disused Ringaskiddy Logistics Centre.

There are two overhead 110kV lines in the vicinity of the proposed Shanbally Interchange. Of the two, the single phase line is located slightly closer to Shanbally Village. A diversion of this line is required. It is proposed to remove two existing pole sets and a tower, which will be replaced with a new pole set and two new towers. A diversion of the double circuit line is also required, which will result in the removal of four towers. In order to facilitate this diversion six new towers will be required. The line of the proposed diversion can be seen on drawing No **DG0210** in **Volume 5.**

The potential impacts associated with these modifications have been assessed in the relevant environmental chapters.

17.4.1.3 Water, Surface Water and Foul Sewers

Watermains

A number of conflicts have been established between the proposed M28 Road Project and existing watermains, surface water and foul sewers. Of particular concern are conflicts with the 1,200mm Cork Harbour & City Watermain which occur at 3 locations, i.e., Carr's Hill Interchange, Shanbally Interchange and the R613 at Barnahely. There are a number of conflicts at each of these locations as follows (**Table 17.8**):-

Table 17.8: Conflicts with 1200mm Cork Harbour & City Watermain

Location	Chainage	Existing Apparatus
M28 Mainline @ proposed Carr's Hill Interchange	2+600 to 2+750	1,200mm Cork Harbour & City Watermain
Proposed Shanbally Southbound Diverge	0+280	1,200mm Cork Harbour & City Watermain
M28 Mainline @ proposed Shanbally Interchange	9+425	1,200mm Cork Harbour & City Watermain
Proposed Shanbally Northbound Merge	0+230	1,200mm Cork Harbour & City Watermain
Proposed L6472 West Link Road @ Barnahely	0+140	1,200mm Cork Harbour & City Watermain
Barnahely Roundabout	N/A	1,200mm Cork Harbour & City Watermain
Proposed R613 North Link Road	0+000 to 0+100	1,200mm Cork Harbour & City Watermain
Proposed Janssen Biologics Access Spur	0+050	1,200mm Cork Harbour & City Watermain

During the course of the design phase completed to date a number of trial holes were excavated at Shanbally and Barnahely to establish the line and level of the main. These trial holes were excavated under the supervision of Cork County Council personnel and to their requirements. Each of these conflicts has been discussed in detail with relevant personnel in Cork County Council.

Other Watermain Conflicts

In addition to the conflicts with the 1,200mm Cork Harbour & City watermain there are a number of conflicts with other watermain of various sizes. These conflicts are listed below in **Table 17.9**.

Table 17.9: Other Watermain Conflicts

Location	Chainage	Existing Apparatus
M28 Mainline	1+250 to 1+300	250mm AC
Intersects L2470 Maryborough Hill (South of Bridge)	1+570	250mm AC
Intersects L2470 Maryborough Hill (North of Bridge) where the proposed Maryborough Hill Link Road intersects Maryborough Hill	1+570	100mm
M28 Mainline	2+090	450mm DI
Proposed Carr's Hill Northbound Merge	0+025	450mm DI
Maryborough Hill Link Road	0+025	450mm DI
Proposed Carr's Hill Southbound Diverge	0+240	450mm DI
Proposed Carr's Hill South Roundabout	N/A	450mm DI 200mm DI
Proposed Carr's Hill Northbound Diverge	0+150	150mm AC
Proposed Carr's Hill Southbound Merge	0+110 to 0+150	150mm AC
Proposed Carr's Hill South Link Road	0+050 to 0+100	450mm DI 200mm DI 150mm AC
M28 Mainline	3+210	175 AC

Location	Chainage	Existing Apparatus
M28 Mainline (Board of Works Underbridge)	3+350	250mm DI
M28 Mainline	4+800 to 4+850	100mm
M28 Mainline	6+025	2 x 150mm AC
Shannonpark Southbound Diverge	0+275	2 x 150mm AC
Shannonpark Northbound Merge	0+200	2 x 150mm AC
Proposed Ballinrea Access Road	0+050 to 0+100	450mm
Proposed R611 Carrigaline Link Road	0+000 to 0+180	450mm
Proposed Shannonpark South Link Road	0+125	450mm
M28 Mainline (Rock Road Underbridge)	6+930	150mm
Proposed Shanbally Southbound Diverge	0+075	150mm and 100mm AC
M28 Mainline	9+230	150mm and 100mm AC
Proposed Shanbally Northbound Merge	0+050	150mm and 100mm AC
L6472 Shanbally to Raffeen Link Road	0+190	150mm
Proposed Barnahely Roundabout	N/A	100mm AC
M28 Mainline	10+900 to 10+950	100mm AC
Proposed L6472 West Link	0+000 to 0+040	100mm AC
Proposed L6472 West Link	0+300	100mm AC
Proposed Loughbeg Roundabout	N/A	300mm AC
Proposed L6517 Loughbeg Road (South)	0+000 to 0+270	300mm AC
Proposed L6517 Loughbeg Road (North)	0+000 to 0+050	300mm AC
Proposed Ringaskiddy Roundabout	N/A	450mm
Proposed L2545 West Ringaskiddy Village Link Road	0+000 to 0+070	450mm
Proposed L2545 East Haulbowline Island Link Road	0+000 to 0+090	450mm

Conflicts with Storm Sewers

In addition to the conflicts with watermains there are a number of conflicts with the existing storm sewer network. These conflicts are listed below in **Table 17.10**.

Table 17.10: Conflicts with Storm Sewers

Location	Chainage	Existing Apparatus
R610 Rochestown Road Underbridge	0+550	Storm
M28 Mainline	0+600 to 2+050	Storm
M28 Mainline	1+230	Stream Diversion
L2470 Maryborough Road Overbridge	1+570	Storm
Proposed Carr's Hill Interchange	Various Locations	Storm
Proposed Barnahely Roundabout	N/A	Storm
Proposed R613 South Link Road	0+000 to 0+150	Storm
Proposed R613 North Link Road	0+000 to 0+140	Storm

Conflicts with Foul Sewers

There are a number of conflicts with the existing foul sewer network. These conflicts are listed below in **Table 17.11**.

Table 17.11: Conflicts with Foul Sewers

Location	Chainage	Existing Apparatus
M28 Mainline	1+250	FS 300mm
M28 Mainline	1+440 to 1+460	FS 300mm
Proposed Shanbally Southbound Diverge	0+075	FS 225 mm
M28 Mainline	9+230	FS 225 mm
Proposed Shanbally Northbound Merge	0+050	FS 225 mm
Proposed L6474 Shanbally to Raffeen Link Road	0+190	FS 225 mm
Mainline – Barnahely to Loughbeg	10+950	FS 225mm
Mainline – Barnahely to Loughbeg	10+950 to 11+150	FS (IDA)

There are no utility or water services currently traversing the Service Area site. Along the L2545 and adjacent to the boundary of the Port of Cork lands, there is a watermain and a network of storm water and foul sewer pipes which are to the west of the development site.

17.4.1.4 Telecommunications

Eir

Consultation with Eir has been ongoing during the design phase of the project. A number of conflicts have been identified between the proposed M28 Road Project and existing Eir infrastructure. These conflicts occur at the following locations: Rochestown Road/Clarke's Hill, Rochestown Link Road Underbridge (S2, BR0201, Drawings in **Volume 5**), Maryborough Overbridge (S3, BR0303 & BR0304 Drawings in Volume 5), R611 at Shannonpark Interchange, L6472 (Raffeen Road), Shanbally Interchange, Barnahely Roundabout, R613 and Ringaskiddy Roundabout. These conflicts are listed in **Table 17.12**.

Table 17.12: Conflicts with Eir

Location	Chainage	Existing Apparatus
M28 Mainline Southbound between Bloomfield and Rochestown Interchange	0+000 to 0+350	UG Fibre Optic Cable
Rochestown Southbound Diverge Slip Road	0+260 to 0+380	UG Fibre Optic Cable
Proposed Rochestown Link Road Underbridge (East-West)	0+550	UG Fibre Optic Cable and Copper Cable
Maryborough Underbridge	0+000 to 0+255	UG Fibre Optic Cable and Copper Cable
Proposed Carr's Hill Interchange	Various Locations	O/H wiring
Proposed Shannonpark Central Link Road	0+000 to 0+140	U/G Fibre Optic Cable and Copper Cable

Location	Chainage	Existing Apparatus
Proposed Shannonpark North Roundabout	N/A	U/G Fibre Optic Cable and Copper Cable
Proposed Shannonpark South Roundabout	N/A	U/G Fibre Optic Cable and Copper Cable
Proposed R611 Carrigaline Link Road	0+150 to 0+300	U/G Fibre Optic Cable and Copper Cable
Proposed Shannonpark North Link Road	0+000 to 0+145	U/G Fibre Optic Cable and Copper Cable
Proposed Shannonpark South Link Road	0+000 to 0+225	U/G Copper Cable
Proposed Ballinrea Access Road	0+000 to 0+100	U/G Copper Cable
Proposed Shanbally Road Underbridge	9+230	U/G Copper Cable
Proposed Barnahely Roundabout	N/A	U/G Copper Cable
Proposed R613 North Link Road	0+000 to 0+220	U/G Copper Cable
Proposed R613 South Link Road	0+000 to 0+150	U/G Copper Cable
Proposed L6472 West Link Road	0+000 to 0+151	U/G Copper Cable
Proposed Janssen Access Road	0+045 to 0+060	U/G Copper Cable
Mainline – Barnahely to Loughbeg	11+930	U/G Copper Cable
Proposed Loughbeg Roundabout	N/A	U/G Copper Cable
Proposed L6517 Loughbeg Road North	0+000 to 0+050	U/G Copper Cable
Proposed L6517 Loughbeg Road South	0+000 to 0+280	U/G Copper Cable
Access Road 12	0+000 to 0+046	U/G Copper Cable
Proposed Ringaskiddy Roundabout	N/A	U/G Fibre Optic and Copper Cable
Proposed L2545 West Ringaskiddy Village Link Road	0+000 to 0+067	U/G Fibre Optic and Copper Cable
Proposed L2545 East Haulbowline Island Link Road	0+000 to 0+095	U/G Fibre Optic and Copper Cable

Vodafone/3/Meteor/UPC

3, Meteor and Virgin Media (formerly UPC) do not have any services within the vicinity of the proposed M28 Road Project.

There is an existing Vodafone mast (Site ID: CK146) located in the vicinity of the proposed Carr's Hill Interchange. A meeting has been held with Vodafone on site and the mast can be retained at its current location.

enet

There are a number of conflicts with the enet network and they are listed below in **Table 17.13**.

Table 17.13: Conflicts with enet

Location	Chainage	Existing Apparatus
Proposed IDA Link Road	0+075 to 0+300	enet Duct
Proposed R613 South Link Road	0+000 to 0+150	enet Duct
Proposed R613 North Link Road	0+100 to 0+140	enet Duct
Mainline – Barnahely to Loughbeg	10+970	enet Duct
Loughbeg Roundabout	N/A	enet Duct
Proposed L6517 Loughbeg Road (North)	0+000 to 0+050	enet Duct
Proposed L6517 Loughbeg Road (South)	0+000 to 0+275	enet Duct
Proposed Ringaskiddy Roundabout	N/A	enet Duct
Proposed L2545 West Ringaskiddy Link Road	0+000 to 0+070	enet Duct
Proposed L2545 East Haulbowline Link Road	0+000 to 0+090	enet Duct

17.4.2 Waste

General construction and demolition waste arisings including, but not limited to, wood, packaging, metals, plastics, bricks, blocks, canteen waste, hazardous wastes {e.g. oils, paints, and adhesives), arisings generated from site clearance works and residual wastes will be generated during the construction phase. While it is difficult at this stage to predict exact volume of the wastes arisings expected to be generated by the proposed M28 Road Project, estimates of the waste materials and volumes likely to be generated and the potential for significant environmental impacts are outlined below.

17.4.2.1 Excavated Material

Given the nature of the project and the construction methodologies outlined in **Chapter 3**: **Description of the Proposed Road Development,** it is anticipated that the main waste types generated during the construction phase of the project will be excavation materials generated from the cut works required along the main line of the route as well as clay, soil, stone and concrete from other excavations such as in structural foundations at bridges, slip roads and side roads, etc. Material will also be excavated for the creation of a wetland as outlined in the Habitat and Species Management Plan (Appendix 12B).

The construction of the road element of the project will require approximately 2.2 million m^3 of fill material. It is anticipated that approximately 1.15 million m^3 of reusable material will be excavated from the cuttings for the project. This means that there will be a deficit of material required to construct the project, including the project requirements for higher quality rock material of the order of 1.05 million m^3. It is anticipated that where possible the majority of this material will be obtained from Raffeen Quarry under its current planning permission.

The advantages of utilising the reserves in Raffeen Quarry maximises the sustainable reuse of materials available close to the site, minimising carbon footprint, noise and air emissions associated with transport and adheres to the principles outlined in the Southern Region Waste Management Plan 2015-2021 in terms of making better use of resources.

The preferred option for the management of waste arisings is re-use on site, where possible. However there is an element of cut material that is likely to be considered unsuitable for reuse on-site. It is estimated that 200,500m^3 of surplus cut material will need to be managed off-site. The preferred off-site option for this material is recovery at a licenced soil recovery site where it is envisaged that this material will be used as backfill[1] material. At the Service Area site there will be approximately 22,300m^3 of excavated material that will need to be managed appropriately through disposal or recovery, as appropriate. At this stage, it is assumed that this material will not be suitable for reuse on site and will require transport off site.

It is estimated that approximately 21,000m^3 of excavated material from Raffeen Quarry will be generated in order to create the wetland habitat area. At this stage, it is assumed that this material will be suitable for re-use on site as fill material.

By reusing excavation material from the proposed cuttings where possible and sourcing the remaining material from the quarry situated adjacent to the proposed M28 Road Project the impact from excavations is considered to be slight negative in the absence of mitigation.

17.4.2.2 Demolished Structures

Mixed demolition wastes will arise on the project mainly from the demolition of the existing overbridge and properties at Maryborough Hill and Shanbally, the demolition of the existing deck cantilever and parapet on the western side of the existing bridge at Carr's Hill and the removal of the existing merge at Maryborough Hill.

It is estimated that approximately 210m^3 of waste materials will be generated from the demolition of the identified properties. Approximately 120m^3 of waste materials will be generated from the demolition of the property at Maryborough Hill and approximately 90m^3 will be generated from the demolition of the property at Shanbally. Concrete / masonry will account for the vast majority of this demolition waste. It is envisaged that the majority of this material, an estimated 175m^3, will comprise concrete and stone and will be suitable for reuse on site as fill materials. The remaining material, approximately 35m^3, will require transfer off site to an authorised waste facility for appropriate waste treatment.

The existing overbridge at Maryborough Hill has a deck area of 465m^2. The decking has a general depth of 1.2m it is therefore considered that approximately 558m^3 of reinforced concrete will need to be demolished. In addition there are two piers that need demolishing which include approximately 275m^3 of reinforced concrete. It is envisaged that the majority of this material will be suitable for reuse on site.

17.4.2.3 Pile Arisings

Soil arisings will be generated from pile bores to be used for bridge structures. The majority of the excavated material will be soils, but the pile arising will also contain sands, gravels and cementitious materials. It is expected that bored pile arisings will total approximately 2,520 m^3.

[1] Backfilling is a recovery operation where suitable waste is used for reclamation purposes in excavated areas or for engineering purposes in landscaping and where the waste is a substitute for non-waste materials. Commission Decision of 18 November 2011 (2011/753/EU) establishing rules and calculation methods for verifying compliance with the targets set in Article 11(2) of Directive 2008/98/EC of the European Parliament and of the Council (notified under document C(2011) 8165)

The pile arisings may be contaminated with cementitious materials and without management of this waste stream on site, the impact significance of pile arising, in the absence of mitigation, is therefore assessed as moderate negative due to the potential to cause pollution of the surrounding environment.

17.4.2.4 Surplus Materials

Surplus material and wastage may occur where material supply exceeds material demand. Surplus materials and wastes could arise from existing site materials such as concrete from demolition or excavations of materials from earthworks which cannot be reused in the proposed development. Materials brought to site but not fully utilised for their original purpose or stored incorrectly can result in waste such as damaged products, off cuts and surplus products.

For surplus materials and waste, the potential environmental effects would be primarily associated with production, movement and transport, processing and recovery or disposal of the wastes at appropriately authorised waste facilities with a waste licence, waste permit or certificate of registration. On this basis, in the absence of mitigation, the impact significance of surplus material is assessed as slight.

17.4.2.5 Made Ground

The disturbance or storage of the 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 and site investigation. In the event that previously unidentified contamination is found during the construction works, the proposed management/mitigation measures in **Section 17.5.2** below 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, in the absence of mitigation.

17.4.2.6 Preliminary/Design Stage Phase

As outlined in **Section 11.4.1**, isolated and minor amounts of waste material were generated during the preliminary ground investigations in BH1012A and TP2001. This material will be removed off-site to a suitably licensed facility.

There is potential for the fill material to contain contaminated material. In 1995 the area adjacent to the site of the proposed Service Area was a green field site. Between 2000 and 2005 this area was used as a car storage area. The fill material comprises limestone quarry fill underlain by sand with occasional shells (Port of Cork Strategic development Study – Glover Site Investigations Ltd 2006). In 2011, the Marine Energy Centre analysed soil samples (at a location immediately south of Paddy's Point) for metals, hydrocarbons and polycyclic aromatic hydrocarbons (PAHs) contaminants' and reported that the contaminant levels were low. The fill material will be subject to appropriate chemical testing to assess its contamination potential and determine an appropriate waste treatment route if this is necessary. The treatment or removal of potentially contaminated material will have a positive impact on soils by removing a potential source of contamination. This is considered a moderately positive impact of permanent duration.

17.4.2.7 Waste Management

Where waste materials are not stored, handled, transported or managed (recovered or disposed of) correctly and where sewage associated with temporary site toilets is not managed appropriately (i.e. collected, treated and disposed or recovered appropriately), there is the potential for the pollution of air, soil, groundwater and/or surface waters to occur. For example, such instances could occur by locating unmanaged stockpiles of wastes too close to watercourses or drainage networks.

On this basis, in absence of management or mitigation without waste management plans on site, the impact of waste management is assessed as moderate due to the potential to cause pollution of the surrounding environment.

17.4.2.8 Operation Phase

The main potential impacts from the operational phase of the proposed road project will arise from road and constructed wetland/attenuation pond maintenance, landscape maintenance, maintenance of the Service Area, and waste generated through littering. The predicted characteristics of the impacts resulting from the operation of the road are considered negligible due to the expected low volume of maintenance wastes. It is envisaged that a high proportion of this material will be green, biodegradable wastes in nature.

17.5 MITIGATION MEASURES

17.5.1 Utilities

17.5.1.1 Gas Distribution

Each of these conflicts has been discussed in detail with relevant personnel in Gas Networks Ireland. The following was agreed.

Ch. 0+550m Bloomfield

There is a distribution line along the R610 Rochestown Road, at the location where the M28 mainline crosses this regional road. A potential conflict could occur with the construction of the bridge abutments for the proposed Rochestown Link Road Underbridge. The design drawings of the bridge structure will be forwarded to Gas Networks Ireland for comment.

Ch. 1+560m Maryborough Overbridge

There is a distribution line along the bridge where Maryborough Hill goes over the M28. This bridge shall be replaced and widened as part of this scheme. It is proposed to initially demolish a section of the bridge (which will not impact on the current operation and alignment of the distribution line) and then permanently divert the distribution line into this new section of the Maryborough Overbridge.

Ch. 9+230 M28 mainline

The new M28 mainline carriageway crosses a 125mm 4bar distribution main. The proposed road project will be in 2m of fill at this point. A protection slab, to GNI specification, will be placed over the pipe and isolation valves inserted on either side of road.

Ch. 0+080 to 0+180 - L6472 Shanbally to Raffeen Link Road and Ch. 0+000 to 0+080 L2492 Shanbally Southern Link Road

It is proposed to provide additional protection when these sections of the L6472 and L2492 are getting upgraded by slabbing over the distribution pipe.

Ch. 0+080 to 0+270 IDA Link Road

The new IDA Link Road crosses a 180mm 4bar distribution line. It is proposed to divert this line outside the boundary of the earthworks associated with this project.

Ch. 0+000 to 0+150 - Proposed R613 South Link Road, Ch. 0+000 to 0+150 - Proposed R613 North Link Road, Barnahely Roundabout

The proposed Barnahely Roundabout and associated link roads runs over a 180mm 4bar distribution line. In order to protect the existing pipe slabbing must be provided over the distribution pipe and/ or divert them outside the road.

Ch. 0+000 to 0+040 L6517 Loughbeg Road (North), Ch. 0+000 to 0+280 L6517 Loughbeg Road (South), Proposed Loughbeg Roundabout

The new Loughbeg Roundabout and associated link roads crosses a 180mm PE-80 4bar distribution line. A diversion solution has been agreed with GNI.

Ch. 0+000 to 0+070 L2545 West Ringaskiddy Village Link Road, Ch. 0+000 to 0+090 L2545 East Haulbowline Island Link Road, Proposed Ringaskiddy Roundabout

The new Ringaskiddy Roundabout and associated link roads crosses a 180mm PE-80 4bar distribution line. A 3m offset would be the scale of the diversion.

It is likely that resolution of these conflicts will be undertaken as part of the *'main construction'* contract rather than as an *'advance works'* contract.

17.5.1.2 Gas Transmission

Each of these conflicts has been discussed in detail with relevant personnel in Gas Networks Ireland. The following was agreed.

Mainline Ch. 8+000m

This conflict occurs adjacent to the L6472 local road immediately east of Raffeen Quarry. The vertical alignment at this location is on an embankment. A suitable slab can be placed over the transmission main at its current location. This slab would be placed under the supervision of GNI and to their specification. This may be done as part of an '*advance works'* contract.

Ch. 1+480m L6472 Shanbally to Raffeen Link Road

This conflict occurs on the proposed L6472 Shanbally to Raffeen Link Road. The vertical alignment at this location is at-grade. A suitable slab will be placed over the transmission main at its current location. This slab shall be placed under the supervision of GNI and to their specification.

Mainline Ch. 11+020m

Vertical alignment at this location is in fill. A suitable slab will be placed over the transmission main at its current location. This slab will be placed under the supervision of GNI and to their specification. This may be done as part of an '*advance works'* contract.

Mainline Ch. 11+610m to 11+720

Vertical alignment at this location is at-grade. A suitable slab can be placed over the transmission main at its current location. This slab would be placed under the supervision of GNI and to their specification. This may be done as part of an '*advance works'* contract.

Loughbeg Roundabout

The 300mm transmission main runs across the southern part of the proposed Loughbeg Roundabout. The roundabout will be slightly in cut where this conflict occurs. A permanent diversion of the main will be required and a design solution has been prepared by Gas Networks Ireland. Any land necessary to accommodate this diversion will be included in the land acquisition for the project. The diversion may be completed as part of an '*advance works'* contract.

L6517 Loughbeg Road

A 100mm transmission supply runs adjacent to the existing L6517 Loughbeg Road, on the eastern side. It is proposed that this local road, to the south of the Loughbeg Roundabout, will be upgraded as part of the proposed M28 Road Project. The existing vertical alignment is poor and is to be lowered to facilitate a compliant northbound approach to the Loughbeg Roundabout. A significant cut will be required (in excess of 5m in places) in order to provide the necessary vertical gradient. A couple of design solutions were considered by GNI as follows:-

1. Permanently divert the main over a distance of 250m approx. Any land necessary to accommodate this diversion would be included in the land acquisition for the project and the diversion would be completed as part of an '*advance works'* contract.

2. Construct a retaining wall on the eastern side of the upgraded L6517 Loughbeg Road. This could enable the existing 100mm transmission main to remain in-situ. This retaining wall would be up to 5m in height in places and extend for approximately 200m. This retaining wall could be constructed as part of the main contract or as part of an '*advance works'* contract. Any land necessary to accommodate the construction of this retaining wall will be included in the land acquisition for the project.

Having considered the 2 options, GNI have a preference for Option 1.

17.5.1.3 Electricity Supply

Conflicts with the LV & MV (excl. 38kV) network have been discussed with ESB Networks and resolution will be by way of diversion. Details of conflict resolution will be discussed in greater detail during the detailed design phase of the project. It is likely that resolution of these conflicts will be undertaken as part of the '*main construction'* contract rather than as an *'advance works'* contract.

There are six conflict points with 38kV overhead and underground cables. Each conflict location was discussed as an individual identity with ESB network. For the existing underground locations the general resolution is to provide a new underground ducting and cable route through the proposed road project and divert the existing cable. For the overhead lines, the general resolution is to provide new sets of poles outside of the proposed road project to carry the existing overhead wires. At Loughbeg Roundabout it is proposed to provide a new underground ducting and cable route through the new scheme and retire a section of the existing overhead line. A new 12m mast will need to be constructed at the point where the new UG cable transfers back to an OH line. It is likely that resolution of these 38kV conflicts will be undertaken as part of the *'main construction'* contract rather than as an *'advance works'* contract. Any land necessary to accommodate these diversions will be included in the land acquisition for the project.

The proposed M28 Road Project passes in close proximity to the existing Raffeen 220kV substation, which is the major transmission node for the South Cork area east of Cork Harbour. This is why it has such a quantity of circuits connected to the substation, at both 110 and 220kV.

The technical term for the intrusion of a planned development with an existing circuit is a 'conflict'. This simply means something that needs to be resolved, rather than in its more literal sense. ESB Networks have a dedicated Conflicts Section, and the resolution of 'conflicts' is an established practice, occurring by way of localised re-design or diversion.

'Conflicts' with the existing 110kV network have been discussed with EirGrid and ESBI. The 110 kV network comprises overhead conductors, supported on double-wood polesets along straights, with lattice steel structures (known as "angle towers") where the circuit alignment changes direction. Where resolution is necessary it is proposed by way of localised diversion, or by raising existing polesets/towers in immediate proximity to the planned road corridor in order to ensure adequate separation distance between the overhead conductors and ground levels (known as "vertical clearance"). At some locations the existing towers can be retained at their current location and the proposed road will pass underneath. Where the vertical clearance is available no works will be required. Where the line will need to be raised between towers to ensure adequate vertical clearance, 'ice loading' will be taken into account - [this is, a greater sag on the conductors due to the additional weight of ice].

The following 'conflict' resolution has been agreed with EirGrid and ESBI, and is proposed in this application: (note: poleset no.'s refer to numbers on internal EirGrid/ESBI mapping system):

- Approximate Chainage 4,450m – a new poleset no. 16A, with a maximum height of 23m, is to be erected at the land take line. Poleset no. 17 is to be relocated to the land take line, approximately 38m from its current location, and increased by approximately 2-3m in height from its current height of 21m. Poleset no. 16 is to remain unchanged;
- Approximate Chainage 7,230m – poleset no. 7 to be increased by approximately 2-3m in height from its current height of 16m;
- Approximate Chainage 8,080m – poleset no. 34 to be increased by approximately 1-2m height from its current height of 17m;
- Approximate Chainage 8,500m – due to the excessive span length across the planned road corridor re-locate poleset no. 3 by 15m to the land take line and poleset no. 4 by 48m to the land take line. Maximum height of both polesets will be 23 metres.
- Single phase line at Shanbally – A local diversion consisting of 2 towers and 1, possibly 2, polesets is required on this line 110kV line at Shanbally; refer to drawing No DG0210 in Volume 5;
- Double Circuit line at Shanbally – Diversion required, refer to drawing No DG0210 in Volume 5; and
- Approximate Chainage 11,550m to 11,700m – 1 no. existing tower to be replaced at its current location and increased in height by approximately 2-3m from its existing height of 13m.

The 220 kV network comprises overhead conductors, supported entirely on lattice steel towers. 'Conflicts' with the 220kV network have been discussed with EirGrid and ESBI. This concerns both an underground cable circuit, and an overhead line circuit. Conflicts with the underground 220kV cable circuit occur at mainline Ch. 7,950m and at Ringaskiddy Roundabout. It is proposed that a suitable protection slab will be placed over the circuit at its current location – there is no alteration to the existing alignment of this circuit. This slab will be placed under the supervision of ESBI and to their specification.

The only 'conflict' with the existing overhead 220kV circuit occurs at mainline Ch. 7+900m. The existing towers can be retained at their current location and the proposed scheme will pass underneath.

Subject to the statutory approval process, and consistent with established practice in this regard, the detailed design of these identified 'conflict' resolutions will be developed subject to statutory approval for the proposed development. Any detailed design will not diverge to any material extent from that which is proposed above, and which is proposed in this application, and which is subject to environmental assessment under EIA.

It is envisaged that resolution of 110kV and 220kV conflicts will be undertaken as part of an *'advance works'* contract, where necessary.

17.5.1.4 Water, Surface Water and Foul Sewers

Of particular concern are conflicts with the 1,200mm Cork Harbour & City Watermain which occur at 3 locations, i.e., south of the Carr's Hill Interchange, Shanbally Interchange and the R613 at Barnahely. During the course of the design work completed to date a number of trial holes were excavated at Shanbally and Barnahely to establish the line and level of the main. These trial holes were excavated under the supervision of Cork County Council personnel and to their requirements. Each of these conflicts has been discussed in detail with relevant personnel in Cork Harbour & City Water Supply Scheme.

M28 Mainline at Carr's Hill Interchange

The M28 mainline will cross the 1200mm watermain on an embankment that is up to 10m high in places. The watermain will remain in-situ and the mainline will be 'bridged' over it for the length of the conflict. The structure will be of sufficient size to facilitate access to the main for routine maintenance or in the event of an emergency. Further discussions will be required during the detailed design phase of the project to decide if this structure will be constructed as part of an '*advance works'* contract or as part of the '*main construction'* contract.

M28 Southbound Diverge at Shanbally Interchange

The M28 southbound diverge at Shanbally Interchange will cross the 1,200mm watermain at-grade. A trial hole was excavated at this location to establish the line and level of the watermain. Following receipt of the trial hole logs, further discussions took place with those responsible for the Cork Harbour & City Water Supply Scheme. It has been agreed to leave the watermain in-situ and use a reinforced concrete slab to protect it at the point of conflict. This slab will be constructed as part of an '*advance works'* contract or as part of the '*main construction'* contract.

M28 Mainline at Shanbally Interchange

The M28 mainline at Shanbally Interchange will cross the 1,200mm watermain on an embankment that is approx. 3m high. The watermain is to remain in-situ and a reinforced concrete slab will be used to protect the watermain at the point of conflict. Further discussions will be required during the detailed design phase of the project to decide if this slab will be constructed as part of an '*advance works'* contract or as part of the '*main construction'* contract.

M28 Northbound Merge at Shanbally Interchange

The M28 northbound merge at Shanbally Interchange will cross the 1,200mm watermain on an embankment that is approx. 3m high. A trial hole was recently excavated at this location to establish the line and level of the watermain. Following receipt of the trial hole logs, further discussions are now required with those responsible for the Cork Harbour & City Water Supply Scheme to establish if a diversion may be required. The preference would be to leave the watermain in-situ and use a reinforced concrete slab to protect it at the point of conflict. This slab will be constructed as part of an *'advance works'* contract or as part of the '*main construction'* contract.

Proposed L6472 West Link Road at Barnahely

The proposed L6472 West Link is a realigned section of the existing L6472 Local Road to the south of the proposed Barnahely Roundabout. This link road crosses over the 1200mm Harbour & City watermain more or less at-grade. The main is located in agricultural land just inside the western roadside boundary of the R613. The 1,200mm watermain will remain in-situ and further consultation will be required during detailed design to agree how it is to be protected during the '*main construction'* contract.

Barnahely Roundabout at Barnahely

The Barnahely Roundabout will be constructed primarily within the agricultural lands located to the west of the R613. The roundabout will be located on top of the 1,200mm Harbour & City watermain and the circulatory carriageway will cross the watermain at 2 locations. The roundabout will be slightly in fill and the watermain will remain in-situ. Further consultation will be required during the detailed design phase to agree how it is to be protected during the '*main construction'* contract.

Proposed R613 North Link Road at Barnahely

The 1,200mm watermain is located inside the western roadside boundary of the R613 from the Barnahely Roundabout as far as the existing N28 at the western Port entrance. A 100m approx. length of the proposed R613 upgrade will be in conflict with the 1,200mm watermain. The R613 will be slightly in cut over the length of the conflict and the watermain will remain in-situ. Further consultation will be required during the detailed design phase to agree how it will to be protected during the '*main construction'* contract.

Proposed Janssen Biologics Access Spur at Barnahely

The proposed Janssen Biologics Access Spur is an improved section of the existing access road to Janssen Biologics from the R613 just north of the proposed Barnahely Roundabout. The current access road crosses over the 1,200mm Harbour & City watermain close to its junction with the R613.

The 1,200mm watermain will remain in-situ and further consultation will be required during detailed design to agree how it will be protected during the '*main construction'* contract.

In addition to the conflicts with the 1,200mm Cork Harbour & City watermain, there are a number of conflicts with other watermain of various sizes. Resolution measures in relation to these conflicts have been discussed with Irish Water/Cork County Council. Further discussion will take place during the detailed design stage of the Contract.

Storm and Foul Sewer Network

There are a number of conflicts with the existing storm and foul sewer network. Resolution measures in relation to these conflicts will be discussed with Irish Water/Cork County Council during the detailed design stage of the Contract.

17.5.1.5 Telecommunications

When dealing with conflict resolution the cost will largely depend on the type of cable in question. Copper and fibre optic are the two main cable types with the latter being the more expensive. When crossing Eir services with a new road embankment, the current standard procedure will be followed, where an access chambers will be introduced on either side of the road. Consultation with Eir personnel will continue during the detailed design and construction phases.

All diversion, etc., for Eircom infrastructure will be included in the '*main construction'* contract. Any works carried out during the construction phase will be in compliance with Eircom standards and specifications. Ducting will be provided by Eir with the Contractor laying the ducting and undertaking associated ancillary works such as access chambers, etc.

There is an existing Vodafone mast (Site ID: CK146) located in the vicinity of the proposed Carr's Hill Interchange. A meeting has been held with Vodafone on site and the mast can be retained at its current location.

It is proposed to provide enet diversion ducting at the conflict locations on the proposed IDA Link Road and the R613.

Between Barnahely and Loughbeg the mainline is on an embankment at the location of the point of conflict with the enet ducting. The preference would be to leave the enet cables in place and use a reinforced concrete slab to protect it at the point of conflict. This slab will be constructed as part of an *'advance works'* contract or as part of the '*main construction'* contract.

The proposed L6517 Loughbeg Road will be in cut over the length of the conflict which will require a diversion of the existing enet ducting. The proposal for this permanent diversion will be finalised during the detailed design stage in consultation with enet.

17.5.2 Waste Mitigation Measures

Waste management will incorporate the principles of the Waste Hierarchy.

The management of all waste associated with the proposed M28 Road Project must take cognisance of the policies and actions outlined in the Southern Region Waste Management Plan 2015-2021. The Southern Region Waste Management Plan 2015-2021 sets a target of 70% reuse, recycling and materials recovery rate of non-soil and stone construction and demolition waste to be achieved by 2020. It will be a requirement of the Contractor to achieve this target during the construction stage.

17.5.2.1 Excavated Materials

Excavated material on site will be managed in accordance with the requirements of the Waste Management Act 1996 (as amended). The Contractor will be required to ensure that the facility, to which any excavated material which requires transfer off-site is brought to, is authorised in accordance with Waste Management Legislation. The Contractor, as holder of the waste, will be responsible under the Waste Management Act for ensuring that all statutory obligations are met. All waste activities at the site will be subject to best practice waste handling procedures (i.e. source segregation, storage and collection). Material will be re-used where possible.

At a minimum the Contractor shall ensure:-

- That any waste haulier employed by the contactor is authorised by a waste collection permit or is exempt from such a requirement;
- That any disposal or recovery facility to be used for the management of waste arising from the proposed M28 Road Project is subject to the appropriate authorisation under the Waste Management Acts or any other legislation, as necessary;
- That the terms and conditions of the authorisations of the waste haulier and next destination waste facility allow for acceptance of the waste in question (i.e. allow the facility to accept the specific EWC/LoW type of waste); and
- That these authorisations will not expire within the lifetime of the project.

Waste arisings generated will only be treated at facilities that are authorised to carry out the appropriate waste treatment activity for the specific waste stream. Records of all waste movements and associated documentation shall be maintained on-site such as waste facility authorisation number, expiry date, class of waste accepted, weighbridge records, treatment methods for each waste stream accepted i.e., backfilling, crushing, screening, etc.

Where waste generated is not reusable on-site, samples will be taken and waste acceptance criteria (WAC) laboratory testing will be undertaken on the excavated material. The results of the laboratory testing will be used to determine whether a waste as inert, non-hazardous or hazardous. Authorised waste facilities will be contacted to establish what their waste acceptance criteria requirements are. The excavated waste from the proposed development will be compared with the facility waste acceptance criteria, and sent to the waste facilities which are authorised to accept the material in line with the waste acceptance criteria. Where practical, the closest suitable facilities to the proposed development will be selected to reduce impacts associated with vehicle movement such as air emissions.

Stockpile areas will be identified and created by the Contractor for the storage of materials in line with the requirements as set out in **Section 3.12.1.4** and **17.5.2.4**.

The Contractor(s) will store, handle and transport demolition material arising in accordance with best practice guidelines and the Waste Management Act 1996 (as amended). As per **Section 17.5.2.1** above, waste arisings that cannot be re-used will be sampled, tested and disposed of, to a licensed waste management facility.

17.5.2.2 Pile Arisings

The Contractor(s) will be required to store, handle and transport pile arising in accordance with best practice guidelines and the Waste Management Act 1996 (as amended). As per **Section 17.5.2.1** above, waste arisings will be sampled, tested and treated at an appropriately authorised waste management facility.

17.5.2.3 Surplus Materials

Any surplus material generated by excavation of cuttings, which cannot be used for landscaping or as fill for road embankments, as per **Section 17.5.2.1** above, will be sampled, tested and treated at an appropriately authorised waste management facility.

17.5.2.4 Made Ground Management

If contaminated soils are encountered during the construction works, further investigation, testing and risk assessments will be undertaken to determine whether the soils require further treatment to make them suitable for reuse or whether they need to be disposed of to a licensed waste facility off-site.

Materials identified (as per **Section 17.5.2.1**) as not being suitable for reuse or treatment (disposal or recovery) due to contamination levels will require to be suitably managed at a licensed hazardous waste facility. Any such material will be managed in accordance with waste management legislation and the following:-

- Topsoil stripping over large areas in advance of main excavation works will not be permitted. It will be restricted to the minimum required for efficient earthworks operations;
- Soil excavation will be targeted and stockpiling will be managed in order to avoid cross-contamination of reusable soil with contaminated material;
- All hazardous waste material generated 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;
- Runoff from a stockpile will be collected via a shallow toe drain, located outside the silt fence, which will discharge to a settlement pond which will be designed to have a retention time of at least 5 hours. Sediment build-up will be removed at regular intervals by manual means only and will be disposed of treated at an appropriately authorised waste management facility;
- Stockpiles of non-granular materials shall be limited in height to not more than 2m;
- Each construction area will be top-soiled as soon as practicable thus limiting both the amount and the length of time for which materials have to be stockpiled;
- Topsoil stripping in proximity to any watercourses will be undertaken in dry weather conditions and all stockpiles will be located greater than 100m from a watercourse. Stockpiles within 200m of a watercourse will be covered;
- If 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 waste materials generated on site including; stockpile locations, volumes, origins and additional testing undertaken; and
- A C1 form will be required for the movement of any hazardous waste within Ireland and Trans-frontier shipment (TFS) of waste is subject to control procedures under EU and National Legislation and guidance, such as Waste Management Transfrontier Shipment of Waste Regulations, 2007.

17.5.2.5 Waste Management

The off-site handling of waste generated is subject to the required statutory authorisations under the Waste Management Acts and the principles of the Waste Hierarchy.

An Outline Project Construction and Demolition Waste Management Plan (refer to **Appendix 17A)** has been prepared for the provision of waste management for the construction phase of the proposed M28 Road Project having regard to the following guidance documents on the management and minimisation of construction and demolition waste:-

- Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects (Department of Environment Heritage and Local Government, July 2006);
- CIRIA document 133 Waste Minimisation in Construction; and
- TII guidelines including Guidelines for the Management of Waste from National Roads Construction Projects (Revision 1, 12 November 2014).

Quantities of materials presented in this chapter and the C&D Waste Management Plan are indicative and are subject to detailed design and should not be taken as definitive. The C&D Waste Management Plan will be updated by the Contractor at the detailed design stage and at the implementation phase of the mitigation.

The Plan shall be incorporated into the Environmental Operating Plan (EOP). The project C&D Waste Management Plan shall include:-

- Analysis of the waste arising/material surpluses;
- Specific waste management objectives for the project;
- Methods proposed for the prevention, reuse and recycling of wastes;
- Material handling procedures; and
- Proposals for education and a workforce and plan dissemination programme.

In order to prevent and minimize the generation of wastes, the Contractor will be required to ensure that raw materials are ordered so that the timing of the delivery, the quantity delivered and the storage is not conducive to the creation of unnecessary waste. The Contractor will be required to develop a programme in conjunction with the material suppliers showing the estimated delivery dates and quantities for each specific material associated with each element of work. By following a "just in time" approach this improves cash flow, utilises storage space better, reduces potential losses to theft and accidental damage as well as making the site safer.

The location of the site compound has been selected to ensure that sewage from temporary toilets can be discharged to the existing sewerage network in the area.

17.5.3 Operational Phase

Management of wastes arising during the operational phase of the proposed road project will be the responsibility of the council or contractors appointed by the maintaining Authority to provide waste management and landscaping services.

Waste silts and Hydrocarbons/oily waters collecting onsite drainage interceptors will be managed by specialists contractors as and when required. The specialist contractors will be appointed to clean out the interceptors and ensure the waste material is sent to a suitable licensed facility for treatment and/or disposal.

The Service Area will provide adequate waste storage facilities to allow the appropriate segregation and storage of waste.

Any waste water generated at the Service Area from toilets etc. will discharge to the existing wastewater sewer located within the existing L-2545 adjacent to the site.

17.6 RESIDUAL IMPACTS

The residual impacts associated with waste mitigation measure are considered to be slight to imperceptible.

The residual impacts associated with utilities mitigation measure are considered to be negligible.

17.7 MONITORING

The Contractor shall develop a record keeping system that will ensure that details of all arisings, movement and treatment of C&D waste are recorded. All materials being transferred from the site, whether for recycling, recovery or disposal, shall be subject to a documented tracking system which can be verified and validated (refer to the Outline C&D Waste Management Plan in **Appendix 17A** for further details).

Further investigations into services will be necessary during the detailed design stage. Methods such as ground penetrating radar (GPR) and silt trenching in the verge areas can be used to verify or locate existing services.

18 INTERACTIONS AND INTER-RELATIONSHIPS OF IMPACTS

18.1 INTRODUCTION

This chapter analyses two types of cumulative effects. The first type is the assessment of effects on receptors or receptor groups, such as local residents, which may be effected by different environmental elements generated by the proposed road project simultaneously or concurrently. This is sometimes referred to as the "inter-relationships" or "in combination effects" between different environmental effects. The assessment includes consideration of particular locations/ receptors where several effects for example noise, air and landscape may all occur.

The second type is the assessment of effects of the proposed road project together with other past, present or reasonably foreseeable projects, where there is potential for overlap spatially or temporally, often referred to as cumulative effects.

The potential for inter-relationship/in-combination effects is described below in **Section 18.2** and the potential for significant cumulative effects is described in **Section 18.3**.

18.1.1 Methodology

For the assessment of Cumulative Effects the methodology and approach is informed by the *Guidelines for the Assessment of Indirect and Cumulative Impacts* (*EC, 1999)* and '*Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions*' prepared for the European Commission, EC DG X1Environment, Nuclear Safety and Civil Protection. The latter guidelines provide information on methods, the assessment process and information needed to assess cumulative impacts.

The study area is defined by the study areas of each of the individual environmental topic assessments, which are discussed in the relevant topic EIS **Chapters 5 - 17**.

The receptors considered as part of the In Combination Effects assessment have been sub-divided into four groups:-

a) Residential property and surrounding local community;
b) Ecological features;
c) Economic impact; and
d) Water features.

Within these broad groups, individual receptors or groups of receptors that are affected by the proposed road project have been considered at both construction stage and operation stage. The potential effects acting upon these receptors include; noise, air quality, visual intrusion, water quality, soils, geology and hydrogeology, traffic, waste and socio-economic.

The technical environmental chapters (**Chapter 5 – 17**) have assessed the residual impact as part of their assessment.

For the purposes of this assessment a 'significant In-Combination Effect' has been defined as 'multiple residual effects which will cause a significant effect on the same receptors resulting in a 'significant adverse combined effect'.

The significance of the In-Combination and Cumulative Effects is based on a consideration of the receptor sensitivity and the magnitude of the In-Combination and Cumulative Effects upon them, as presented in the matrix in **Table 18.1** below.

Table 18.1: Significance of Effects Matrix

Magnitude of Effect	Sensitivity of Receptor			
	Negligible	Low	Medium	High
Neutral	Insignificant	Insignificant	Insignificant	Insignificant
Minor (Adverse/ Beneficial Effect)	Insignificant	Insignificant	Minor	Minor
Moderate (Adverse/Beneficial Effect)	Insignificant	Minor	Moderate	Moderate
Major (Adverse/ Beneficial Effect)	Insignificant	Minor	Moderate	Major

The identification of past, present and reasonably foreseeable developments was informed by consultation with a range of organisations including Cork County Council, Utilities Organisations, National Parks and Wildlife Service (NPWS) and Inland Fisheries Ireland (IFI) as well a review of the relevant Local Authority, An Bord Pleanála (ABP), and Environmental Protection Agency (EPA) registers. The principal developments from which there is a potential for cumulative impacts to arise in combination with the proposed road project are listed in **Table 18.4**.

The determination of interrelated/in combination and cumulative impacts was facilitated through an iterative design process that included a series of workshops throughout the design process. This allowed for dynamic interaction between all parties/topics. Furthermore, the process was informed by extensive consultation with land and property owners, statutory and non-statutory consultees and in particular with the NPWS and IFI. Where a potential exists for interaction/in combination effects between two or more environmental topics or where there is potential cumulative impacts, these have been taken into account as part of the specialist assessments and where possible complimentary mitigation measures have been proposed i.e. noise and landscape.

18.2 IN-COMBINATION EFFECTS/INTER-RELATIONSHIPS

This section describes the significant residual effects that will remain post-mitigation.

The combination of residual effects identified within the environmental technical chapters (**Chapter 5 - 17**) are summarised diagrammatically for both construction and operational phases of the project in **Table 18.2** and **Table 18.3** respectively.

Table 18.2: Construction Stage In-Combination Effects

Phase	Impacts	Receptor	Potential Combined Effects	Mitigation	Residual Combined Effect
Construction	Construction works along the proposed road project	Residential Properties/Communities	**Air Quality & Climatic Factors:** Dust-short term, minor adverse. Greenhouse gas emissions- permanent, minor adverse impact.	Individual environmental topic mitigation measures and **Section 3.13** of **Chapter 3: Description of the Proposed Road Development**.	Overall construction related impacts are short term with **no significant adverse residual impact.**
			Noise and Vibration Effects: Localised construction noise moderate to major adverse; Traffic noise will be minor to moderate adverse; Vibration impacts Minor to Moderate Adverse.		
			Visual Effects: Short term minor to moderate adverse effects locally.		
			Health: Taking into account the level of emissions (air and noise) generated on-site, their intermittent nature/duration and the mitigation measures set out in the EIS, the risk to community health is not of a level to quantify any meaningful adverse health outcome.		
			Traffic Effects: Short term slight to moderate adverse		
			Waste Effects: Minor adverse. Use of material from Raffeen Quarry considered a minor benefit on residential receptors and communities due to reduced HGVs on the road and sustainable use of resources.		
		Ecological	**Designated sites**: No effect; Ecological Receptors: minor to moderate adverse on 3 ecological receptors; Japanese Knotweed minor beneficial.	Individual environmental topic mitigation measures and **Section 5.11** of **Chapter 5: Traffic and Transport**. Habitat and Species Management Plan Traffic Management Plan Dust Minimisation and Management Plan Water Quality monitoring	**No effect to Minor Beneficial** resulting in no significant residual effect.
			Water: Insignificant.		
			Soils, Hydrology and Hydrogeology: Insignificant negative of temporary to permanent duration.		
			Construction Dust: Impact of construction dust on sensitive ecosystems is negligible.		
			Construction Dust: Impact of construction dust on sensitive ecosystems is negligible.		

Phase	Impacts	Receptor	Potential Combined Effects	Mitigation	Residual Combined Effect
		Economic	**Employment**: Short term significant benefit. **Traffic and Transportation:** Short term minor to moderate adverse.	Individual Environmental topic mitigation measures and **Section 3.13** of **Chapter 3: Description of the Proposed Road Development**. Implementation of Traffic Management Plan (**Chapter 5: Traffic and Transport**)	**Overall no significant adverse residual impact.** During the construction phase there will be **significant positive impacts** due to increased employment. Traffic diversions required during the construction phase may result in short term minor to moderate impacts on local industry. This will however be temporary in nature and undertaken/ planned in consultation with local industry/ employers and detailed traffic management plans.
		Water Features	**Water:** Elevation of suspended solids through demolition & Soil stripping; release of pollutants is considered insignificant as it will be a requirement of the Contractor to protect water quality during the construction phase.	Individual environmental topic mitigation measures and **Section 3.13** of	**Neutral to Negligible** resulting in no significant residual effect.

Phase	Impacts	Receptor	Potential Combined Effects	Mitigation	Residual Combined Effect
			Designated sites: No effect.	**Chapter 3: Description of the Proposed Road Development**.	
			Soils, Hydrology and Hydrogeology: Imperceptible adverse of temporary to permanent duration.		

Table 18.3: Operation Stage In-Combination Effects

Phase	Impacts	Receptor	Potential Combined Effects	Mitigation	Residual Combined Effect
Operation	Operational Phase of the proposed road project	**Residential Properties/community**	**Air Quality & Climatic Factors** Dust Effects and local emissions: Negligible. Greenhouse Gas emissions- Long-term , minor adverse impact Overall a net decrease in the impact of road traffic noise on properties after the construction of the road project. – Minor Benefit	Individual environmental topic mitigation measures Specific Landscape Mitigation Planting	**Minor to Moderate** adverse and **Minor to Moderate Benefit** combined effect resulting in no significant residual effect.
			Noise Effects: Overall net reduction in the number of properties that will be exposed to noise levels greater than 60 dB(A) L_{den} and 57 dB(A) L_{night}. – minor to moderate benefit. At the High Priority Areas identified in the Cork County Noise Action Plan and the Cork Agglomeration Area Noise Action Plan noise levels will be reduced to meet the noise action plan threshold.		
			Visual Effects: Minor to moderate adverse effects at some locations.		
			Traffic Effects: Overall moderate benefit on traffic flows and journey times along the proposed road.		
			Waste: Insignificant		
			Water: Slight benefit- As a result of the proposed development surface water run-off from traffic on the existing N28, which was previously untreated, this traffic will now travel on a road which has been designed to have adequate capacity to collect, treat and discharge run-off generated by the proposed M28 Road Project.		

Phase	Impacts	Receptor	Potential Combined Effects	Mitigation	Residual Combined Effect
			Seveso: The new road will improve the overall emergency response in the Ringaskiddy area and will have a net minor benefit impact in the area		
			Health: The new road will improve capacity and reduce congestion, will reduce residential exposure to air quality and noise over and above what can be achieved through the Do Minimum scenario.		
		Ecological	**Designated sites**: No effect **Protected species**: no significant effect.	Individual environmental topic mitigation measures	**No effect to Minor** Beneficial resulting in no significant residual effect.
			Noise: No effect on designated sites.		
			Hydrology and Drainage: Minor beneficial; short to long term		
			Soils, Geology and Hydrogeology: Imperceptible negative of permanent duration.		
			Air Quality: Slight decrease from the predicted deposition levels from the existing N28 alignment- slight positive.		
		Economic	**Employment**: Moderate to major positive long-term. **Visiting community and Tourism:** Moderate to major positive long-term.	N/A	**Moderate to Major beneficial.**
			Hydrology and Drainage: Minor beneficial; short to long term.		
			Traffic and Transport: Overall moderate benefit on traffic flows and journey times along the proposed road.		
			Seveso: The new infrastructure will improve the overall emergency response in the Ringaskiddy area and have a net minor benefit impact in the area.		
		Water Features	**Hydrology and Drainage**: Minor beneficial; short to long term.	Individual environmental topic mitigation measures	**Minor beneficial** resulting in no significant residual effect.
			Soils, geology and hydrogeology: Imperceptible negative of permanent duration.		

The construction phase has potential in-combination impacts that will result in short-term moderate to major adverse effects upon the residential receptors. These individual impacts will be mitigated through the measures proposed in the EIS and NIS together with any conditions and/or restrictions attached to any approval/consent as may be granted. Those living in closest proximity to the construction site will experience a period of combined moderate to major adverse impact. The construction stage will also have short-term beneficial effects in terms of employment for the local economy. Overall the operational phase has potential for in combination impacts that will result in long term minor to moderate benefit effects as well as long minor to moderate adverse effects (landscape and visual) on residential receptors, economy and water resulting in no significant residual impacts.

18.3 CUMULATIVE EFFECTS

A list of projects that have been considered as part of the cumulative assessment is provided in **Table 18.4** below**.** Large scale applications and developments considered relevant to the assessment by virtue of their nature and scale were considered as part of the assessment.

The following cumulative impacts assessment has been prepared based on the headings of the technical chapters of this EIS as set out below-

- Traffic and Transport
- Socio Economic and Community
- Agricultural Land Uses
- Hydrology and Drainage
- Aquatic Ecology
- Soils, Geology and Hydrogeology
- Terrestrial Ecology
- Air and Climate Factors
- Noise and Vibration
- Cultural Heritage
- Landscape and Visual
- Material Assets

18.3.1 Cumulative Effects of the M28 Road Project and Individual Projects

Table 18.4 below addresses in detail the potential for cumulative effects, where relevant, of the proposed M28 Road Project occurring with each existing or potential project in the study area under Human Environment and Natural Environment.

Table 18.4: Existing and Future Projects in the Study Area Considered as Part of the Cumulative Effects

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
Cork Lower Harbour Main Drainage Scheme (CLHMDS)	Ongoing: Granted 24/06/2009, currently under construction due to be completed in 2019.	Construction of a new Wastewater Treatment Plant at Shanbally, Circa. 14 new pumping stations and the upgrading of 4 existing pumping stations. Approximately 30km of new sewers and a drilled crossing under the Estuary.	This scheme is currently undergoing construction and will be completed prior to the commencement of the construction phase of the M28 therefore cumulative effects during the construction phase are not considered further. During the operation of the WWTP positive impacts will include improved water quality in Cork Lower Harbour resulting in positive effects to human health and facilitating in the enhancement and increased residential commercial and recreational development in the harbour. This project in combination with the proposed M28 Road Project has therefore the potential to result in positive cumulative impacts as the road will also result in an improvement to water quality through provision of a new improved drainage system. There will be negligible increases in NO_2 and PM_{10} as a result of the CLHMDS therefore no cumulative adverse air quality impacts will occur. No impacts from noise are anticipated as part of the CLHMDS during its operation stage therefore no cumulative effects with the proposed	This scheme is currently undergoing construction and will be completed prior to the commencement of the construction phase of the M28 therefore cumulative effects during the construction phase are not considered further. During the operation of the WWTP the overall Conservation value of Cork Harbour and water quality will improve this in combination with the improved road drainage design proposed as part of the proposed M28 Road Project it is likely to result in a potentially positive cumulative effect to aquatic ecology and water quality. Loss of hedgerows is considered to be imperceptible as part of the CLHMDS and not significant from the proposed M28 Road Project therefore with the planning and mitigation proposed within this EIS no significant cumulative effects will occur to ecology. Any potential for spillages and impacts to surface water and groundwater has been addressed	**Implementation of the mitigation measures as set out in planning documents for both projects.** **No further mitigation required. No additional mitigation required.**

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
			M28 Road Project are anticipated. After mitigation there are no residual impacts on archaeology arising from either of the projects therefore there is no potential for significant effects. The EIS for the CLHMDS project has predicted long term and permanent landscape effect with moderate to significant visual effects. The project components are however in the majority of cases are well separated from the proposed M28 Road Project and are also predominantly set low in the landscape to prevent any significant cumulative landscape or visual effects.	through the drainage design of both projects.	
Ballyhemiken/ Raffeen Quarry	Ongoing: Granted quarrying permitted from July 2008 to 2038.	Continuation of quarrying activities to include processing of aggregates, landscaping, restoration and associated works.	The cumulative effects on Raffeen Quarry are assessed on the basis that the quarry has permission and therefore can extract anytime between now and 2038. It is proposed to utilise material from the quarry where feasible for the construction phase of the proposed M28 road project. This has a slight positive cumulative effect for air quality and climate, noise and traffic as a result of reduced transport requirements on the local and regional road network and in turn air and noise emissions during the construction phase of the road and the operation phase of the quarry. There is however a heightened risk of	Quarrying operations at Raffeen would result in the disturbance (direct and indirect) of semi-natural habitats under the quarry footprint, access routes and adjoining areas including in-situ wetland habitats, scrub, semi-natural grassland and areas of recolonising bare ground which support pennyroyal (*Mentha pulegium*), a plant species protection under the Flora Protection Order, 2015. Quarrying operations may affect breeding bird activities upon areas of quarried cliff face, principally through indirect	**Implementation of the mitigation measures as set out in planning documents for both projects.** **No further mitigation required. No additional mitigation required.** **Implementation of a Habitat and Species Management Plan as part of the M28 Road Project at the Quarry**.

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
			windblown dust from materials handling and noise from the construction phase of the proposed road project and of the quarrying activity occurring simultaneously impacting on properties in the immediate vicinity of the quarry. This risk will be mitigated through the mitigation measures which will be carried out under the quarry's current planning permission and the mitigation measures proposed as part of this application with respect to dust and noise minimisation.	disturbance, which have previously supported breeding Peregrine. Quarrying activities may also result in increased release of dust and particulate matter which can reduce photosynthetic potential for plants associated with in-situ and adjacent semi-natural habitats. Construction of the road will also result in the disturbance and removal of semi natural habitats and pennyroyal resulting in the potential for cumulative effects to these species during the construction phase of the road and the operation phase of the quarry. A Habitat and Species Management Plan has been development for the M28 Road Project to reduce negative effects from the road resulting in Negligible Impacts over the short to medium term and thus the potential for cumulative impacts associated with quarrying activities is avoided. There is potential for cumulative impacts on sensitive ecosystems from dusts and particulate matter during the construction and operational phases of the road	

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
				and quarrying activities. Dusts and particulate matter can be deposited on the leaves of plants reducing the photosynthetic potential. The literature suggests that the most sensitive species appear to be affected by dust deposition at levels above 1000 $mg/m^2/day$. As such, once dust deposition rates are maintained within the standard guideline for human nuisance ($350mg/m^2/day$), as set out in the mitigation measures specified in **Chapter 13: Air and Climatic Factors**, the impact of construction dust on sensitive ecosystems is considered negligible.	
DePuy Synthes Turbine	Future. Granted 19/08/2016. Unknown start. Construction Phase 6 months.	Erection of a wind turbine with hub height of up to 100m, rotor radius of up to 50.5m and overall height from ground to tip of rotor of up to 150.5m, upgrade of existing site roads, and all other associated works.	No significant cumulative effects to humans are expected during the construction phase as it is anticipated that should planning be granted the turbine will be constructed prior to the commencement of works on the proposed M28 Road Project. During the operation stage there is potential for impacts from the turbine on landscape and visual receptors. The construction of the other turbines in the harbour area had been completed at the time of the assessment for the	No significant cumulative effects to natural environment are expected during the construction phase as it is anticipated that should planning be granted the turbine will be constructed prior to the commencement of works on the proposed M28 Road Project. No impacts to habitats, birds, water or mammals were identified in the EIS for the turbine therefore no significant	**Implementation of the mitigation measures as set out in planning documents for both projects.** **No further mitigation required.**

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
			proposed development and these turbines formed part of the baseline for this landscape and visual impact assessment. The DePuy wind turbine if constructed will be consistent with the wind farm landscape now found around Ringaskiddy and is a separate distinctive feature than the proposed development that is located at lower levels and not visually dominant across the wider landscape like the turbine. No significant cumulative effects were predicted for the combination with this planned project. The carbon impact of this turbine is positive and cumulatively will reduce the adverse impacts predicted with the proposed M28 Road Project. There are no recorded Archaeological sites within the proposed development site therefore there is no potential for cumulative effects on archaeology and cultural heritage. Residual impacts to noise and air are considered negligible therefore no significant cumulative effects will occur on the human environment.	cumulative effects will occur on the natural environment.	
Redevelopment of existing port facilities at Ringaskiddy	Ongoing: Granted 28/05/2015 currently under construction	Redevelopment of existing port facilities at Ringaskiddy, Co. Cork, incorporating: ▪ Ringaskiddy East	Construction stages of Phase 1 and 2 will be completed prior to the commencement of the M28 Road Project and construction of Phase 3 of the Port of Cork plans will not	Construction stages of Phase 1 and 2 will be completed prior to the commencement of the M28 road project and construction of phase 3 of the Port of Cork plans	**Implementation of the mitigation measures as set out in planning documents for both projects.**

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
	due to be completed over 3 phases with Phase 3 - Ringaskiddy East: RoRo dependent on the M28 being operational.	(Container berths and Multi-Purpose berth); ▪ Ringaskiddy West (Deepwater Berth Extension) ▪ Paddy's Point amenity area; ▪ Road improvements and external road works; and ▪ Associated development works	commence until the M28 road project is in operation therefore cumulative effects on the human environment during the construction phase will not occur. The construction of the Port of Cork project had commenced at the time of the assessment for the proposed road project and the harbour has formed part of the baseline for the landscape and visual impact assessment. There is limited visual or landscape connection between the proposed road project and the Port of Cork project however the proposed Service Area is located within the port area. The separation distance and intervening topography between the majority of the proposed road project and the port area prevent significant cumulative impacts. The SA is similar in character to the characteristics of the port area and will blend with the wider port redevelopment plans. No significant cumulative effects were therefore predicted on the landscape and visual resource. Traffic volumes associated with the Port of Cork have been factored into the baseline traffic modelling and in turn the air and noise predictions for the proposed road and therefore no	will not commence until the M28 road project is in operation therefore cumulative effects during the construction on the natural environment will not occur. No significant residual effects upon terrestrial or aquatic ecology or soils, geology and hydrogeology during the operation phase are predicted from both projects therefore no significant cumulative effects are likely to occur.	**No further mitigation required.**

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
			cumulative effects are predicted to human receptors from air and noise during the operation phase. There are no known archaeological features within the port area. The potential for cumulative effects associated with unknown finds will be addressed during the construction stage of the proposed road project and the redevelopment of the port lands existing planning permission conditions.		
Dunkettle Interchange Improvement Motorway Scheme 2012 - CPO / EIS	Future: Granted 30/04/2013, construction expected to commence in Q3 of 2018 and due to be completed Q1 2022. (3.5 year construction period).	Improvement Motorway Scheme to include 43 major structures of various forms comprising: ▪ 1 overbridge, 7 underbridges, 2 railway bridges, 1 footbridge, 7 retaining walls, several culverts and 24 gantries; ▪ Modification of the northern approach structure to the Jack Lynch Tunnel; ▪ Pedestrian and cyclist facilities, together with ancillary and consequential works.	It is expected that the construction phase of the Dunkettle Interchange will be complete prior to the commencement of the construction phase of the M28 therefore no cumulative effects during the construction phase are anticipated on the human environment. The future year traffic analysis assumes no "bottleneck" for traffic at Dunkettle and therefore the Dunkettle scheme has been included in the baseline assessment for Traffic. Positive long-term cumulative effects are anticipated to human beings and economy of the Cork area should both projects be constructed due to reduced traffic delays, bottlenecks, commuting times and improved access to IDA lands, Pharma, Strategic Employment Area of	It is expected that the construction phase of the Dunkettle Interchange will be complete prior to the commencement of the construction phase of the M28 therefore no cumulative effects during the construction phase are anticipated on the natural environment. This development is unlikely to contribute to cumulative or in-combination effects on the natural environment as best practice and mitigation measures, including in particular provision of landscaping and attenuation for both projects. Residual impacts on water quality for the Dunkettle Interchange are	**Implementation of the mitigation measures as set out in planning documents for both projects.** **No further mitigation required.**

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
			Ringaskiddy and Little Island, etc. The noise and air quality Chapters of the EIS assumes the proposed upgrade of the Dunkettle Interchange and the associated traffic flows in their overall assessments.	considered to be neutral, long term, negligible as are the residual impacts from the M28.	
East Tip Remediation Project	Ongoing: Granted on the 01/05/2014. The remediation of the East Tip is due to commence under licence from the EPA (Licence Register W0289-01) in early 2017 and will take 18-24 months to complete with a likely start date of late Q2/early Q3 2017.	Remediation of the East Tip site including demolition and site clearance, construction of a perimeter engineered structure (PES) and an engineered capping system with surface water drainage system, provision of a public park on the site and improved access.	Due to the timing of the works for the remediation project which is expected to be completed in advance of construction of the M28 no cumulative effects are anticipated during the construction phase on the human environment. Long term positive cumulative effects to humans are considered likely due to the provision of an amenity site which can be readily accessed via the proposed M28 Road Project. The primary objective of the East Tip project is to remediate the East Tip thereby ensuring that potential risks to humans and the wider environment are minimised. Therefore the drainage design of the proposed road project and the remediation of the East Tip cumulatively will reduce the risk of contamination of waster courses and associated risks to humans resulting in potential positive cumulative effects to humans due to improved water quality. The residual impact of the remediation	Due to the timing of the works for the remediation project which is expected to be completed in advance of construction of the M28 no cumulative effects are anticipated during the construction phase on the natural environment. The design principles and the mitigation measures employed during the construction and operation phase of the M28 road project and the East Tip Remediation Project will prevent any negative cumulative effects with neighbouring developments on soils, geology, hydrogeology and water. It is anticipated that the remediation project will result in an overall positive effect to Cork Harbour by reducing the potential for pollution from the East Tip site and this together with the robust drainage design to be provided by the road	**Implementation of the mitigation measures as set out in planning documents for both projects.** **No further mitigation required.**

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
			project will be a long-term positive moderate impact to air quality. The residual impact to local receptors in Ringaskiddy Village from the proposed road project is considered to be negligible as outlined in **Chapter 13: Air and Climate**, therefore the cumulative effects at a local level to the closest receptors to both projects in Ringaskiddy Village is considered to be negligible to slightly positive.	project will result in positive cumulative effects to Cork Harbour.	
Martello Tower Site Reprofiling	Future: Granted 27/10/2016, dependent on East Tip schedule. 11month construction phase which is due to start in Q1/Q2 2018.	Excavation of soil and topsoil materials from the site and transporting same to the East Tip site on Haulbowline. Subsequent re-profiling and remediation of the site.	The Martello Tower Site Re-profiling is linked to the East Tip Remediation project as the materials excavated from the proposed site will be transferred from one site to the other. Due to the timing of the works which are expected to be completed in advance of construction of the M28 no cumulative effects are anticipated during construction. It is proposed to reinstate the development site to rough grassland habitat therefore no long-term cumulative impacts will occur on the human environment.	As part of the Martello Tower project it is proposed to reinstate the development site to rough grassland habitat. The post remediation stage of the development will not result in impacts to ecological receptors either within the study area footprint, or those areas fringing or adjoining the proposed development site therefore there is no potential for cumulative effects with the proposed road project.	The implementation of traffic management plans and dust minimisation plans required for both projects will ensure that cumulative effects from dust and traffic on the human environment is minimised during the construction phase should the timeframes for the projects overlap. **Implementation of the mitigation measures as set out in planning documents for both projects.** **No further mitigation required.**

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
Indaver Waste to Energy Facility	Awaiting Planning Decision. Expected duration of construction 10 years.	Construction of a Waste to Energy Facility	The site for the proposed building of the Waste to Energy Project lies directly to the east of the proposed M28 Road Project. This proposal has however yet to receive planning permission. Should the proposal receive planning the construction phases of both projects are likely to overlap. This could potentially result in cumulative positive effects to employment in the area. However should the construction phases overlap increased traffic associated with both project is likely to result in negative cumulative effects to human beings due to increased noise and dust. The M28 road project however poses strict controls on construction noise and dust and from a review of the planning permissions for the Indaver application it is considered that appropriate control measures would also be in place for both developments. There is potential for the landscape and visual impacts arising from the operational phase of the Indaver facility, to have an effect on the cultural heritage features of the area such as Martello Tower and Spike Island, and on the tourism potential and the residential and recreational amenity of the area. It is considered that given the	It is likely that the construction of the M28 road project and the Indaver Waste to Energy Facility (should permission be granted) will result in severance of wildlife corridors and loss of hedgerows and treelines. However appropriate mitigation measures in the form of planting and landscaping as part of this M28 road project and the Indaver development in the area will reduce the potential for significant cumulative effects. No significant impacts to designated sites, flora and fauna and biodiversity are predicted from both projects therefore the potential for significant cumulative effects is low. The implementation of mitigation measures for both projects will ensure the potential for significant effects to soils, geology, hydrology and hydrogeology remain low.	The implementation of traffic management plans and dust minimisation plans required for both projects will ensure that cumulative effects from dust, noise and traffic on the human environment is minimised during the construction phase should the timeframes for the projects overlap. **Implementation of the mitigation measures as set out in planning documents for both projects.** **No further mitigation required.**

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
			already industrial nature of the area and the proposed planting proposed as part of the M28 road project that there are no predicted residual impacts associated with the M28 on the visual or cultural setting of Martello Tower therefore there is no potential for significant cumulative effects on landscape or archaeology. Once operational, the Indaver facility will emit levels of combustion gases (NO_x, CO, etc.), particulates (dust, PM_{10}, metals, etc.) and other waste incineration pollutants (dioxins, etc.) under licence from the EPA. The EIS for the Indaver facility notes that background NO_2, in addition to NO_2 from the road traffic serving the facility will result in an annual average concentration of 12μg/m^3 in 2020 in the area around the facility. Other major sources in the area (pharma-chem operators in Ringaskiddy, ESB Aghada, BGE Whitegate) are predicted to contribute a further 2.9μg/m^3 as an annual average. Operations at Indaver are predicted to contribute a further 1.2μg/m^3 of NO_2 resulting in a cumulative annual average of 16.1μg/m^3 compared to the limit of 40μg/m^3.		

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
			Emissions from the proposed M28 road project are predicted to contribute a further 2-4μg/m^3 as an annual average NO_2 along the alignment of the new road in the Ringaskiddy area but with a negligible impact at distances greater than 50 metres from the proposed road. Combining the annual average background levels of NO_2 (12μg/m^3) with the existing major sources in the area (2.9μg/m^3) and the direct impact from the Indaver facility (1.2μg/m^3) presents a potential impact of 16.1μg/m^3 in the area east of Ringaskiddy. The worst case cumulative impact of the M28 in the Ringaskiddy area (based on a further 2-4μg/m^3 increase) on top of this "existing" level would be 18.1-20.1μg/m^3. This cumulative impact represents a negative air quality impact as a result of increased exposure of the population in this area to combustion pollutants. However, the predicted levels remain well below the statutory limits for the protection of human health and the cumulative impact is considered to be a slight adverse impact in the long term.		

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
Shannon Park Housing Development- Phase 1	Future: Phase 1 granted 09/09/2016. Expected date to be completed by is2021. Additional Phases to be submitted for planning in the future.	There is a masterplan for the development of housing at Shannonpark that may happen in the future. Construction of Phase 1 of the residential development is permitted and further phases will be subject to subsequent planning applications. Phase 1 works will include demolition of existing structures and construction of a mixed use development consisting of residential development of 297 no. residential units, neighbourhood centre, public transport interchange and all ancillary site development works. Access to the proposed development will be via a new spine road from the Carrigaline Road which will also serve possible future phases of development should permission be granted. The proposed roadworks include road widening	Future development of lands within the Masterplan for Shannonpark may occur at the same time as construction of the proposed M28 Road Project. The main impacts anticipated from the Shannonpark Housing Estate development will be through increased traffic related impacts once the Masterplan lands have been fully developed. The expected traffic figures from the Masterplan have been factored into the traffic data employed in determining the impacts of the proposed road project and a result in the potential for cumulative impacts to humans from traffic, air and noise. Housing is typical of the Shannonpark area and construction requirements are not significant. There will be no potential cumulative landscape and visual impacts during operation/ completion of the proposed Masterplan for housing.	This development is unlikely to result in cumulative or in-combination effects to European sites. The footprint of this development does not support suitable habitat for avifaunal species associated with Cork Harbour SPA and the findings of avifaunal surveys completed for this development did not identify this area as a suitable or viable site for over-wintering avifauna associated with Cork Harbour SPA. Drainage design and water attenuation mitigation is proposed for both projects restricting un-attenuated run-off to receiving watercourses including the Glounatouig Stream which supports connectivity to Monkstown Creek designated as part of Cork Harbour SPA. The Masterplan lands are underlain by limestone bedrock which is susceptible to karstification as is the proposed M28 in places and the potential for the occurrence of unidentified karst features could lead to subsidence and subsequent damage to structures for both projects. Both the EIS for the M28 road project and Shannonpark	**Implementation of the mitigation measures as set out in planning documents for both projects.** **No further mitigation required.**

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
		and the provision of a new signalised junction opposite the existing entrance to Carrig na Curra.		have provided mitigation to avoid impacts should karst be encountered during the construction works. In addition the proposed M28 road project provides for a robust drainage system and therefore in the long-term has potential for positive cumulative effects associated with road run off from vehicles accessing Shannonpark during the operation stage.	
GE Healthcare Life Sciences Biopark	Future: Awaiting Planning Decision – Third Party appeal (13/03/2017) to Bord Pleanála.	A BioPark and all ancillary site development works including landscaping, fencing and signage. The proposed BioPark consists of no. 2 storey bio-manufacturing buildings, 4 no. 2 storey administration/laboratory buildings with roof top plant room, a 2 storey warehouse building with 6 storey storage tower, a 2 storey hydration facility building, a 2 storey central utilities building with external boiler flues, and a 2 storey canteen and administration building with roof top plant room and service	No cumulative effects are anticipated during the construction phase on the human environment as the work within GE Healthcare will be constructed prior to the commencement of the M28 road project should permission be granted. Biopharma plant operations typically have a considerably lower chemical input and waste output and hence have significantly lower emissions to atmosphere. No negative cumulative impact for air quality predicted. The traffic, noise and air quality assessments within the EIS for the M28 Road Project consider future traffic in the opening year of 2020 and the design year of 2035 taking account of the Carrigaline Electoral Area Local Area Plan and land use planning for residential development and industry	No cumulative effects are anticipated during the construction phase on the natural environment as the work within GE Healthcare will be constructed prior to the commencement of the M28 road project should permission be granted. No significant ecological residual impacts are predicted from either the proposed GE Healthcare application or the proposed M28 Road Project therefore significant cumulative effects on ecology will not occur. With mitigation measures in place for both projects there will be no significant cumulative impacts to surface water and groundwater.	**Implementation of the mitigation measures as set out in planning documents for both projects.** **No further mitigation required.**

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
		yard. Primary access to the proposed development is from the R613 with a secondary access via an existing entrance from the L2496.	development in in the area. Therefore potential cumulative effects due to increased traffic, noise and air during the operation phase have been factored in the baseline assessment and no significant cumulative effects are anticipated. With landscape planting in place for both projects there will be no significant cumulative effect on landscape. The application for the GE Healthcare project identified the potential for a slight permanent negative impact on a boundary wall in the vicinity of Barnahely due to groundworks. The M28 Road Project has been designed to avoid any direct impacts on walls associated with the Castle or graveyard at Barnahely. Therefore no significant cumulative impacts to archaeology will occur.		
Janssen Biologics	Future: Granted 17/02/2017 and will be constructed over a 5 month period.	Consists of site development works including: site excavation and regrading, creation of new landscaped berms along the north western site boundary, relocation of 3 existing single-storey 360m2 pre-fabricated temporary modular office	No cumulative effects are anticipated during the construction phase as the work within Janssen will be constructed prior to the commencement of the M28 road project should permission be granted. During the operation phase there are no predicted residual impacts from noise and air predicted to human receptors from the buildings therefore	No cumulative effects are anticipated during the construction phase as the work within Janssen will be constructed prior to the commencement of the M28 road project should permission be granted. The EIS for the proposed Janssen project predicts residual negative	**Implementation of the mitigation measures as set out in planning documents for both projects.** **No further mitigation required.**

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
		units to the existing car park and erection of 1no. single-storey 360m2 pre-fabricated temporary modular office unit at the existing car park for a period of 5 years. The works will also include the construction of 95 no. temporary car park spaces, for a period of 5 years, to replace the car park spaces required to accommodate the temporary modular office units and the relocation of 2 no. existing fire water storage tanks and an existing firewater pump house and all associated works, including modification of internal underground services and drainage at the existing facility at Barnahely, Ringaskiddy, Co. Cork.	there is no potential for significant cumulative effects with the proposed M28 road project. This site is licensed by the EPA with strict controls on air quality and noise. Further the traffic, noise and air quality assessments within this EIS for the M28 Road Project consider future traffic in the opening year of 2020 and the design year of 2035 taking account of the Carrigaline Electoral Area Local Area Plan and land use planning for industrial/Pharma development in in the area. Therefore potential cumulative effects due to increased traffic, noise and air during the operation phase have been factored in the baseline assessment and no significant cumulative effects are anticipated There is no significant residual change to the broader landscape character of the area as a result of the Janssen proposals therefore no significant cumulative effects with the proposed M28 road project are considered likely. There is potential for cumulative effects to unknown finds associated with both projects, this however will be mitigated through pre-construction testing and monitoring required as part of the planning application for both projects.	impacts to Yellow hammer at a local scale. The EIS for the M28 road project predicts no significant impacts on avifauna therefore no Significant cumulative effects are anticipated.	

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
Maryborough Ridge Housing Development	Future: Awaiting Planning Decision.	Residential development works to include 200 no. residential units, crèche and all associated ancillary development works including the completion of a roundabout and road improvements onto Maryborough Hill, footpaths and cycle lanes, bus stop, foul and storm water drainage, boundary treatments, landscaping and amenity areas and the removal of existing electricity transformer/substation and construction of new electricity substation.	No cumulative effects are anticipated during the construction phase as it is considered the Maryborough Ridge development will be constructed prior to the commencement of the M28 road project should permission be granted. The traffic, noise and air quality assessments within this EIS for the M28 Road Project consider future traffic in the opening year of 2020 and the design year of 2035 taking account of the Carrigaline Electoral Area Local Area Plan and land use planning for residential development in in the area. Therefore potential cumulative effects due to increased traffic, noise and air during the operation phase have been factored baseline assessment and no significant cumulative effects are anticipated Housing is typical of the Maryborough area with landscape proposals in place for both projects there will be no potential significant cumulative landscape and visual impacts during operation/completion of the proposed development.	No cumulative effects are anticipated during the construction phase as it is considered the Maryborough Ridge development will be constructed prior to the commencement of the M28 road project should permission be granted. This development is unlikely to contribute to cumulative or in-combination effects to aquatic ecology or terrestrial ecology as best practice and mitigation measures will be implemented for this project to attenuate emissions to receptors such as air, watercourses and the surrounding terrestrial and coastal environments	**Implementation of the mitigation measures as set out in planning documents for both projects.** **No further mitigation required.**
Novartis	Ongoing construction activities	Construction of new production facilities, storage units and ancillary upgrade works. No EIS or Environmental	The traffic, noise and air quality assessments within the EIS for the M28 Road Project consider future traffic in the opening year of 2020 and the design year of 2035 taking account of	No residual ecology, soils, geology impacts were noted in a review of the planning files for the Novartis site therefore no significant cumulative effects are	**Implementation of the mitigation measures as set out in planning documents for both projects.**

Development	Approximate Timeframe	Summary Description	Summary of Potential for Significant Effects Human Environment	Summary of Potential for Significant Effects Natural Environment	Mitigation Measures
		Reports prepared for the application.	the Carrigaline Electoral Area Local Area Plan and land use planning for residential development in in the area. Therefore potential cumulative effects due to increased traffic, noise and air during the operation phase have been factored into the baseline assessment and no significant cumulative effects are anticipated.	predicted with the proposed M28 Road Project.	**No further mitigation required.**

18.3.2 Cumulative- In Combination Effects of all Projects

This section addresses the potential for cumulative effects and in combination effects should all projects listed in **Table 18.4** above proceed within the study area simultaneously (worst case scenario).

Traffic and Transport

A number of transportation studies and strategies relevant to the area have been considered including the N40 Demand Management Study, Douglas Land Use and Transportation Study and Carrigaline Area Transportation Study. None of these studies/strategies contained recommendations that are currently "committed". The only significant transportation project considered to be committed is the proposed N8/N25 Dunkettle Interchange Improvement Scheme and is thus considered to be completed in the future year Do Minimum scenario as TII have confirmed that the Dunkettle Interchange Scheme will be constructed and open to traffic in advance of the proposed M28 road project. Thus, the future year analysis assumes that the future year Do-Minimum road network will be the same as the base year network plus the proposed upgrade of the Dunkettle Interchange. Therefore, the future year analysis assumes no "bottleneck" for traffic at Dunkettle. No significant adverse cumulative effects as a result of this project are envisaged as a result.

The noise and air quality assessments within the EIS use data from **Chapter 5: Traffic and Transportation** which considers future traffic in the opening year of 2020 and the design year of 2035. High growth traffic rates were used and future traffic growth was distributed locally taking account of the Carrigaline Electoral Area Local Area Plan and land use planning for residential development and industry development in in the area. The cumulative noise and air quality effects from traffic generated from new housing and future employment uses in the Ringaskiddy Strategic Employment Area have already been considered as part of the baseline within these assessments and therefore built into the assessment of the proposed road project.

At the operational stage, the proposed M28 Road Project will have no direct impact on the five COMAH establishments in the area and will not alter the risk profile of these operations. The reduced travel time on the proposed M28 will facilitate a faster response time for emergency medical services from Cork University Hospital and/or additional fire services if required from Ballincollig. As a result, the new infrastructure will improve the overall emergency response in the Ringaskiddy area.

Socio-Economic and Community

In the event that the construction phase of one of the projects listed in **Table 18.4** and the M28 Road Project coincide there is potential for short term cumulative impacts associated with the construction of the both projects on human beings due to increased traffic, noise and air. These impacts have been addressed as part of the mitigation measures outlined in **Chapter 5: Traffic and Transportation**, **Chapter 13: Air and Climate** and **Chapter 14: Noise and Vibration**.

The operation of the proposed M28 Road Project in combination with the projects listed above is likely to generate long-term positive cumulative effects to the resident, working and visiting community due to reduced journey times and reduced congestion and the potential to open up employment opportunities within the area as a result.

Negative effects may arise in some cases due to increased noise or air pollution during the operation phase of the road and other planned or existing development in the area, however as outlined below (under the noise and air sections) this is not considered to be a significant cumulative effect as the traffic model has already factored in future traffic scenarios in the model, which has in turn been used to predict cumulative noise and air impacts.

Agriculture and Landuse

The residual impact of the proposed road on agriculture in the State and County Cork is assessed as not significant. Given the lands to be developed with the projects listed above in **Table 18.4** are primarily zoned for industry or housing significant cumulative effects to agriculture and landuse will not occur.

Hydrology and Drainage

If the M28 Road Project does not proceed, ongoing activities would continue within the study area including continued increase in traffic, localised quarrying at Raffeen and the potential progression of residential, commercial and industrial developments. These activities would be likely to result in localised and small scale cumulative negative impacts to the hydrology and drainage characteristics within the study area. The surface water drainage network on the existing N28 is limited to the area at Bloomfield/ Rochestown with drainage provided at the existing roundabouts along the route. Currently surface water run-off generated along the N28 is discharged over the existing embankments and makes its way to existing surface watercourses nearby.

The M28 road project has been designed to provide a robust drainage system and therefore in the long-term has potential for positive cumulative effects associated with road run off from HGVs and cars accessing other permitted and proposed development sites in the area i.e. Port of Cork where traffic currently travel along a national road where the drainage system is not as efficient.

As all new developments must obtain agreement from CCC for their drainage systems and any IPPC/waste license companies must receive a discharge license from the EPA, which ensures the requirements of the WFD are met, no cumulative effects on drainage as a result of neighbouring developments is predicted.

Due to the linear nature of the proposed M28 Road Project, the project has been designed to accommodate the 1 in 100 year flood flow plus an allowance of 20% to account for climate change in line with the requirements of the OPW and the NRA DMRB (Design Manual for Roads and Bridges). Flood risk assessment and management of all development is undertaken with an aim of not increasing flood risk of the land take and any third party land. Furthermore, cumulative risks from flooding is likely to be controlled through any future planning and consent process insofar as development cannot be permitted to the detriment of other projects or existing receptors. As all new developments are required to demonstrate compliance with *The Planning System and Flood Risk Management Guidelines (OPW, 2009)*, therefore no cumulative effects with regards flood risk is identified as a result of other developments.

Aquatic Ecology

The M28 road projects construction methodology and operational design ensures that surface water and groundwater pollution is managed to prevent deterioration. Operationally the principal direct risk to the water environment is from road run-off pollution from traffic. The assessment undertaken has used predicted AADT data from a traffic model, which includes key future development allocations. The impacts on the water environment are therefore reflective of cumulative effects taking into consideration those developments that could generate increases in traffic flows. The proposed road project has been designed to best practice drainage design standards and therefore increases in road traffic runoff from the proposed road project and any other development in the area will be better served by the new M28 than the existing N28, which currently experiences un-attenuated outfalls and runoff. The overall cumulative effect is therefore considered to be positive on water quality and the receiving aquatic environment in the long-term.

Soils, Geology and Hydrogeology

The design approach and the mitigation measures proposed as part of the proposed M28 road project will prevent any negative cumulative effects with other developments on soils, geology and hydrogeology during both the construction and operational stages.

Terrestrial Ecology

Whilst there is potential for landtake effects as a result of loss of semi-natural habitat as a result of the proposed road project and other developments in the area, the mitigation proposed in the EIS provides for landscape planting, translocation of habitats and species such that no significant residual impact arise.

It is likely that the construction of the M28 road project and other projects in the area will also result in severance of wildlife corridors and loss of hedgerows and treelines i.e. the Indaver Waste to Energy Facility. However appropriate mitigation measures in the form of planting and landscaping as part of this M28 road project and other projects in the area will reduce the potential for significant cumulative effects.

The Cork Harbour area supports a number of developments that have been granted planning permission that could have in-combination effects with the proposed M28 Road Project resulting in cumulative or in-combination effects to Cork Harbour SPA. However, the large infrastructural developments in the Cork Harbour area have been granted planning permission on the basis that targeted and site specific mitigation is completed to address any potential impacts to Cork Harbour SPA. Further the remote connectivity of the Great Island Channel SAC to the proposed M28 Road Project means that potential impacts are unlikely. The implementation of best practice design, construction and operational measures will negate any potential impacts to the integrity of this European site.

All possible sources of effects from the proposed road project, in combination with all other sources in the existing environment and any other effects likely to arise from other proposed plans or projects have been identified, considered and assessed.

No pathway of in-combination effects upon sites designated for nature conservation importance has been identified. The proposed road project is therefore not likely to give rise to significant ecological impacts alone, cumulatively or in-combination with other proposed and approved developments.

Air Quality and Climatic Factors

There is potential for dust impacts on the same receptors in any area where the proposed road project is in close proximity to other planned and permitted development i.e. Shannonpark Masterplan or Indaver should they be constructed at the same time. The proposed road project however includes strict controls on construction dust and from a review of the planning permissions applications for other project in the area it is considered that appropriate control measures would also be in place for other developments.

Short term operational dust events are experienced periodically from the operations in the Port of Cork, in particular from grain handling. Construction of the proposed road project in the Ringaskiddy area has the potential for cumulative negative dust impacts for residents in the village where the construction dusts coincide with an operational dust event from the port.

In terms of air quality, the levels of control that have been applied to each of the construction and operational phases of the development are such, that individually dust impacts should not be significant. Furthermore, the relative scheduling of the projects is such that the potential for cumulative dust impacts is low and these are considered negligible.

An examination of the various EIAs for the major projects in the area (**Table 18.4** above) indicate the following Green House Gas (GHG) emissions from the construction stage:-

- Indaver – not quantified but not considered significant;
- Port of Cork – 210,600 tonnes of CO_{2eq};
- East Tip – 17,899 tonnes of CO_{2eq};
- Shannonpark Housing Estate – not quantified but not considered significant; and
- Martello Tower – (included within the quantities reported in the East Tip EIS).

Based on the above data the cumulative GHG emissions from the proposed development in addition to other major infrastructure projects in the study area will be a minimum of 282,908 tonnes of $CO_{2eq.}$

In terms of the operational stage, Indaver estimate annual GHG emissions of 83,310 tonnes of CO_{2eq} for 30 years of operation (2,499,300 tonnes of CO_{2eq} in total). Note this excludes carbon savings from the recovery of energy from waste which has a positive impact in terns of GHG reductions. The East Tip will have no operational emissions and the Port of Cork operational emissions are not quantified.

The cumulative impact of greenhouse gas emissions from both the construction and operational phases of each of the developments are considered a permanent slight adverse impact.

Noise and Vibration

Planning permission has been approved for a number of developments within the vicinity of the proposed road project as outlined in **Table 18.4** above. Whilst it is expected that most of these projects will be completed before the construction of the proposed M28 Road Project, should the construction of any of these developments coincide with the construction of the proposed road project it is likely that noise levels within the vicinity of the works will increase temporarily. The mitigation measures set out in the EIS for the M28 Road Project have considered this possibility and the noise levels will be required to be below the limits given in **Table 14.2** of **Chapter 14: Noise and Vibration.**

A noise model of the operational phase of the approved developments in combination with the proposed M28 Road Project was generated. The model considered noise from the port development at Ringaskiddy and the DePuy Synthesis Ireland wind turbine as these are the most relevant developments that will emit noise following construction. The Dunkettle Interchange will also emit noise following construction; however it is at a sufficient distance away from the proposed M28 Road Project so as not to have an impact on noise levels in the vicinity. The noise model showed that following the insertion of the port development at Ringaskiddy and DePuy wind turbine that noise levels in the vicinity increased by less than 1 dB. In accordance with **Table 14.2** this increase is classed as barely perceptible. **Table 18.5** shows the difference in noise levels between the 'Do-Something' with Mitigation scenario and the Cumulative Impact model in the area of the port development at Ringaskiddy and the proposed DePuy wind turbine.

Table 18.5: Cumulative Impact L_{den} Noise Levels

Noise Sensitive Location	'Do-Something' with Mitigation L_{den} dB(A)	'Do-Something' with Mitigation Cumulative Impact L_{den} dB(A)	Difference in Noise Level L_{den} dB(A)
Warren's Court 1	55.7	56.0	0.3
St. Carthege Place 1	56.0	56.2	0.2
Bloomfield 1	52.0	52.3	0.3
Bloomfield 2	55.0	55.1	0.1
Old Post Office Road 1	53.0	53.2	0.2
Old Post Office Road 2	52.0	52.4	0.4
Old Post Office Road 3	57.9	57.9	0
Ringaskiddy Community Centre	53.3	53.9	0.6
Church (Ringaskiddy)	61.6	61.6	0
Shamrock Place 1	60.3	60.4	0.1
Shamrock Place 2	58.6	58.6	0
Shamrock Place 3	58.6	58.6	0
Martello Park 1	56.9	57.0	0.1
Martello Park 2	53.5	54.1	0.6
Ringaskiddy 1	57.0	57.5	0.5
Ringaskiddy Lower Harbour National School	60.2	60.2	0

Noise levels from port development were modelled as 55 dB at the site boundary. The planning permission requires that the noise level be 55 dB at the nearest sensitive receptor and therefore the noise model represents a worst case scenario. A correction was added to the port development in the noise model to account for the requirement for lower noise levels during the evening and night-time periods. Data for the DePuy wind turbine was obtained from the EIS for the turbine. It is not envisaged that there will be any cumulative vibration impacts as a result of the proposed developments in the area.

Furthermore, the noise assessment within the EIS is based on data from **Chapter 5: Traffic and Transportation** which considers future traffic in the opening year of 2020 and the design year of 2035 for a medium growth scenario. High growth traffic rates were used for the noise assessment and future traffic growth was distributed locally taking account of the Carrigaline Electoral Area Local Area Plan and land use planning for residential development and industry development in in the area. As such, the cumulative noise effects from traffic generated from new housing and future employment uses in the Ringaskiddy Strategic Employment Area have already been considered as part of the baseline within these assessments.

Cultural Heritage

A number of other infrastructural projects are proposed or planned in the area surrounding the proposed M28 Road Project; these include the materials extraction scheme at the Martello Tower and the Du Puy Turbine, both of which are located in the vicinity of Ringaskiddy. This assessment had consideration for these projects in order to identify any resulting cumulative impacts. No cumulative impacts to archaeological features are predicted in combination with any proposed or planned projects in the vicinity of the proposed M28 proposed project.

As with any project, there is potential for cumulative effects to unknown finds, this however will be mitigated through pre-construction testing and monitoring required as part of the consenting process for the M28 road project and any other future projects in the area.

Landscape and Visual

The proposed M28 Road Project is likely to have slight negative to moderate impact on visual amenity and receptors during the construction phase should the timing of construction of the proposed M28 Road Project coincide with other future development in the area. With the planting proposals in place for the M28 and the projects listed in **Table 18.4** above, no long-term significant cumulative effects are predicted in- combination with any other projects within the area.

Material Assets

There are no anticipated cumulative impacts associated with waste management predicted as a result of the proposed M28 Road Project. The principles of the waste hierarchy have been incorporated into the Construction and Demolition Waste Management Plan prepared for the project. Further there are a range of suitable permitted waste sites with capacity to accommodate any material that cannot be reused from the M28 project or other projects within the area.

18.4 SUMMARY

No significant adverse residual effects are likely to occur through in-combination and/or cumulative impacts. Any effects identified can be mitigated through management of the construction and operation processes by adherence to the mitigation measures set out in the EIS together with any conditions/restrictions in any approval/consent as may be granted.

19 SUMMARY OF MITIGATION MEASURES

19.1 INTRODUCTION

The following environmental commitments are an integral element of the application for Approval.

The purpose of this chapter of the EIS is to provide a summary of the main commitments under each of the environmental headings listed. Full details of the various commitments should be obtained by reference to the individual chapters and to this EIS and NIS as a whole.

19.1.1 Commitments: Introduction

No	EIS Ref	Description of Commitment
1	New	All mitigation measures, controls, procedures, monitoring and other requirements described in the EIS and NIS and any other conditions attached to approvals as may be granted by An Bord Pleanála for the proposed road project will be implemented in full.
2	New	The Contractor will be required to provide appropriate staff training in the implementation of the environmental protection measures, mitigation measures, monitoring and audit requirements, procedures, and the emergency response as set out in the EIS and the NIS.
3	New	A protocol for regular communication with statutory agencies such as National Parks and Wildlife Service (NPWS) and Cork County Council (CCC) and other third parties shall be established, by the Contractor.
4	New	CCC will appoint an Environmental Manager (EM) as part of the Employers Site Representative staff. The EM will report directly to the Client and will monitor site operations and audit the Contractor's operations (including the implementation of the environmental commitments). The EM will be the Employer's liaison for environmental organisation including the NPWS and IFI.
5	New	**Chapter 3: Description of the Proposed Road Development** of the EIS sets out the construction details including environmental management measures to be followed. Prior to the commencement of works the Contractor will be required to develop a Construction Environmental Management Plan (CEMP). The Contractor will be required to incorporate all the mitigation and management measures detailed in the EIS and NIS for the construction stage into the CEMP and include any additional requirements stipulated by An Bord Pleanála should the proposed road project be approved. It will be a requirement of the contract documents that prior to the commencement of work on site that the Contractor submits a CEMP to CCC and that this CEMP is assessed by the Employer's Site Representative Staff, including the Environmental Manager to ensure that it fully addresses the environmental requirements of the proposed road project as set out in the EIS, NIS and any conditions imposed by An Bord Pleanála.
6	3.12.1.1	Before earthworks commence the Contractor(s) shall prepare the Environmental Operating Plan (EOP) which shall set out the Contractors approach to managing environmental issues and provide a documented account to the implementation of the environmental commitments as set out in the EIS and any approval/consent as may be granted. To oversee the implementation of the EOP the Contractor will be required to appoint a responsible Environmental Manager/Ecologist/Ecological Clerk of Works to ensure that the mitigation measures included in the EIS, NIS and

No	EIS Ref	Description of Commitment
		the EOP are executed in the construction of the work and to monitor that the mitigation measures are implemented successfully.
7	3.13.1.1	An **Outline Construction and Demolition (C&D) Waste Management Plan** has been prepared (Refer to **Appendix 17A**) and it will be a requirement of the Contractor to update and maintain this Plan for the duration of the construction phase. The Plan shall be incorporated into the EOP.
8	3.13	The works will be carried out by the Contractor in compliance with the following documents/guidelines:- ▪ Construction industry guidelines (such as CIRIA C502 Environmental Good Practice on site). ▪ CIRIA Guidance - Control of Water Pollution from Construction Sites, Guidance for Consultants and Contractors (C532), (Masters- Williams et al (CIRIA, 2001). ▪ Control of Water Pollution from Linear Construction Projects. Technical guidance (C648), CIRIA (E. Murnane, A. Heap and A. Swain. (CIRIA, 2006). ▪ PPG 6 Working at Demolition and Construction Sites (Environment Agency, 2012). ▪ PPG 26 Safe Storage – Drums and Intermediate Bulk Containers (Environment Agency, 2012). ▪ PPG 7 Safe Storage –The Safe Operation of Refuelling Activities (Environment Agency, 20111b). ▪ BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*. And BS 5228-2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part2: Vibration* (together referred to as B.S. 5228). ▪ *Control of Dust from Construction and Demolition Activities' (BRE 2003)*, ▪ NRA Environmental Construction Guidelines (various dates):- o Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Water (IFI, 2016); o Guidelines for the Treatment of Badgers prior to the Construction of a National Road Scheme; o Guidelines on Provisions for the Conservation of Bats during the Planning and Construction of Roads; o Best Practice Guidelines for the Treatment of Bats during the Construction of National Road Schemes; o Guidelines for the Crossing of Watercourses during the construction of National Roads Scheme; o Guidelines for the Testing and Mitigation of the Wetland Archaeological Heritage for National Road Schemes: o Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub prior to, during and post-construction of National Schemes; o Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes; o Guidelines on the Management of Noxious Weeds and non- native Plan Species on National Roads; o Guidelines for the Treatment of Noise and Vibration in National Road Schemes; o Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes; o Guidelines for the Treatment Otters Prior to the Construction of National

No	EIS Ref	Description of Commitment
		Road Schemes; o Guidelines on the Implementation of Landscape Treatments on National Road Schemes in Ireland; o Guidelines for the Management of Waste from National Road Construction Projects; and o Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan.
9	3.12.1/3.10	Once appointed the main Contractor shall be required to provide a detailed programme prior to commencement of the works. This shall set out:- ▪ The overall programme of construction; ▪ Programming of the key elements and phases of construction; ▪ Programming of environment mitigation and monitoring; and ▪ The duration of each element and phase. The programme will be regularly updated to reflect any changes in programmed activities and shall provide the basis for notification to residents and local communities where sensitive activities would be likely to involve temporary disturbance to access or non-routine events such as blasting of rock or piling or temporary local road diversions. The timing and scheduling of blasting activities for the road will be included in the programme agreed with CCC in advance of commencement on site.
10	3.12.1.1	All on site drainage, erosion and sediment control measures for the construction works shall be in place and functioning prior to the commencement of earthworks/site clearance.
11	3.12.1.3	The Contractor will be required to adhere to the following measures for all temporary construction compounds:- ▪ Each temporary compound will have a dedicated Waste Storage Area for construction waste generated; ▪ In order to minimise any impact on surface water and groundwater from material spillage, all oils, solvents, paints and other potential contaminants used during construction will be stored within suitably designed bunded areas, at least 100m from watercourse and in accordance with Guidance Note for the Control of Pollution (Oil Storage) (England) Regulations 2001 by the Department of Environment Food and Rural Affairs (DEFRA) in the UK; ▪ Oil and fuel storage tanks will be stored on designated areas of hardstanding, and these areas will be bunded to a volume of 110% of the capacity of the largest tank/container within the bunded area(s) (plus an allowance of 30mm for rainwater ingress); and ▪ Drainage from the office facilities will be connected to a foul sewer and surface water drain. Oil interceptors will be installed in the compound vehicle parking areas to control runoff. Pollution control measures will be implemented elsewhere in the compounds where required (for example, chemical storage areas).
12	3.12.1.4	The following restrictions will apply to stockpiles:- ▪ Topsoil stripping over large areas in advance of main excavation works will not be permitted. It will be restricted to the minimum required for efficient earthworks operations; ▪ Each construction area will be top-soiled as soon as practicable thus limiting both the amount and the length of time for which materials have to be stockpiled; ▪ Stockpiles will not be located within 10m of any watercourse or within 50m of a

No	EIS Ref	Description of Commitment
		sensitive watercourse or water body; ▪ Run-off from a stockpile will be collected via a shallow toe drain, which will discharge to a settlement pond which will be designed to have a retention time of at least 5 hours. Sediment build-up will be removed at regular intervals by manual means only and will be disposed of at appropriately licensed facilities only; and ▪ Stockpiles of non-granular materials shall be limited in height to not more than 2m.
13	3.13.1.2	Prior to commencing works, the Contractor shall prepare an Environmental Emergency Response Plan/Contingency Plan. The Plan will detail the procedures to be undertaken in the event of the release of any sediment into a watercourse, a serious spillage of chemical, fuel or hazardous wastes (e.g., Concrete) or other such risks that could lead to a pollution incident, including flood risks.
14	3.13.2.1	Normal working times will be 07.00 to 20.00 hours Monday to Friday and 07.00 to 14.00 hours 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 Local Authority. Any approval for night working will give consideration to the potential disruptive effects there may be on nearby residences and significant restrictions on noise and other adverse environmental emissions may be conditioned to any approval granted.
15	3.13.5.1	In the event that material from the quarry is used, the construction phase haulage of material from the quarry will access the Land Made Available (LMA) and avoid using local roads where possible. Where the proposed route crosses an existing Regional or Local Roads, 'crossing points' will be formed to ensure that construction vehicles can cross safely from one side to the other. These 'crossing points' will be within the LMA and priority will be given to vehicles on the public road network.
16	3.14.4	Lighting will be provided as illustrated on Drawings series PL001 - PL005 and in accordance with the measures set out in **Section 12.7.2.5** of **Chapter 12: Terrestrial Ecology** for the protection of bats and birds.
17	3.14.5	Emergency Accesses and crossovers will comply with TII Publication DN GEO-03031. Emergency telephones will be provided on the M28 in accordance with NRA policy at an approximate spacing of 1.5km in accordance with UK DMRB TA 73. Vehicular restraints (safety barriers) will be provided along the proposed road project in compliance with TII Publication DN-REQ-03034. Police Observation Platforms on Motorways will be designed in accordance with TII publication DN GEO-03027**.**

19.1.2 Traffic and Transportation

No	EIS Ref	Description of Commitment
1	5.11.1	The successful Contractor will be required to submit a Construction Traffic Management Plan (CTMP) to be agreed with CCC and appropriate emergency services, i.e., An Garda Síochána, ambulance services and fire services in order that potential road closures and restrictions and diversions are carried out safely and efficiently and to the satisfaction of the relevant stakeholders. The CTMP shall incorporate the controls as set out in **Section 5.11.3.4** of the EIS.
2	5.11.1/5.11.2 /5.11.7	All local roads will remain open to traffic at all times during the construction stage. This includes the existing N28 and other key routes in the area, with the exception of Bloomfield Interchange to Carr's Hill Interchange where specific mitigation measures will apply. The Contactor will be required to strictly limit road closures to critical works only.
3	5.11.5	The Contractor will be required to manage the deliveries so that:- ▪ Material will be transported along haul route through the site as much as possible. ▪ HGV drivers are instructed not to use unsuitable local roads. ▪ HGV trips will be scheduled to avoid peak traffic periods during the day. ▪ Deliveries will, for the most part will be confined to using the existing N28 route.
4	5.11.2	The following specific measures will be applied by the Contractor for traffic management in the area of Bloomfield Interchange to Carr's Hill Interchange:- ▪ The existing N28 will remain open to two-way traffic at all times, except for short term managed road closures for critical works, such as the proposed demolition of the Maryborough Hill overbridge. This will entail careful phasing and sequencing of the works along the N28 in order to maintain traffic flows. ▪ All traffic movements will be accommodated on the section of the works between Bloomfield Interchange and Rochestown Road. Phasing of the works will be carefully planned and sequenced to maintain traffic flows at all times. An illustrative outline of a possible construction sequence is described in **Section 5.11.6.2** in **Chapter 5**. ▪ Local road closures will not be permitted, except for critical works. Any road closures permitted will be for limited periods, e.g., night-time or weekend. ▪ Works on the local road network at the northern end of the project will not coincide. ▪ A designated construction order and sequence shall apply to the proposed works between Rochestown Road and Carr's Hill.
5	5.11.3.1/ 3.13.1.3	Construction related traffic will be restricted from entering the local road network during the AM (07.45-09.00) and PM (17.00-18.00) commuter peak periods.
6	5.11.3.2/ 5.11.3.3/ 3.12.1.2	All CTMPs prepared for road closures, temporary diversion of traffic and night or weekend working will be subject to the approval of CCC and will be prepared in consultation with the emergency services, e.g., An Garda Síochána, ambulance services and fire services. Any approval for night/weekend working will give consideration to the potential disruptive effects there may be on nearby residences and significant restrictions on noise and other adverse environmental emissions may be conditioned to any approval granted.
7	5.11.6	It is a requirement of the Contractor to manage the order and sequence of the works at the northern end (Bloomfield to Carr's Hill) so that maximum local road capacity is maintained throughout the construction period, as described in **Section 5.11.6.**

No	EIS Ref	Description of Commitment
8	Appendix 1A	For the works around the R613, consultation with the COMAH establishments impacted will also be carried out.
9	5.11	The specific mitigation measures as set out in **Section 5.11** of **Chapter 5: Traffic and Transportation** will be implemented in full.

19.1.3 Socio- Economic and Community

No	EIS Ref	Description of Commitment
1	7.5.1.2	Best practice management will be put in place, by the Contractor, to minimise disruption to those working in the area or passing through to workplaces elsewhere. The Contractor will be required to update and implement the CTMP as described in **Chapter 5: Traffic and Transportation** and **Section 19.1.2** above.
2	7.5.1.3	Where widening of the roadway along the route is likely to affect entrances to homes and farms within the land take area, entrances will be reinstated and will be maintained during construction by the Contractor. Otherwise, reasonable temporary access will be provided.
3	7.5.2.2	Directional signage to by-passed settlements such as Shanbally in line with TII signage policy will be provided.
4	7.5.2.3	Pedestrian crossings will be provided as shown on the **GA Series** Drawings in **Volume 5**.
5	7.5	The specific mitigation measures as set out in **Section 7.5** of **Chapter 7: Socio Economic and Community** will be carried out.

19.1.4 Agricultural Land Uses

No	EIS Ref	Description of Commitment
1	8.5.1	A Project Liaison Officer (PLO) will be appointed by the local authority. The PLO will be required to carry out the duties listed in A4.3 of the NRA Project Management Guidelines (2010).
2	8.5.1	Existing accesses to property, including homes, farms and farm facilities will, where practicable, be maintained during construction, otherwise reasonable temporary access will be provided. Any lands temporarily acquired will, before return to the landowner, be subsoiled to alleviate compaction and minimise risk of impeded crop growth.
3	8.5.1	All drainage likely to be affected or disturbed during the construction phase will be identified and reinstated. Any disruption to water supply will be reinstated immediately by the Contractor or an alternative source supplied until the source is reinstated, unless otherwise agreed with the landowner.
4	8.5.1	All machinery coming from outside of the State will be cleaned and disinfected on entry to the country and will be sprayed with appropriate disinfectant prior to arrival on site. The Contractor will verify to the PLO that this has been done. The PLO will liaise with the local District Veterinary Office (DVO) to establish the location of any restricted herds along the route of the proposed road project. Where the PLO has been informed of a restricted herd along the route, it will require the Contractor to disinfect machinery and personnel before leaving the land concerned. The number of accesses across the working strip will be reduced to one in the case of lands having restricted herd status. The Contractor will arrange for disinfectant mats/baths to be replenished with disinfectants, as required.
5	8.5.1	In the event of an outbreak of a Notifiable Disease, the proposed road project will be subject to such operational restrictions as are imposed by DAFM.
6	8.5.2	All agricultural lands, temporarily acquired, will be re-instated to pre-construction conditions unless otherwise agreed with the landowner. Ducting will be provided to allow for the provision of services (electrical/water) across severed areas unless otherwise agreed with the landowner and where practicable. Where required, suitable stock proof fencing shall be erected along the proposed road project. Where any fences, walls or hedges are damaged they will be made stock proof immediately, unless otherwise agreed with the landowner.
7	8.5	The specific mitigation measures as set out in **Section 8.5** of **Chapter 8: Agricultural Land Uses** will be implemented in full.

19.1.5 Surface Water (Hydrology), Groundwater (Hydrogeology) and Aquatic Ecology

No	EIS Ref	Description of Commitment
1	9.6.1	The drainage system standards as set out in TII DN-DNG-03065 – Road Drainage and the Water Environment and as described in **Section 9.6** of the EIS shall be implemented in full.
2	10.7 / 11.8	To ensure the mitigation measures are effective for the protection of surface water and groundwater monitoring will be carried out as outlined in **Chapter 10: Aquatic Ecology** and **Chapter 11: Soils, Geology and Hydrogeology.**
3	9.7.1.3/ 10.5.1.1	Sediment control measures to be incorporated by the Contractor, during the construction phase will be consistent with the following guidance: ▪ Technical Guidance C648: Control of Water Pollution from Linear Construction Projects, (CIRIA, 2006); ▪ Technical Guidance C532: Control of Water Pollution from Construction Sites: Guidance for Consultants and Contractors (CIRIA, 2001); ▪ PPG 6 Working at demolition & construction sites (Environment Agency, 2012); and ▪ Guidelines for the protection of Fish during Construction Works in and adjacent to Waters (IFI, 2016).
4	10.5.1.1	The level of suspended solids in any discharges to fisheries waters (Woodbrook, Donnybrook and Glounatouig streams) as a consequence of construction works shall not exceed 25 mg/l1 nor result in the deposition of silts on gravels or any element of aquatic flora and fauna (as per IFI (2016) guidelines).
5	9.6.9/9.6.8 and 10.5.1.4/ 10.5.1.5	The design and the construction of all culvert, stream crossings and bridge structures shall:- ▪ Be carried out in line with the guidelines and standards of Transport Infrastructure Ireland (TII) and Inland Fisheries Ireland (IFI) ▪ Prevent impact to river morphology and impoundment or alteration of surface water flow hydrodynamics; ▪ Have obtained Section 50 Consent under Section 50 of the Arterial Drainage Act; ▪ Maintain or improve on provisions for aquatic and mammalian species migration; ▪ Have been agreed with IFI; and ▪ Supervised by the Contractors appointed Ecologist/Ecological Clerk of Works.
6	3.12.1.3	Foul drainage from all site offices/ compound with be discharged to the existing network or will be contained and disposed of in an appropriate manner to prevent pollution of nearby watercourses.
7	9.7.1.1	In order to avoid causing flooding during the construction phase all existing surface water drainage and discharge points will be maintained. In order to avoid materials and substances entering Cork Harbour as a result of flooding, the working platform within the Service Area site will be above a level of 3.30 m OD for the duration of the works. Dewatering of excavations will be treated prior to any discharge to Cork Harbour.
8	9.7.1.2/ 10.5.1.2/ 11.5.1	The mitigation measures for the protection against accidental spillages as outlined in **Section 9.7.1.2 Chapter 9: Hydrology and Drainage, Section 10.5.1.2 Chapter 10: Aquatic Ecology** and **Section 11.5.1 Chapter 11: Soils, Geology and Hydrogeology** will be implemented in full.

[1] The standard is expressed as an average concentration over a period of 12 months and does not apply to suspended solids with harmful chemical properties. http://www.irishstatutebook.ie/eli/1988/si/293/made/en/print

No	EIS Ref	Description of Commitment
9	9.7.1.2/ 10.5.1.2/ 10.5.1.6	The following procedures will be followed to reduce the potential risk of oil or chemical spillage:- ▪ The storage of oils, fuel, chemicals, hydraulic fluids, etc. will not occur within 100m of all watercourses and will be undertaken in accordance with current best practice for oil storage (Enterprise Ireland, BPGCS005) on an impervious base within a bund and appropriately secured; ▪ Fuel, oil and chemical storage will be sited on an impervious base within a bund and secured. The base and bund walls will be impermeable to the material stored and of adequate capacity. PPG 26 "Safe storage – drums and intermediate bulk containers" (Environment Agency, 2011a) shall be implemented to ensure safe storage of oils and chemicals. ▪ The safe operation of refuelling activities shall be in accordance with PPG 7 "Safe Storage – *The safe operation of refuelling facilities"* (Environment Agency, 2011b). ▪ Guidelines for the protection of Fish during Construction Works in and adjacent to Waters (IFI, 2016); and ▪ During stream diversions or culvert placement works, an emergency spill kit and oil spill containment equipment will be available in near proximity to the works.
10	11.5.1	The retention capacity of bunded areas will be as follows:- ▪ To a volume not less than 25% of the total volume of substance which could be stored within the bunded area. ▪ All hazardous materials on site will be stored within secondary containment designed to retain at least 110% of the storage contents. ▪ Temporary bunds for oil/diesel storage tanks will be used on the site during the construction phase of the project as appropriate. Safe materials handling of all potentially hazardous materials will be emphasised to all construction personnel employed during this phase of the project and an emergency response plan will be in place, in case of accidental spillage. Spill kits will be retained on site to ensure that any spillages or leakages are dealt with immediately.
11	11.5.1/ 10.5.1.6	An emergency plan to deal with accidental spillages will be kept on site during the construction period. The pollution control methods are to be agreed with CCC prior to the commencement of the works. Spill kits will be retained on site to ensure that any spillages or leakages are dealt with immediately.
12	10.5.1.3 / 9.7.1.2	The measures outlined in **Section 10.5.1.3** will be adhered to when using concrete. Where in situ concrete is required, the control measures outlined in PPG 6 - Working at demolition & construction sites (Environment Agency, 2012) and Guidelines for the protection of Fish during Construction Works in and adjacent to Waters (IFI, 2016)., shall be adhered to. Placing of concrete in or near watercourses will be carried out only under the supervision of the Contractors appointed Ecologist/ Ecological Clerk of Works.
13	10.5.1.7	Abstraction from local water courses for use as dust suppression will not take place. Wheel washes will be self-contained systems that do not require discharge of the wastewater to water bodies and water misting or sprays shall be used as required if particularly dusty activities are necessary during dry or windy periods (See **Chapter 13: Air and Climatic Factors**).
14	10.5.1.10	Instream works where required will be undertaken between the period 1st of May to 30th September (as directed by IFI during the consultation for the design implementation for the proposed road).

No	EIS Ref	Description of Commitment
15	Appendix 12C/ 10.5.1.8	All contractors and sub-contractors shall follow basic biosecurity measures as outlined for aquatic species by IFI (http://www.fisheriesireland.ie/fisheries-research-1/73-biosecurity-protocol-for-field-survey-work-1/file).
16	9.7/10.5/ 11.5	The mitigation measures for the protection against suspended solids/sediment as outlined in **Chapter 9: Hydrology and Drainage, Chapter 10: Aquatic Ecology** and **Chapter 11: Soils, Geology and Hydrogeology** will be implemented in full.

19.1.6 Aquatic Ecology

No	EIS Ref	Description of Commitment
1	10.5	The specific mitigation measures as set out in **Section 19.1.5** above and **Chapter 10: Aquatic Ecology** will be implemented in full to ensure protection of aquatic ecology.

19.1.7 Soils, Geology and Hydrogeology

No	EIS Ref	Description of Commitment
1	19.1.5	The specific mitigation measures as set out in **Section 19.1.5** above and **Section 11.5.1 of Chapter 11: Soils, Geology and Hydrogeology** will be implemented in full to ensure protection of groundwater.
2	11.5.1	Removed soil will be reused on site subject to testing. Chemical analysis will be carried out to assess whether fill material presents a risk to human and/or environmental receptors and to determine a suitable on-site or off-site disposal route.
3	11.5.1	Accidental Spillage and Erosion control and sediment control measures outlined in **Chapter 9: Hydrology and Drainage**, **Chapter 10: Aquatic Ecology** and summarised above under **Section 19.1.6** will be implemented in full to protect groundwater during Excavation of Unconsolidated Material and from accidental spillages.
4	11.5.1 / 3.12.1.4	Restrictions that apply to stockpiling of material as outlined under **Section 3.12.1.4 of Chapter 3: Description of the Proposed Road Development** will be implemented in full.
5	11.5.1/ 3.12.1.4	In order to mitigate against compaction and erosion of soil as a result of access road required to access the works area during the construction stage, the topsoil will be removed and stored as per the restrictions set out in **Section 3.12.1.4** of the EIS. Following the removal of the access road upon completion of the construction phase, the soil surface will be scarified and the topsoil replaced and reseeded.
6	11.5.1/ Appendix 17A	Waste material excavated during the construction works will be removed to a suitably licensed facility (refer to **Chapter 17: Material Assets** and the **Outline Construction and Demolition Waste Management Plan - Appendix 17A**).
7	11.5.1	To determine the extent of karstification, a geophysical survey will be required prior to construction as part of the further SI so that the risk can be adequately managed.
8	11.5.1	Karst features will require protection from surface water run-off and the construction of the drainage shall be undertaken in accordance with the guidelines in the following publications; *Drainage Design for National Road Schemes - Sustainable Drainage Options*, NRA (2014) and Method C – Groundwater Protection Response (GWPR) for the Use of Permeable Drain Systems on Road Schemes as detailed in the TII Publication - *Road Drainage and the Water Environment, DN-DNG-03065.* In particular the

No	EIS Ref	Description of Commitment
		following shall be implemented by the Contractor:- ▪ A closed drainage system required in areas of extreme (rock at or near surface) vulnerability (Ch.7, 340-7,825 and Ch. 5,240-5,920). ▪ Where possible, drainage shall be 15m set back from karst features at Ch. 6,500, Ch. 7,000, and at the swallow hole at Ch. 9,150. ▪ Where possible, drainage shall be at least 15m set back from potential karst features between Ch.7, 825-Ch. 7,900 and Ch. 10,900-Ch. 11,300 should karst features be encountered during the geophysical surveys, to be included as part of further SI, within potential karst areas. ▪ Within the area of significant cut between Ch. 12,020-Ch. 12,450 a minimum consistent thickness of 1m of either natural or man-made material beneath the invert level of the point of discharge. ▪ Lining of attenuation ponds with a suitable membrane, where there is less than 1.5m of low permeability soils beneath the base of the pond and the top of the groundwater table. ▪ Where rockhead is exposed during construction, any fissures or cavities encountered will be cleaned of loose soils and backfilled with granular fill material in order to maintain the flow path to rock and to support the road pavement. ▪ Where an embankment is to be created, a geotextile will be placed at the base to prevent sudden, catastrophic failures.
9	11.5.1/ 11.8	The Contractor will be required to implement a monitoring programme as outlined in **Section 11.8** to monitor the impact of the areas of cut on groundwater levels in private wells. The monitoring programme will be carried out prior to, during and post construction to demonstrate that construction of the road is not impacting on the groundwater levels and to monitor seasonal low and high water table levels. If the groundwater quality or groundwater level at individual wells is identified as having been impacted a new well will be provided in agreement with the well owner.
10	11.5.2	The use of stabilisation techniques such as rock bolting, rock netting, shotcrete are required as part of the detailed design stage for areas of slope instability on cut sections, particularly in the area between boreholes RC1064 and RC1025, (Ch. 5,000) where a disparity in rock quality suggests that there is a fault zone in close proximity to this cut (Ch. 4,640 to Ch. 5,960).
11	11.5.2	The following guidance documents regarding fuel filling station activities shall be adhered to during the operational phase of the proposed Service Area. ▪ PPG2 (above ground storage tanks), PPG3 (Use and design of oil separators in surface water drainage systems), PPG7 (Refuelling Activities), PPG26 (drums and bulk containers) and PPG27 (underground storage tanks). ▪ The Institute of Petroleum Guidelines for Soil, Groundwater and Surface Water Protection and Vapour Emission Control at Petrol Fillings Stations, June 2002; ▪ Draft Code of Practice for assessing the Risks from Petrol at Relevant Petrol Stations under The Dangerous Substances (Petrol Stations) Regulations 1999, and ▪ DEFRA (UK) Groundwater Protection Code: Petrol Stations and other fuel dispensing facilities involving underground storage tanks, November 2002.
12	11.5.2	In order to prevent the contamination of groundwater through infiltration of contaminated surface water run-off the drainage system as described in **Chapter 9: Hydrology and Drainage** will be implemented in full.
13	11.5	The specific mitigation measures as set out in **Section 11.5** of **Chapter 11: Soils, Geology and Hydrogeology** and outlined above in **Section 19.1.6** will be implemented in full.

19.1.8 Terrestrial Ecology

No	EIS Ref	Description of Commitment
1	Chapter 12/Appendix 12B	A site ecologist/Ecological Clerk of Works will be employed by the Contactor for the duration of the works to oversee ecological mitigation measures.
2	Appendix 12B	The measures set out in the **Habitat and Species Management Plan** contained in **Appendix 12B** of this EIS will be implemented in full and lead and monitored by the site ecologist/Ecological Clerk of Works.
3	Appendix 12B	All of the proposed translocation works will be monitored and will involve the participation of and will be led by a suitably qualified ecologist/Ecological Clerk of Works. An ecologist/ Ecological Clerk of Works will monitor and co-ordinate all matters of the translocation works, as follows:- ▪ Preparation of receptor site at Shanbally; ▪ Identification of pennyroyal populations at Raffeen and Shanbally; ▪ Selection and removal of pennyroyal vegetative material at Raffeen and Shanbally; ▪ Excavation of aggregate materials from donor sites at Raffeen quarry and Shanbally; ▪ Transport, tipping and re-grading of excavated aggregate material within the receptor site; and ▪ Ongoing monitoring during the project's construction phase to assess establishment of pennyroyal plants, drainage within the proposed translocations areas and monitor the growth rate of ruderal and shrub species within the receptor area.
4	12.7.1.5	The measures set out in the **Outline Invasive Species Management Plan** contained in **Appendix 12C** of this EIS will be implemented in full and supervised by the site ecologist/Ecological Clerk of Works. The plan will be updated by the Contractor following a preconstruction IAS survey.
5	12.7.1.1	Specific measures set out in **Table 12.40** to **Table 12.60** for each ecological receptor shall be implemented in full.
6	12.7.1.2 / 13.5.1	Mitigation measures as outlined in **Section 12.7.1.2** and **Section 13.5.1** of the EIS to control airborne pollutants/dust during the construction phase shall be implemented in full.
7	12.7.1.6	The Contractor shall implement the NRA *Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes* (2006a), *NRA Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes* (2006b) and *NRA Guidelines for Crossing of Watercourses During the Construction of National Road Schemes* (2005) to ensure the protection of non-volant mammals.
8	12.7.1.7 & 12.7.1.8	If 36 months have lapsed from the time the baseline surveys were completed for this EIS and the grant of approval and commencement of construction, a pre-construction otter and badger survey will be completed in accordance with the *NRA Guidelines* (2006a & 2006b). Where dense vegetation prevents adequate determination of the presence or absence of holts or setts, these areas will require monitoring during vegetation clearance to ensure that any setts present will be found and treated appropriately.
9	12.7.1.9	Measures for the protection of badgers during the construction stage will be carried out in accordance with the mitigation outlined in **Section 12.7.1.9**. No construction machinery will be used within 30m of badger setts (extended to 50m for active setts during the breeding season, December to June inclusive).

No	EIS Ref	Description of Commitment
		Evacuation and destruction of active badger setts will be carried out under the supervision of an appropriately qualified ecologist under licence from the NPWS. Evacuation and destruction will be undertaken during the period 1st July to 30th November.
10	12.7.1.10	The location of any depots, spoil heaps or other additional site usage during clearance and construction will avoid any disturbance to the location of active badger setts and will also avoid areas identified for the installation of mammal underpasses and mitigation.
11	12.7.1.11	Exclusion and destruction of any otter holts will be undertaken under licence, in accordance with the NRA *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes* (2006b).
12	12.7.1.12	The NRA Guidelines (*Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes* and the *Guidelines for the Treatment of Bats during the Construction of National Road Schemes*) will be implemented by the Contractor. The Contractor shall ensure that there is no disturbance to trees and vegetation (1st March to 31st August inclusive). If bats are found during the pre-construction surveys of mature broadleaved trees they shall be felled, under supervision by a bat expert, in the period late August to late October, or early November, in order to avoid disturbance of any roosting bats as per *NRA Guidelines* (NRA 2006a and 2006b) and also to avoid the bird breeding seasons. Trees with ivy-cover, once felled, will be left intact onsite for 24 hours prior to disposal to allow any bats beneath foliage to escape overnight. Any trees and treelines along approach roads and planned site access tracks shall be retained. An exclusion zone of at least 7m or equivalent to the tree canopy drip zone to protect retained trees from root damage by machinery will be provided. Such protected trees will be fenced off by adequate temporary fencing prior to other works commencing. Severed linear features such as hedgerows and treelines shall be reconnected to the specific landscape measures and ecological landscape measures using semi-mature trees under-planted with hedgerow species to compensate for the loss of treelines and hedgerows as illustrated in the **Habitat and Species Management Plan** (**12B** in **Volume 4**) and the Specific Landscape Measures **Figure 16.5** in **Volume 5** of the EIS. Native species will be used as specified in **Section 12.7.1.12** of **Chapter 12.** Mitigation measures for loss of semi natural habitats (including woodlands) will be carried out in accordance with the measures specified in the **Habitat and Species Management Plan (Appendix 12B)** and **Table 12.40** of the EIS. Bat boxes will be provided along the route (on trees or buildings) to mitigate against the loss of potential roosting features and foraging/commuting habitat coupled with the wider loss of commuting territory. The appropriate number of bat boxes to compensate for loss of potential roosting features shall be calculated following pre-construction Potential Roost Feature (PRF) inspection/presence absence surveys. Structures identified in **Chapter 12: Terrestrial Ecology** with potential to support bat roosting and foraging that are scheduled for removal shall be re-surveyed by a suitably qualified bat specialist immediately prior to demolition to determine if any bats are present. If a roost is discovered in a building to be removed three Schwegler bat boxes or similar shall be erected adjacent to the site one month prior to works to provide alternative roost sites for the bats.

No	EIS Ref	Description of Commitment
		Demolition of these structures shall preferably be undertaken between November and March.
13	12.7.2.1	Underpasses and ledges will be constructed in accordance with the NRA Guidelines (NRA, 2006a and 2006b) at the locations listed in **Table 12.41** and **Figure 12.7** of **Chapter 12: Terrestrial Ecology**. Where engineering difficulties arise i.e. in areas of cut, underpasses will be moved to the nearest suitable location, but not more than 250m away.
14	12.7.2.2	Mammal proof fencing will be provided in accordance with NRA Guidelines (NRA 2006a and 2006b).It will be recessed and tied into bridge, culvert and mammal underpass locations to guide badgers and other mammals safely under the road and prevent them accessing the road carriageway.
15	12.7.2.3	The Contractor will be required to create and secure 4 no. artificial setts within the LMA/CPO line at the locations shown on **Figure 12.7**.
16	12.7.2.4	Quarterly monitoring will be carried out to determine the success of the mammal mitigation measures employed. Monitoring will be continued for a minimum of one year after construction ceases, in accordance with the NRA Guidelines.
17	12.7.2.5	Lighting restrictions for bats and other taxa as outlined in Section 12.7.2.5 of the EIS will be implemented during the operation phase of the proposed road project.
18	12.7.2.7	The Contractor shall ensure that there is no disturbance to trees and vegetation (1st March to 31st August inclusive). If works must proceed during this season a derogation licence will be applied for from the Wildlife Licencing Unit of the NPWS.
19	12.9/ Appendix 12B	Monitoring outlined in **Section 12.9** and in the **Habitat and Species Management Plan** (See **Appendix 12B** in **Volume 4**) will be carried out by Contractor during the construction stage and CCC once the road is open to traffic. The monitoring will include:- ▪ Monitoring of mammal proof fencing to determine defects, gaps and weaknesses; ▪ Monitoring of mammal underpasses to determine usage, efficacy and functionality for mammals in the surrounding locality; ▪ Monitoring of tree, woodland and landscape planting established for the project; ▪ Monitoring of bat boxes erected along the road project in addition to a condition assessment of landscape planting. Seasonal inspection of bat boxes shall be undertaken (excluding mid-June to mid-August, the lactation period of females, where any disturbance at this time can be detrimental to survival of young) to monitor bat usage and in wintertime for general wear and tear and to remove droppings following use the previous summer. This shall be undertaken by a licensed bat-handler[2]. ▪ Monitoring of habitat creation measures at Raffeen Quarry; ▪ Monitoring of invasive species populations within the project and environs; and ▪ Monitoring of attenuation and mitigation measures, such as silt traps and hydrocarbon interceptors to attenuate run-off to watercourses and waterbodies.
20	12.7	The specific mitigation measures as set out in **Section 12.7** of **Chapter 12: Terrestrial Ecology,** the **NIS** in **Volume 3** and outlined above in **Section 19.1.6** will be implemented in full.

[2] National Roads Authority (2006d): Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes. National Roads Authority, Dublin.

19.1.9 Air and Climatic Factors

No	EIS Ref	Description of Commitment
1	13.5.1	A Dust Risk Assessment and a Dust Minimisation Plan will be prepared by the Contractor and incorporated into the EOP in accordance with the NRA Air Quality Guidelines and the NRA *Guidelines for the Creation and Maintenance of an Environmental Operating Plan* (NRA, 2007). The plan will be based upon the industry guidelines in the Building Research Establishment document entitled '*Control of Dust from Construction and Demolition Activities' (BRE 2003)*, as referenced in the NRA Guidelines.
2	13.5.1	The Contractor will be required to maintain monthly dust levels below the guideline of 350mg/m^2/day as an annual average at sensitive receptors. Where dust levels are found to be above this threshold, the mitigation measures in the area shall be reviewed as part of the Dust Minimisation Plan.
3	13.5.1	The following specific measures will be applied in the vicinity of Raffeen Quarry in the event that material is extracted from the quarry:- ▪ Site traffic in these areas will be restricted to 20km/hr to minimise dust re-suspension. ▪ All material handling will be carried out to minimise drop heights from plant to plant or from plant to stockpile. ▪ Water bowsers will be used across the areas as required on roads, stockpiles and material handling systems.
4	13.5.1	Mitigation measures to minimise CO_2 emissions from transport during the construction phase, as set out in **Section 13.5.1** will be implemented during the construction phase including implementation of TMP, local sourcing of construction materials.
5	13.5.1	As part of the EOP/ CEMP, the Contractor will be required to implement an Energy Management System for the duration of the works.
6	13.5	The specific mitigation measures as set out in **Section 13.5** of **Chapter 13: Air and Climatic Factors** will be implemented in full.

19.1.10 Noise and Vibration

No	EIS Ref	Description of Commitment
1	14.6.1.1	Prior to and during the construction phase the Contractor will be required to:- ▪ Install temporary acoustic barriers at the locations adjacent to the Maryborough overpass shown in Drawing TM0010 (barriers 3m high). ▪ Install additional screening at the piling machine at Maryborough Hill that will be capable of providing a reduction of 10dB(A) at the nearby noise sensitive locations. ▪ Reinstate and upgraded the existing wall and fence (2m high) shown on Drawing No. TM0001 to provide an acoustic screen for the construction phase, prior to the installation of AB01. ▪ Construct acoustic noise barriers AB01 to AB04, AB06 to AB08, AB10 to 14 and AB26, AB27 and AB28 as early as possible during the construction phase.
2	14.6.1.1	The Contractor will be required to set out an acoustic barrier construction schedule to maximise acoustic screening for the construction phase and to minimise the duration of activities in each area.
3	14.6.1.1	Contractors will employ the Best Practicable Means to minimise noise emissions and will be obliged to comply with the general recommendations of *BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise. And BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part2: Vibration (together referred to as B.S. 5228).*
4	14.6.1.1	A noise and vibration monitoring programme will be implemented for the duration of the construction phase (to include vibration monitoring at Castle Warren).
5	14.6.1.1	For works outside normal working hours or the Contractor's method statement for any proposed works indicates that the levels set out in **Table 14.1** of **Chapter 14: Noise and Vibration** may be exceeded, permission for these works shall be sought from CCC in advance of any works taking place. The application for such works will require a detailed noise control plan and follow up report to be prepared.
6	14.6.1.1/ 3.10	Blasting will only be permitted between 0900 and 1800 hrs Monday to Friday inclusive. Blasting will not be permitted on Weekends or Bank Holidays. In the advance of any blasting operation the Contractor will inform occupants of all dwellings within 500m of the blast that blasting will take place and the duration of blasting operations. The timing and scheduling of blasting activities for the road will be agreed with CCC in advance of commencement on site. Air overpressure from any blast will not exceed 125 dB (linear) max peak, with a 95% confidence limit when measured at the nearest air overpressure sensitive location. No individual air overpressure value shall exceed the limit value by more than 5 dB (Lin).
7	14.6.1.1	The measures specified in **Section 14.6.1.1** will be incorporated into the Contractors CEMP.
8	14.6.2	Low road noise surfacing will be used along the entire mainline of proposed M28 Road Project and at the additional locations listed in **Table 14.14**.
9	14.6.2	Acoustic mitigation measures (noise barrier/walls) will be installed at the locations listed in **Table 14.15** and shown on **Figure 14.9** in **Volume 5**. Acoustic mitigation will be provided in accordance with the relevant standards (listed in **Section 14.2.3** of **Chapter 14)** and where proprietary barriers are used they will be required to have a design life of 30 years with no gaps or leaks in the structure.
10	14.6	The specific mitigation measures as set out in **Section 14.6** of **Chapter 14: Noise and Vibration** will be implemented in full.

19.1.11 Cultural Heritage

No	EIS Ref	Description of Commitment
1	11.5.1	Archaeological mitigation measures will be carried out in advance of the construction in accordance with **Section 11.5.1** of the EIS.
2	11.5.1.1	A geophysical survey will be undertaken, by a competent geophysical archaeologist, to assess the greenfield lands within the proposed CPO (where not already undertaken), subject to approval by the appointed TII Project Archaeologist in consultation with the National Monuments Service and under ministerial direction.
3	11.5.1.1	The geophysical survey will also seek to identify whether any archaeological features or deposits survive within the proposed CPO at the locations listed in **Section 15.5.1.1** of the EIS & located on **Figures 15.1a-h** in **Volume 5**). (AH1. AH2, AH3, AH4, AH5, AH7, AH8, AH9, AH13, AH15, AH16, AH17, AH20, AH21, AH23, AH24, AH25, AH26, AH28, AH31, AH34, AH35, AH38, AH40 , AH42 to AH45, AH46, AH47, AH48, AH49, AH50, AH51, AH52, AH53, AH54 to AH60, AH63, AH64, AH65, AH66, AH67, AH68, AH69).
4	15.5.1.1	The use of Ground Penetrating Radar (GPR) will be explored as a means to assess the area where the Service Area is proposed.
5	15.5.1.2	A detailed programme of archaeological test excavation will be undertaken, by suitably qualified archaeologists, under ministerial directions within the land acquisition area. Where sites of archaeological significance are identified, due regard will be given to the feasibilty of preserving such remains *in-situ*. Where preservation *in*-situ is not deemed feasible, all features of agreed archaeological significance will, subject to ministerial directions, be preserved by record (by means of archaeological excavation, post-excavation analysis, reporting and dissemination).
6	15.5.1.2 / 15.5.3	Any archaeological features revealed by the test-trenching, or by any other means, which will be directly impacted by the proposed works, will be preserved by record by means of archaeological excavation, recording and publication of results. Where deemed appropriate by the National Monuments Service (DAHRRGA) archaeological features or sites revealed by the test trenching, which will be directly impacted by the proposed works, may be preserved in-situ (by avoidance or design). If features are to be left *in-situ*, details plans will be required as to the layout and extent of these features/ sites as well as a geographical location. Before and after photographs will be required as well as a full report on the preservation of the site and how this was achieved, by the National Monuments Service. In accordance with the Code of Practice between the National Roads Authority (now TII) and the Minister for Arts, Heritage, Gaeltacht and Islands in 2000 where possible all archaeological excavation will be completed pre-construction, or if not, then during the early stages of construction phase.
7	15.5.1.2	A wade survey will be undertaken at all of the (active) watercourses where they are traversed by the proposed road (AH30, AH32, AH36, AH39, AH41 and AH70). The survey will be carried out by a qualified underwater archaeologist under ministerial directions.
8	15.5.2	Appropriate measures outlined in **Section 15.5.2** including photographic records, scaling and written descriptions will be undertaken in order to mitigation for potential impacts to architectural heritage (BH 5, 10, 19, 20 22 and 23).
9	15.5.2	Appropriate screening will be put in place to mitigate the visual impacts identified at Castle Warren (BH11), the Martello Tower (BH1), Ring House (BH3), and the farm complexes in Ballinrea and Carrigaline Middle (BH7 & BH8) as illustrated on **Figure 16.5** in **Volume 5** entitled **"Specific Landscape Measures".**

No	EIS Ref	Description of Commitment
10	15.5.3	Vibration monitors will be installed within the grounds of the 18th century Country House and the earlier medieval structures at Castle Warren (AH22 / BH11) prior to commencement of works, with alerts to identify any undue level of vibration at the structure during construction of the road (refer to **Chapter 14: Noise and Vibration**)
11	15.5	The specific mitigation measures as set out in **Section 15.5** of **Chapter 15: Cultural Heritage** will be implemented in full.

19.1.12 Landscape and Visual

No	EIS Ref	Description of Commitment
1	16.5.1	The Contractor shall implement the Specific Landscape Measures (SLM) as set out in **Table 16.10** and illustrated on **Figure 16.5** of **Chapter 16: Landscape and Visual**. Where cuttings and embankments are not present the SLM will require a minimum width of 5m planting.
2	16.5.2	All trees, shrubs and other plant material shall comply with the standards set out in National Plant Specification (NPS) prepared by the Committee on Plant Supply and Establishment and published with the backing of the Joint Council of Landscape Industries (JCLI, 1989). All trees, shrubs, transplants, hedging material and ground cover planting shall be maintained and guaranteed for a period against death, deformation, die-back, or disease other than that caused by malicious damage.
3	16.5.2	Road verge or bank planting will consist of 'bare root transplants', 'whips' and 'feathered trees', will adapt more easily to the disturbed ground and exposed site conditions. All plants are to be positioned in the locations and in the required numbers and centres indicated on the agreed planting plan.
4	16.5.2	**Woodland Mix** Landscape mitigation planting of road verges and slopes and as compensation for loss of existing screening and loss of woodland, individual trees and hedgerows along the proposed M28 Road Project will exclusively use Irish native species that reflect the existing vegetation of the area. Core species will include; Hybrid Oak, Scots Pine, Hawthorn, Hazel, Holly, Blackthorn, Goat Willow, Alder, Rowan and Birch. Additional species at certain locations will include; Blackthorn, Broom, Elder, and Grey Willow. Woodland Mix areas will be planted as whips and feathered transplants at a standard size of 60-90cm or 90-120cm augmented by semi-mature individual trees. Species shall be randomly planted in groups. The majority of species used will be quickly maturing species and will have formed dense woodland within ten years. The canopy will reach at least 7 to 10m, in places where groups of trees are planted. In addition to whip and feathered transplants individual semi-mature trees shall be used to provide screening at SLM locations where limited roadside space is available or where early effect is required as set out in **Table 16.10**.
5	16.5.2	Individual semi-mature tree planting using the core native species (Hybrid Oak and Scots Pine) shall include standard (2.5-3.0 m) and heavy standard (3.5-4.25 m) trees located in locations to provide specific screening and early effect as per **Table 16.10** and **Figure 16.5.**
6	16.5.2	Shrub planting shall consist of native species from the core and additional species listed above to provide woodland understorey, woodland edge and scrub areas. Shrub planting mixes shall complement areas of woodland and be used at locations consistent with the ecological assessment mitigation measures.

No	EIS Ref	Description of Commitment
		Hedgerows shall be reinstated at interrupted field boundaries or where new boundaries with fields are created using native hawthorn, blackthorn and holly that shall be the predominant species used. Shrub planting shall also be planted to soften the appearance of noise barriers.
7	16.5.2	The road verges will be seeded with a general (Grade II) grass seed mix. Areas away from designated sight lines where mowing regimes are not required to be of a regular nature will be seeded with wild grasses and meadow flowers. Grass and wildflower mixes using seed from Irish native sources shall be employed to provide quality areas of low maintenance, rapid establishment, and visual appearance.
8	16.5.2	The construction Contractor will adhere to the NRA's *Draft Guidelines on the Implementation of Landscape Treatment on National Road Schemes in Ireland*, 2011. Storage areas will be located so 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.
9	16.5.2	The following measures will be implemented by the Contractor to mitigate potential visual impacts by night:- ▪ Use of directional down light style cut-off luminaries to prevent up lighting and reduce glare and sky glow; ▪ Use of baffles were street lights are located in close proximity to properties to reduce light spill on to properties and to reduce glare and sky glow; and ▪ Use of lighting control systems to reduce the amount of light spill, sky glow, and visual appearance during the construction phase where works take place in proximity to properties.
10	New	Noise mitigation features (barriers) will be, wherever possible, integrated within the proposed landscaping measures.
11	16.5	The specific mitigation measures as set out in **Section 16.5** and **Figure 16.5** of **Chapter 16: Landscape and Visual** will be implemented in full.

19.1.13 Material Assets

No	EIS Ref	Description of Commitment
1	17.7	Further investigations into services will be necessary during the detailed design stage. Methods such as ground penetrating radar (GPR) and silt trenching in the verge areas can be used to verify or locate existing services.
2	17.5.2	Waste arising from the construction phases will be dealt with in accordance with the provisions of the Waste Management Act and amendments. The Contractor is required to meet the 70% target set by the Southern Region Waste Management Plan 2015-2021 for the material reuse, recycling and recovery.
3	17.5.2	Any material that cannot be re-used on site will be sampled, tested and treated at appropriately authorised facility.
4	3.12.1.4	Restrictions that apply to stockpiling of material as outlined under **Section 3.12.1.4** of **Chapter 3: Description of the Proposed Road Development** will be implemented in full.
5	17.5.2	Construction waste will be managed in accordance with the measures outlined in **Chapter 17 - Section 17.5.2** and the **Outline Construction and Demolition Waste Management Plan** in **Appendix 17A**. The Outline C&D Waste Management Plan will be updated by the contractor in advance to construction works and will be prepared having regard to: ▪ Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects (Department of Environment Heritage and Local Government, July 2006); ▪ CIRIA document 133 Waste Minimisation in Construction; and ▪ TII guidelines including Guidelines for the Management of Waste from National Roads Construction Projects (Revision 1, 12 November 2014). The Contractor will have regard to the By-product notifications (under Article 27 of the EC Waste Directive Regulations 2011) which provide an opportunity for reuse of surplus clean soil & stone material arising from construction activity. An EOP will be prepared in advance of the works to incorporate these measures.
6	17.5.2	The Contractor will be required to ensure that the facility to which the waste is brought to is authorised in accordance with the Waste Management Legislation.
7	17.7	The Contractor shall develop a record keeping system that will ensure that details of all arising's, movement and treatment of C&D waste are recorded. All materials being transferred from the site, whether for recycling or disposal, shall be subject to a documented tracking system which can be verified and validated
8	17.5.3	Specific measures for management of operational waste will be carried out in line with **Section 17.5.3** of the EIS.
9	17.5.3	The Waste Management Plan for the operation phase will be prepared in accordance with "NRA Guidelines for the Management of Waste from National Road Construction Projects" and the British Standard BS 5906 "Waste Management in Buildings Code of Practice". Waste arising as a result of the operation of the road and Service Area will be dealt with in accordance with the provisions of the Waste Management Act and amendments.
10	17.5	The specific mitigation measures as set out in **Section 17.5** of **Chapter 17: Material Assets** will be implemented in full.

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