March 2019

GLENAMUCK DISTRICT ROADS SCHEME

Environmental Impact Assessment Report

Volume 2: Main Report

dlr Comhairle Contae County Council

Future Analytics
Planning | Research | Economics

DBFL CONSULTING ENGINEERS

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1 Introduction

Dún Laoghaire-Rathdown County Council (DLRCC) proposes to improve the Glenamuck/Carrickmines/Kiltiernan area's multi-modal transport infrastructure by developing the Glenamuck District Roads Scheme (GDRS).

The Environmental Impact Assessment Report (EIAR) presents a systematic analysis of the impact of the Proposed Project in relation to the existing environment and follows guidelines published by the Environmental Protection Agency (EPA). The EIAR document is prepared as part of the Environmental Impact Assessment (EIA) process and will be submitted to the Competent Authority (An Bord Pleanála) as part of the planning process for the project.

1.1 Proposed Scheme

The GDRS will involve construction of;

- The Glenamuck District Distributor Road, approximately 890 metres of four lane dual carriageway and 660 metres of two lane single carriageway road which will connect the existing R117 Enniskerry Road with the Glenamuck Road; and
- The Glenamuck Link Distributor Road - approximately 1800 m of two- lane single carriageway road, which will connect the new distributor road with the existing Glenamuck Road and Ballycorus Road providing an alternative to the Enniskerry Road for north south travel

The proposed new distributor and link roads, with associated traffic management measures and site works (including attenuation ponds), would join the existing road network with new junction(s) to be formed with the R117 (Enniskerry Road), the R116 (Ballycorus Road), Barnaslignan Lane and the Glenamuck Road.

The proposed road development would be located in the electoral divisions of Glencullen, Cabinteely-Loughlinstown and Shankill-Rathmichael; and the townlands of: Carrickmines Great, Glenamuck South, Glenamuck North, Jamestown, Kiltiernan Domain, Kiltiernan.

The location of the proposed GDRS is to the east of the R117 and southwest of the M50 Motorway, between Carrickmines and Kiltiernan in the central part of the DLRCC area. This rural location is situated at the urban fringes of Dublin City and County with access onto the M50 motorway, which provides linkages to the majority of the national road schemes in the country.

The GDRS is included in the DLRCC County Development Plan 2016–2022 as a 'six-year roads objective' and is further detailed in the Kiltiernan/Glenamuck Local Area Plan 2013 (LAP).

The layout of the proposed road development is illustrated in Figure 1-1 below.

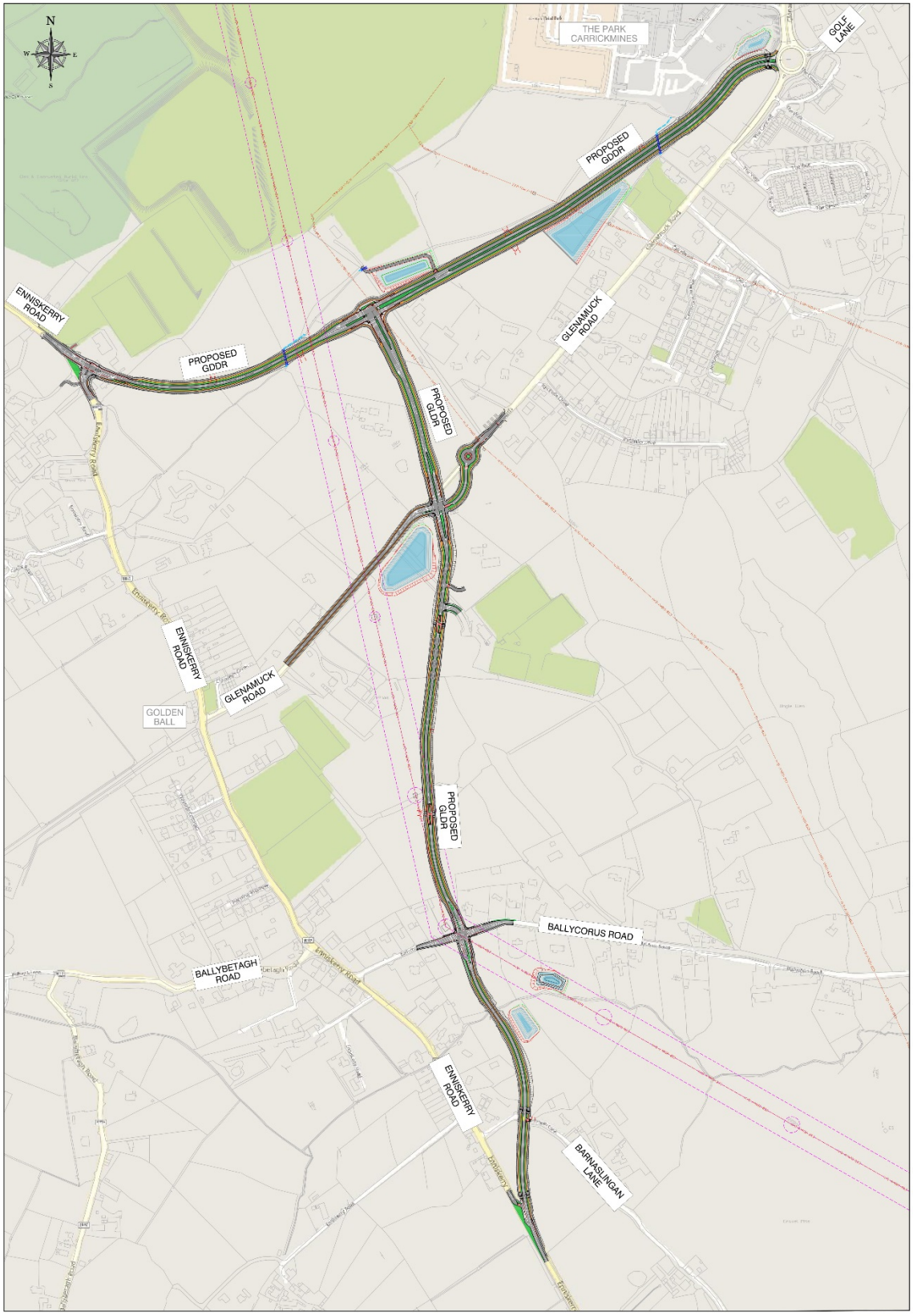

Figure 1- 1: Overview of Scheme Layout.

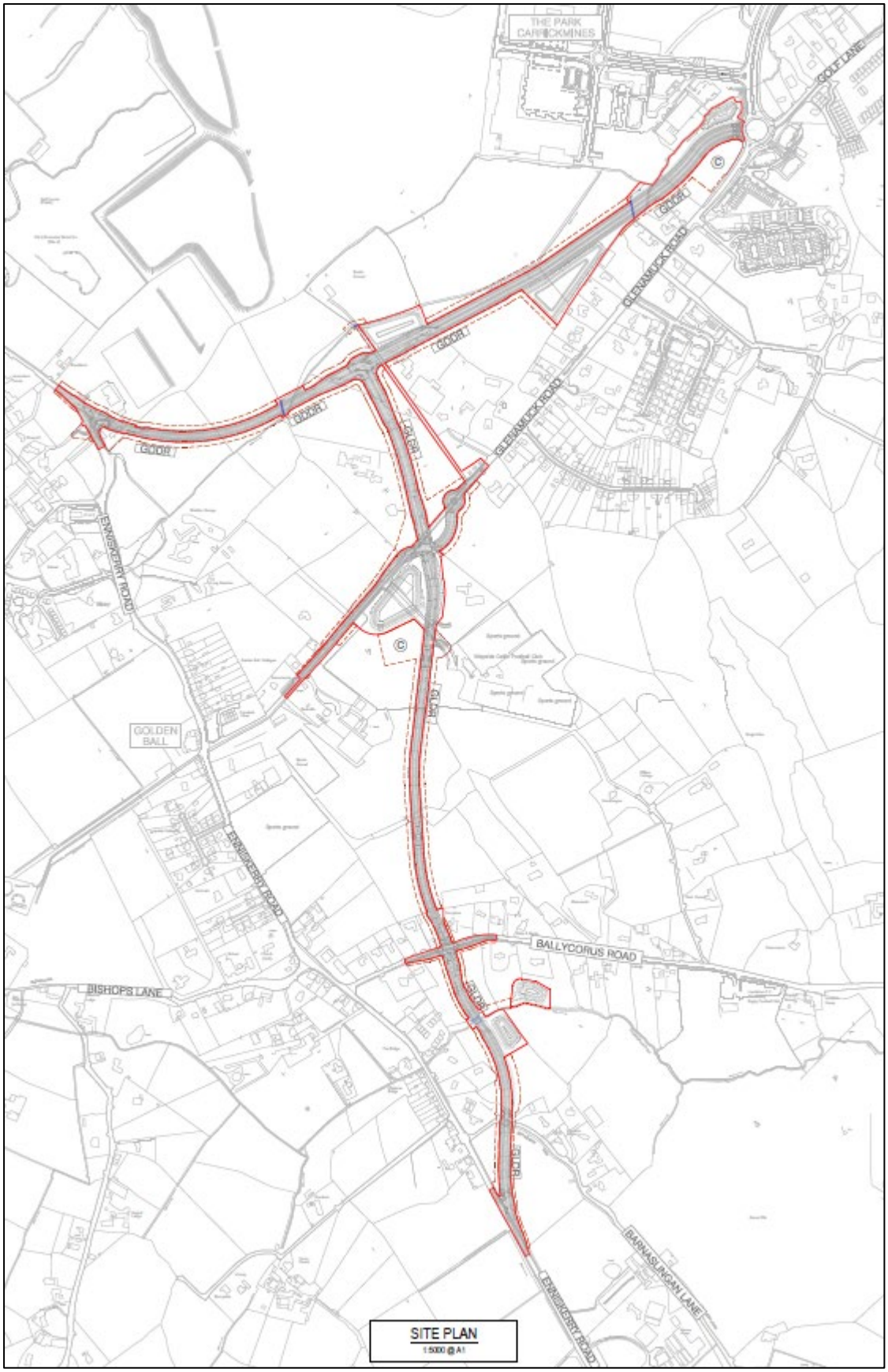

Figure 1- 2: Site Location Map including Permanent and Temporary CPO Extents.

1.1.1 EIAR Format

The format used in this EIAR document is referred to as the 'grouped format' in that it seeks to enable the reader to readily access the issues of interest to them. The EIAR has been divided into the following chapters;

1. Introduction
2. Background to the Scheme
3. Alternatives Considered
4. Consultations
5. Description of the Scheme
6. Planning and Policy
7. Traffic and Transport
8. Air Quality and Climate
9. Noise and Vibration
10. Biodiversity
11. Archaeology, Architectural and Cultural Heritage
12. Landscape/Townscape and Visual
13. Land and Soils
14. Water and Hydrology
15. Resource and Waste Management
16. Population and Human Health
17. Material Assets: Land Use and Property
18. Material Assets: Utilities
19. Interrelationships, Interactions and Cumulative and Indirect Effects
20. Summary of Mitigation Measures and Residual Impacts

Each element of the environment is described in a separate chapter generally under the following headings:

- Introduction;
- Assessment Methodology;
- Baseline Environment;
- Predicted Impacts;
- Mitigation Measures;
- Residual Impacts;
- Difficulties Encountered; and
- References.

1.2 Planning Procedure for the Proposed Scheme

1.2.1 Introduction to the EIA Process

The primary purpose of the EIA Directive (Directive 2011/92/EU as amended by 2014/52/EU) is to ensure that public and private projects which are likely to have significant effects on the environment

are granted development consent only after an assessment of the likely significant environmental effects of those projects has been carried out i.e. an EIA. EIA concerns a process of evaluating potential effects upon the environment that result from a proposed development or project at a particular site. Where these effects are assessed to have an unacceptable or harmful impact, the design of the development can be altered, or other measures taken, to avoid or reduce the effect to an acceptable level known as mitigation measures.

The initial EIA Directive dates back to 1985 (85/337/EEC) and was amalgamated alongside its amendments into Directive 2011/92/EU in December 2011. This was transposed into Irish regulations through Part X of the Planning and Development Act 2000 (as amended) and Part 10 and Schedules 5, 6 and 7 of the Planning and Development Regulations 2001 (as amended). The 2011 Directive has subsequently been revised through the 2014 EIA Directive (2014/52/EU).

Circular letter PL1/2017 on Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive) – Advice on Administration Provisions in Advance of Transposition, advised that applications for planning permission or other development consent received on or after 16th May 2017 falling within the scope of Directive 2011/92/EU, or within the scope of Directive 2014/52/EU were to apply the requirements of Directive 2014/52/EU by way of administrative provisions in advance of the transposition of Directive 2014/52/EU into Irish law.

The European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 came into operation on 1st September 2018 formally providing for the transposition of the Directive 2014/52/EU into Irish law.

The terminology used for what was previously described as an Environmental Impact Statement (EIS) in Irish law, is now an Environmental Impact Assessment Report (EIAR). This Environmental Impact Assessment Report (EIAR) has been prepared in order to meet the requirements of the 2018 Regulations in accordance with Directive 2014/52/EU.

The need for an EIAR was determined following the preparation of an EIAR Screening Report in December 2017 pursuant to Section 50 of the Roads Act, 1993. The relevant EIAR trigger thresholds as set out in the Roads Act. Design under Article 8 of the Roads Regulations, 1994 refers to;

- *The construction of a new road of four or more lanes, or the realignment or widening of an existing road so as to provide four or more lanes, where such new, realigned or widened road would be eight kilometres or more in length in a rural area, or 500 metres or more in length in an urban area.*

A portion of the GDDR from the intersection with the GLDR to the intersection with the Golf Lane roundabout is proposed to be 4 lanes wide over a length of some 890m. The road scheme was therefore considered to be over the threshold for which an EIAR is required, and the road authority undertook to prepare an EIAR for submission to the Competent Authority. The content of the EIAR was determined pursuant to the preparation of a Scoping Report in March 2018 which was issued to stakeholders and statutory consultees for comment and feedback.

1.3 EIAR Methodology

1.3.1 Purpose of the Environmental Impact Assessment Report

Environmental Impact Assessment Reports require the assimilation, co-ordination and presentation of a wide range of relevant information in order to allow for the overall assessment of a proposed development. To allow for ease of presentation, and consistency when considering the various environmental factors, a systematic structure is used for the main body of the report.

The EIAR includes an assessment on potential significant environmental impacts (both Direct and Indirect) of the Proposed Project, and highlights the proposed mitigation measures, where applicable.

For roads developments, the legislative requirements which deem whether an EIAR is mandatory for a project are outlined in Section 50 of the Roads Act, 1993 (as amended) and in Article 8 of the Roads Regulations, 1994.

The requirement to submit the EIAR to An Bord Pleanála is set out in Section 50 of the Roads Act 1993 (as amended) and section 172 of the Planning and Development Act 2000 (as amended). Where an environmental impact assessment report has been prepared pursuant to subsection (1), the local authority shall apply to the Board for approval.

The principal elements of the EIAR assessment process can be described as follows:

1. Screening
2. Scoping
3. Consideration of Alternatives
4. Project Description
5. Baseline Description of Environment Factors
6. Identification and Assessment of Impacts
7. Monitoring and Mitigation Proposals

1.3.2 Statutory Requirements and Guidance for the Contents of an EIAR

The amended Directive and legislation include requirements around the topics and factors that should be addressed through the EIAR. These matters can then be used to formulate the structure of the report. Article 5(1) of the amended Directive describes what an EIAR is to contain as follows (EPA, 2017, p.6).:

a) a description of the project comprising information on the site, design, size and other relevant features of the project;

b) a description of the likely significant effects of the project on the environment;

c) a description of the features of the project and/or measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment;

d) a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment;

e) a non-technical summary of the information referred to in points (a) to (d); and

f) any additional information specified in Annex IV relevant to the specific characteristics of a particular project or type of project and to the environmental features likely to be affected.

The EPA 'Guidelines on the information to be contained in Environmental Impact Assessment Reports' Draft August 2017 describe inclusion of the following as good practice in the preparation of an EIAR:

- Key alternatives considered;
- Proposed project;
- Receiving environment;
- Likely significant effects; and
- Mitigation and monitoring measures and residual effects.

A non-technical summary must also be provided.

The receiving environment and the effects of the project can then be explained by reference to its possible effects on the following environmental factors:

- Population and Human Health;
- Biodiversity;
- Land and Soils;
- Water;
- Air;
- Climate;
- Material Assets;
- Cultural Heritage;
- Landscape; and
- Interactions.

Within each of these factors, different specialist topics may be of relevance and included as part of the assessment.

A full list of relevant legislation and guidance is included in the References at the end of this chapter.

1.3.3 General EIAR Methodology

Introduction

The methodology adopted for the preparation of this EIAR comprised a systematic analysis of the impact of the Proposed Project in relation to the existing environment. The overall methodology for preparation of the EIAR is discussed under the following headings;

- Basis for assessment;

- Impact assessment and mitigation; and
- Significance of environmental issues.

Basis for Assessment

The impact assessment examines the existing environmental conditions within the study area for each element of assessment and then determines the potential impacts associated with the Proposed Project during its construction and operational phases.

The study area considered within this EIAR differed for each environmental aspect and extended to incorporate all areas where there was potential for significant impact (i.e. any sensitive areas which could be affected by this development were included in the study area). Further information on the extent of the study area considered for each topic is addressed in the relevant corresponding EIAR chapter.

Impact Assessment and Mitigation

The preparation of the EIAR was an iterative process, linking into the design development process. The approach adopted in the impact assessment and preparation of the EIAR was based on the recommendations in the *Draft Guidelines on information to be contained in Environmental Impact Assessment Reports (EPA, 2017)*.

The proposed design was developed and the potential impacts of the proposal on the receiving environment were identified. Mitigation measures have been considered where necessary and will be implemented as required.

Significance of Environmental Issues

The glossaries contained in the Draft Guidelines on the information to be contained in EIAR (EPA, 2017) describes an impact as '*change resulting from the implementation of project*.'

The following factors were considered when determining the significance of the impact (both positive and negative) of the Proposed Project on the receiving environment:

- The quality and sensitivity of the existing/baseline receiving environment;
- The relative importance of the environment in terms of national, regional, county, or local importance;
- The degree to which the quality of the environment is enhanced or impaired;
- The scale of change in terms of land area, number of people impacted, number and population of species affected, including the scale of change resulting from cumulative impacts;
- The consequence of that impact/change occurring;
- The certainty/risk of the impact/change occurring;
- Whether the impact is temporary or permanent; and
- The degree of mitigation that can be achieved.

The criteria outlined in the EPA guidelines have also been followed when quantifying the duration and magnitude of impacts. The quality of the impact is described as 'negative', 'neutral' or 'positive'. Particular consideration is also given to whether significant impacts are 'Direct' or 'Indirect'. Further information on the specific methodologies utilised for the assessment of each environmental aspect are included in the relevant EIAR chapters.

Where no impact or a positive impact was predicted to occur, the design of the Proposed Project remained unchanged. Where significant adverse impacts are predicted, mitigation measures are proposed to avoid or minimise impacts. Where feasible, these measures were then incorporated into the design of the Proposed Project.

The Proposed Project presented in the planning application (including the environmental mitigation measures) will be further progressed and refined during the detailed design and construction stages. This includes any mitigation measures contained in such planning permission, as may be granted.

The detailed design and construction will develop the Proposed Project in a manner such that there is no material change in terms of a significant adverse effect on the environment. Opportunities may be identified to further reduce the significance of an adverse effect/impact and, in some cases, improve the residual effect/impact through modifications to the Proposed Project. Such modifications may be identified through detailed design or construction in order to allow for innovations in construction methods, available technology or changes in the existing situation.

Any modification to the Proposed Project will only be possible where there would be no significant change, or where there would be an improvement, in environmental impacts. The final Proposed Project design and construction will have to comply with all relevant statutory approvals.

1.3.4 Consultation Process

Information on all consultation undertaken on the Proposed Project, including a summary of the comments and feedback received, is outlined in Chapter 4 of this EIAR.

1.3.5 EIAR and Design Team

The design team is led by DBFL Consulting Engineers on behalf of DLRCC.

This EIAR has been prepared by Future Analytics Consulting (FAC) and various specialist sub-consultants on behalf of DLRCC which includes the relevant specialists and their qualifications. The list below presents the experts[1] who contributed to the preparation of the report:

[1] EPA guidance requires experts preparing an EIAR to list to include: (ii) his or her competence and experience, including relevant qualifications, if any, in relation to such parts, and (iii) such additional information in relation to his or her expertise that the person or persons preparing the EIAR consider demonstrates the expert's competence in the preparation of the report and ensures its completeness and quality."

Table 1-1: Experts who contributed to the preparation of the EIAR

Environmental Aspect	Company Name	Person Responsible	Qualification
EIAR Manager	Future Analytics	Richard Hamilton	BA (Hons.) MSc MIPI MRTPI Richard Hamilton is a chartered Town Planner with over 20 years experience, a member of the Irish Planning Institute and the Royal Town Planning Institute. He is a Director in Future Analytics Consulting (FAC) which provides consultancy services in Planning, Research and Economics. Relevant EIA experience includes the M1 Motorway Service Areas-EIS for the NRA 2011; Profile Park, Grangecastle Masterplan and EIS, South Dublin (2005 – 2006), Lidl Regional Distribution Centre, Newbridge, Kildare – Planning Application and EIS (2015/2016), College Green Plaza EIAR (2017), Dublin Airport, Northern Parallel Runway EIS (2005 – 2007), and Luas light rail Dublin (lines A and B) EIA.
EIAR Support	Future Analytics	Ben Duignan	BA MRUP Ben Duignan is a consultant town planner at Future Analytics Consulting (FAC) and a member of the Irish Planning Institute. He has been involved in a wide range of projects including development management and research.
EIAR Reviewer	Future Analytics	Meadhbh Nolan	BA MRUP Meadhbh Nolan is a Senior Associate (Planning) With over 7 years' experience as a town planner working on large scale developments across all sectors. She holds a Masters of Regional and Urban Planning from UCD and is a Member of the Urban Lands Institute. Relevant experience includes the EIS for the redevelopment of the Star Casino Sydney for the Star Entertainment Group Limited and the Stony Pinch Master Plan for the rehabilitation of an active coal mine on 3,500ha and the Sydney Olympic Park – Mixed Use Development with 700 residential units for Mirvac.
Traffic and Transportation	DBFL	Danny Pio Murphy	BEng (Hons) Meng Danny Pio Murphy holds an MEng in Civil Engineering from University College Dublin and has also attained a BEng (Hons) in Civil

			and Environmental Engineering from University College Cork. He is a Member of the Institute of Engineers of Ireland and has over five years' experience in the traffic and transportation industry, primarily focused in consultancy."
Air Quality and Climate Factors	AWN	Ciara Nolan	BSc MSc (First Class) Ciara Nolan holds an MSc. (First Class) in Environmental Science from University College Dublin and has also completed a BSc. in Energy Systems Engineering. She is an Associate Member of both the Institute of Air Quality Management and the Institution of Environmental Science. She has been active in the field of air quality for 2 years, with a primary focus on consultancy.
Noise and Vibration	AWN	Aoife Kelly, PHD	BSc PHD Aoife Kelly holds a BSc (Hons) in Environmental Health, a Diploma in Acoustics and Noise Control and a PhD in Occupational Noise. Aoife has specialised in acoustics since 2014 and has extensive knowledge in the field of occupational noise risk assessments, environmental noise and vibration impact assessment and inward impact assessments. She has extensive experience in environmental and occupational noise surveying and environmental acoustics.
Biodiversity	Openfield	Pádraic Fogarty	BSc MSc IEMA Pádraic Fogarty has worked for over 20 years in the environmental field and in 2007 was awarded an MSc from Sligo Institute of Technology for research into Ecological Impact Assessment (EcIA) in Ireland. He has an honours degree in Analytical Science from DCU, and diplomas in Environment and Geography (Open University) and Field Ecology (UCC). Pádraic is a full member of the Institute of Environmental Management and Assessment (IEMA).
Cultural Heritage	Byrne Mullins	Martin Byrne	BA MA Martin Byrne holds a BA in Archaeology and History from University College Cork, where he also completed an MA in Archaeology. He also holds a Dip. EIA Mgmt. from University College Dublin. He is a Full member of the Institute of

			Archaeologists of Ireland and has served on the Board in three capacities, including chairperson. He has been active in the field of archaeology for over 30 years and has been a joint owner of Byrne Mullins & Associates-Archaeological & Historical Heritage Consultants, since 1994.
Landscape and Visual Impact	Cunnane Stratton Reynolds	Declan O'Leary	B.Agr.Sc.(Land Hort) PGDip LArch MILI MLI(UK) Declan O'Leary has over 30 years' experience in development, landscape design, urban and environmental renewal. This includes masterplanning and design to implementation of a broad range of strategic environmental improvement schemes to industrial, highway and urban regeneration sites as well as reclamation, amenity, rural/countryside, educational and housing projects. He is experienced in working closely with developers, community organisations and statutory agencies to deliver local environmental, social and economic development.
Land and Soils	DBFL	John Carr	BEng MSc C. Eng John Carr holds an BEng in Civil Engineering from University College Dublin and has also attained a MSc in Environmental Engineering from Queens University Belfast. He is a Chartered Engineer with the Institute of Engineers of Ireland and has over eight years' experience in Civil and Environmental Consultancy."
Hydrology and Hydrogeology	DBFL	John Carr	BEng MSc C. Eng As Above.
Resource Waste Management	Future Analytics	Richard Hamilton	BA (Hons.) MSc MIPI MRTPI As Above.
Population and Human Health	Future Analytics	James Sweeny	BA MSc MRUP MSc MIPI James Sweeney is a GIS and Analytics specialist and a Director of Future Analytics Consulting (FAC) with over 7 years' experience. His work involves detailed socio-economic analysis, spatial analysis and economic research He has worked on strategic plans for cities and undertaken numerous socio-economic studies,

			utilising the use of demographic analysis in forecasting future population projections. He also has a Master of Science in Health Informatics. As part of Future Analytics' professional service provision, he is experienced in the provision of: Housing needs analysis; Retail analysis; Urban economic studies; GIS visualisation, modelling, and web application development. Relevant experience includes Socio-Economic Assessment of the Greater Dublin Area Drainage Scheme for Fingal County Council (2016); Socio-economic and environmental assessment for the Local Economic and Community Plan for Dublin City Council (2016) and the Dublin City Council Housing Strategy for DCC (2015) Rachel Gleave O'Connor LLB (Hons) MA MRTPI MIPI Rachel Gleave O'Connor is a Chartered Town Planner with over 12 years experience in private and public sectors in Ireland and the UK, specialising in development management and with particular expertise in large scale urban regeneration development. Rachel has managed an extensive portfolio of large scale planning applications for both residential and non-residential developments, including student housing, build-to-rent, co-living, office, retail and academic floorspace. Rachel has managed a number of high profile planning applications in the UK through the assessment and approval stages at the London Legacy Development Corporation, working on high density housing, tall building and extensive public realm/landscape redevelopment. She is experienced in Environmental Impact Assessment (EIA), EIA Screening and EIA Scoping.
Material Assets	Future Analytics	Richard Hamilton	BA (Hons) MSc MIPI MRTPI As Above.

1.4 What Happens Next?

DLRCC has forwarded copies of the consent application documents including this EIAR to An Bord Pleanála. Copies have also been circulated to the relevant prescribed bodies, as follows:

- Office of Public Works;
- Bord Fáilte Éireann;
- An Taisce-The National Trust for Ireland;
- Córas Iompair Éireann;
- Transport Infrastructure Ireland;
- National Transport Authority;
- An Chomhairle Ealaíon;
- Eastern Midlands Regional Authority;
- Heritage Council;
- Minister of Culture, Heritage and the Gaeltacht;
- Minister of Transport, tourism and Sport; and
- Minister for Housing, Planning, Community and Local Government.

The formal adjudication period for the Proposed Project commences when the planning application is lodged to the Board. The planning application will be placed on display for public inspection for a statutory period of at least six weeks from the date of lodgement of the application. Any person may make a submission or observations to An Bord Pleanála, 64 Marlborough Street, Dublin 1 in relation to the application during this period.

A copy of the consent application and each document accompanying the application (including this EIAR) may be inspected, free of charge, during normal office or opening hours at the following location:

- Dún Laoghaire-Rathdown County Council, Marine Road, Dún Laoghaire, County Dublin; and
- An Bord Pleanála, 64 Marlborough Street, Rotunda, Dublin 1, D01 V902.

All planning documents will also be available for download from the DLRCC website[2].

The EIAR is also available for inspection at the EIAR Portal[3]. This is a central point for notification to the public on all applications for development consent that are subject to an EIA, including development, works or activities, made across the country and under the various legislative codes. The EIA Portal also provides access to these applications and provides a link to the relevant information and documents associated with the application held by the relevant authorities responsible for approving such applications.

Submissions or observations on the application may be made only to An Bord Pleanála and must be accompanied by the appropriate fee of €50 (except for certain prescribed bodies).

[2] https://www.dlrcoco.ie/en/council-democracy/public-consultation-hub/dlr-consultation-hub
[3] http://housinggovie.maps.arcgis.com/apps/webappviewer/index.html?id=d7d5a3d48f104ecbb206e7e5f84b71f1

1.5 Difficulties Encountered During the Study

Difficulties encountered in the preparation of the EIAR are outlined in each chapter as they relate to the various environmental topics.

The Proposed Project area as with all environments, is ever changing and evolving. In instances where difficulties arise determining what represents baseline conditions, a worst-case scenario is assessed. Proposals for the Proposed Project are made within a rural environment, with zoning for development on the surrounding land. At present there are no developments along the majority of the proposed scheme.

1.6 References

- European Union (2018) The European Union (Planning and Development) (Environmental Impact Assessment) Regulations;
- European Union (1999) European Communities (Environmental Impact Assessment) (Amendment) Regulations (S.I. No. 93 of 1999);
- Irish Statute (2000) The Planning and Development Act (No. 30 of 2000), as amended;
- Irish Statute (2001) Planning and Development Regulations (S.I. No. 600 of 2001) as amended;
- European Commission, (2001) Guidance on EIA – Scoping;
- EPA (2017) Draft Guidelines on preparation of Environmental Impact Assessment Reports;
- Department of the Environment, Community and Local Government (DoECLG), (2018) Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment;
- National Roads Authority (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide (Transport Infrastructure Ireland (TII), (formerly);
- TII (2004) Environmental Assessment and Construction Guidelines;
- EPA (2002) 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 (2015) Draft Revised Guidelines on the Information to be contained in Environmental Impact Statements;
- EPA (2015) Draft Revised Advice Notes on Current Practice in the Preparation of Environmental Impact Statements;
- EPA (2015) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- Department of Housing Planning and Local Government (2018) EIA Portal. Available from: https://www.housing.gov.ie/planning/environmental-assessment/environmental-impact-assessment-eia/eia-portal.

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List of Figures:

2 Background to the Scheme

2.1 Introduction

This chapter of the EIAR provides an overview of the GDRS scheme background. In order to minimise repetition in this report, this section presents a high-level introduction to the proposal. Chapter 5 of this EIAR sets out in detail a 'Description of the Proposed Scheme'. Chapter 3 'Alternatives' reviews the strategic study and assessment process that led to the formation and confirmation of the road alignment and reservation here under assessment in this EIAR document.

2.2 Need for the Scheme

The GDRS is included in the Dún Laoghaire-Rathdown County Development Plan 2016-2022 as a 'six-year roads objective' and is further detailed in the Kiltiernan/Glenamuck Local Area Plan 2013 (LAP) (see Figure 2- 1: below).

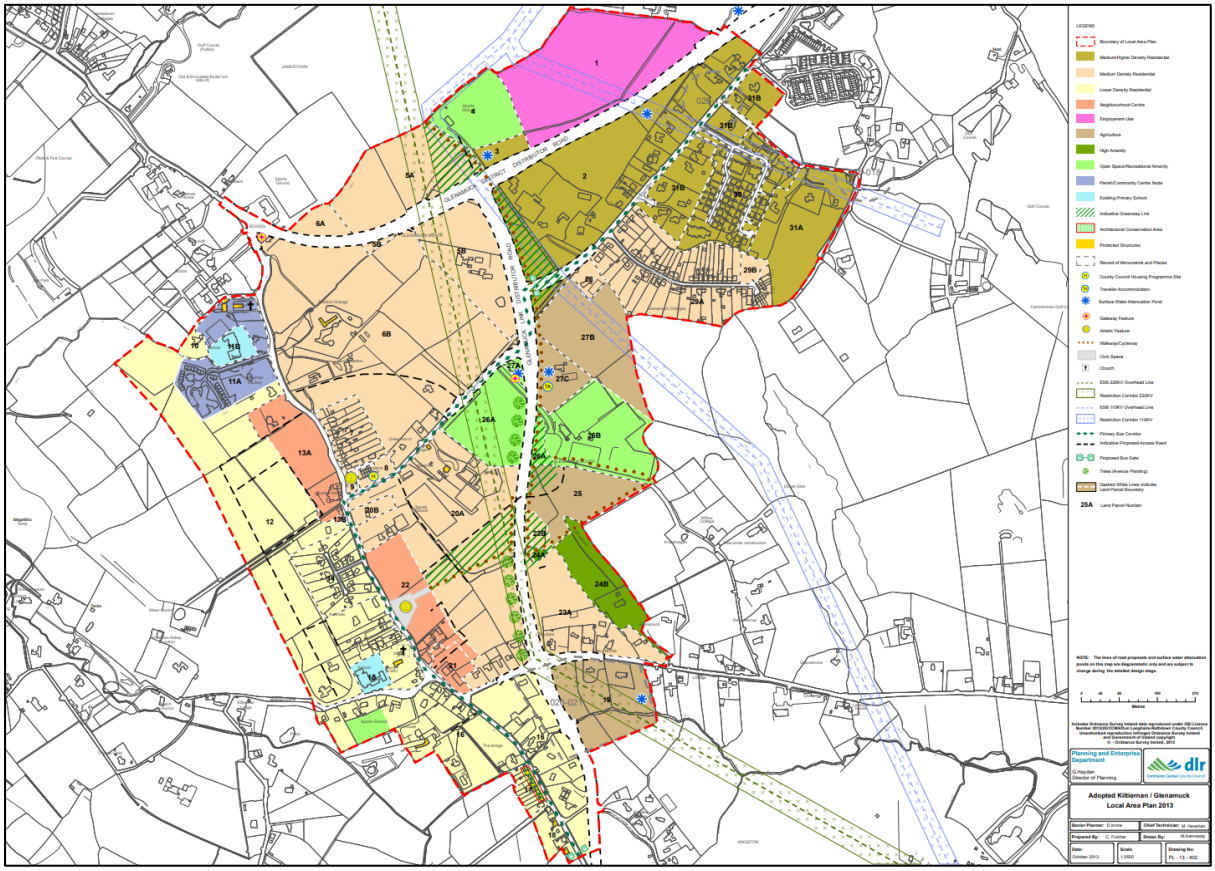

Figure 2- 1: Map of the Kiltiernan/Glenamuck Local Area. (Source: Kiltiernan/Glenamuck LAP 2013).

The need to improve the road network within the Kiltiernan-Glenamuck area has been a long-term objective of Council policy and was incorporated in the DLRCC County Development 2004-2010 as a 'six year roads objective' for the Glenamuck Road corridor to be upgraded between Enniskerry Road and the Carrickmines M50 Interchange.

This was on the basis that the current road infrastructure was considered unsatisfactory for the current and predicted traffic volumes, and there was evidence of congestion and delay on the Glenamuck Road particularly at the Golden Ball junction.

The Glenamuck Road Scheme was initially developed using traffic modelling work by the National Transport Authority (NTA) in advance of the scheme being included in the 2006 Glenamuck LAP. This was reviewed and re-assessed in the Traffic Modelling Report (2013) which was accompanied by a report entitled Review of Glenamuck Local Area Plan. This report guided the evolution of the scheme and its incorporation as a statutory objective in the Kiltiernan/Glenamuck Local Area Plan 2013. It is noted that The Kiltiernan Glenamuck Local Area Plan was adopted in September 2013. In June 2018 it was extended for a further period up to and including September 2023.

The Glenamuck Local Area Plan, Traffic Modelling Report (2013) examined the capacity of the local transport network and identified the necessary road infrastructure required for the sustainable development of the whole area.

In terms of the road infrastructure, the study suggests that an essential minimum provision of a new distributor road system will need to be provided for lands to be developed in a rational and sustainable manner. This minimum essential (core) level of road infrastructure consists of;

- GDDR (Glenamuck District Distributor Road - (primary link road)) – From Enniskerry Road to Southern Roundabout at Carrickmines;
- GLDR (Glenamuck Link Distributor Road - (primary link road)) – From Enniskerry Road to GDDR;
- Junction GDDR and GLDR;
- Junction between GLDR and the existing Glenamuck Road;
- Junction of GLDR and Ballycorus Road;
- Junction of Enniskerry Road and GDDR;
- Junctions of Barnaslingan Lane and GLDR.

All of the above infrastructure elements are incorporated into the proposed GDRS.

It is noted that Section 10 of the KGLAP describes a Phasing proposal for permitted development in the LAP area in advance of the proposed GDRS. This proposal allows for approximately 700 dwelling units to be constructed in advance of the proposed scheme which can be generally served by the existing road network, development in excess of this number is dependent on the proposed roads scheme. DLRCC planning department have noted that pre application consultations are ongoing for in excess of this development quantum across the plan lands so therefore progression of the roads scheme is imperative.

2.3 Scheme Objectives

DLRCC proposes to improve the Glenamuck/Carrickmines/Kiltiernan areas multi-modal transport infrastructure by developing the GDRS. The main objectives of the GDRS are to:

- Design the new road layout to meet the needs of all road users using best practice standards complementing the surrounding environment;

- Facilitate the diversion of through-traffic away from Kiltiernan Village core;
- Improve safety along the existing roads and junctions;
- Provide high quality pedestrian and cyclist infrastructure along the proposed route;
- Facilitate local public transport infrastructure; and
- Facilitate the development of the zoned lands within the Local Area Plan by providing suitable transport infrastructure.

The design approach to the GDRS addressed in this EIAR is dictated by the principles of the Design Manual for Urban Roads & Streets (DMURS) 2013 by the Department of the Environment, Community and Local Government/Department of Transport, Tourism and Sport. This approach to the design of the road reflects the need to develop the area in a sustainable manner, supporting the integration of land uses and multi-modal movement for pedestrians, vehicles, public transport and bicycles.

The design of the GDRS in the context of the LAP and surrounding land uses has been guided by GDRS Urban Design Report by Brady Shipman Martin presented in Appendix 12-4. This is a non-statutory document. The overall Urban Design Concept seeks to ensure that the Scheme Objectives of the GDRS support and integrate with the following sustainable planning principles for the area:

- Networks are Connected: To support the creation of integrated street networks which promote higher levels of permeability and legibility for all users, and in particular more sustainable forms of transport;
- That Streets are Multi-Functional: The promotion of multi-functional, place based streets that balance the needs of all users within a self-regulating environment;
- That Streets are Pedestrian Focused: The quality of the street is measured by the quality of the pedestrian environment; and
- A Multi-Disciplinary Approach has been applied throughout: Greater communication and co-operation between design professionals through the promotion of a plan-led, multidisciplinary approach to design.

The Overall Design Concept is illustrated in Figure 2- 2: below.

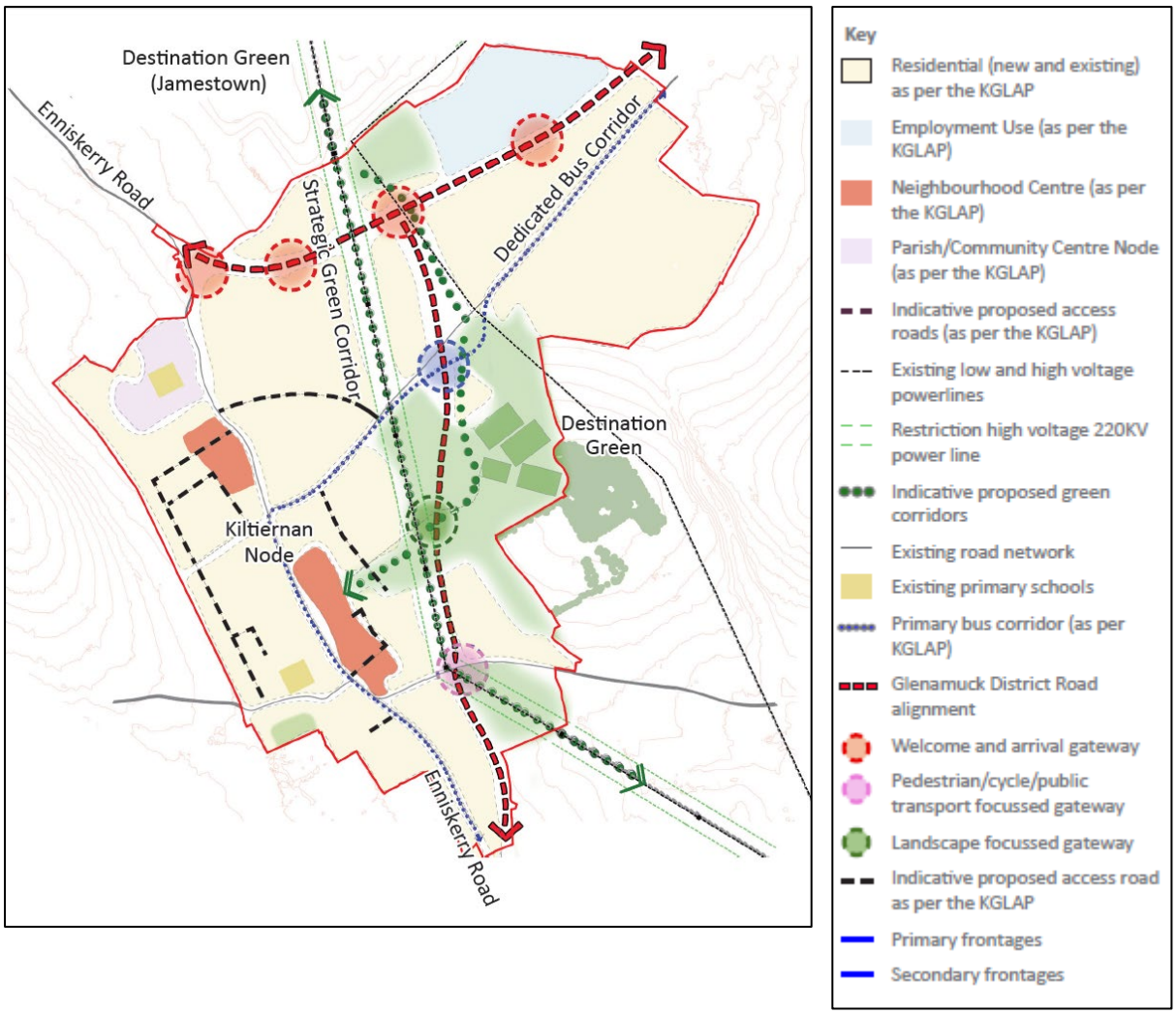

Figure 2- 2: Overall urban design concept (Source: GDRS Urban Design Report, Brady Shipman Martin)

2.4 References

- Dún Laoghaire-Rathdown County Development Plan 2004-2010;
- Dún Laoghaire-Rathdown County Development Plan 2016-2022;
- Kiltiernan/Glenamuck Local Area Plan 2013;
- The Design Manual for Urban Roads & Streets (DMURS) by the Department of the Environment Community and Local Government/Department of Transport Tourism and Sport;
- GDRS Urban Design Report, Brady Shipman Martin.

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3 Alternatives Considered

3.1 Introduction

Article 5(1)(d) of the EIA Directive 2014/52/EU requires an EIAR to contain:

> *A description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment.*

The EPA EIAR Guidelines (2017) refer to Alternatives in section 3.4 noting the following:

> *Higher level alternatives may already have been addressed during the strategic environmental assessment of relevant strategies or plans. Assessment at that level is likely to have taken account of environmental considerations associated, for example, with the cumulative impact of an area zoned for industry on a sensitive landscape. Note also that plan-level/higher-level assessments may have set out project-level objectives or other mitigation that the project and its EIAR should be cognisant of. Thus, these prior assessments of strategic alternatives may be taken into account and referred to in the EIAR. This is particularly the case for public sector projects where it is often appropriate to consider a wider range of alternatives than for private sector projects.*

The GDRS is included in the Dún Laoghaire-Rathdown County Development Plan 2016-2022 (CDP) as a 'six–year roads objective' and is further detailed in the 'Kiltiernan Glenamuck Local Area Plan 2013' (LAP). The LAP is accompanied by a Strategic Environmental Assessment Statement and by a report entitled Review of Glenamuck Local Area Plan; Traffic Modelling Report (2013). Previous traffic modelling work was undertaken by the NTA in advance of the scheme being included in the 2006 Glenamuck LAP and the environmental impact of route alternatives considered in the Glenamuck District Distributor Road, Environmental Study (2007).

The road alignment under consideration in this EIAR therefore reflects the development of strategic alternatives in these studies referenced below. For the Glenamuck area to facilitate its development over time, it is pertinent to refer to a 'Do-Nothing' scenario in consideration of land use trends and potential environmental impacts, in the event that the GDRS did not proceed. Finally, the consideration of design alternatives describes the evaluation of detailed design, alignment and construction options. In summary alternatives are considered under the following headings:

- Strategic Alternatives – Land use policy and Route Alignment options;
- Do-Nothing Alternative; and
- Design Alternatives.

3.2 Strategic Alternatives – Land Use Policy and Route Alignment Options

The Dún Laoghaire-Rathdown County Development Plan 2004-2010 recognised the need to improve the road network within the Kiltiernan-Glenamuck locality and included a 'six-year roads objective' for the Glenamuck Road corridor to be upgraded between Enniskerry Road and the Carrickmines M50 Interchange.

This was on the basis that the current road infrastructure was considered unsatisfactory for the current and predicted traffic volumes, and there was evidence of congestion and delay on the Glenamuck Road particularly at the Golden Ball junction. In addition, since the completion of the South Eastern Motorway, further demand had been placed on this corridor, as it is a direct strategic link to the motorway off the already heavily trafficked Enniskerry Road. In addition, DLRCC commissioned the following studies:

- Glenamuck District Distributor Road, Environmental Study (Vol 1-3), 2007, RPS;
- Glenamuck District Distributor Road, Preliminary Design Report, 2007, RPS;
- Glenamuck District Distributor Road, Feasibility Study & Route Selection Report, 2007, RPS; and
- Glenamuck District Distributor Road, Constraints Study, 2007, RPS.

Following the above studies, Dún Laoghaire-Rathdown County Council commissioned the following reports which considered the overall Draft LAP proposals, including the GDRS alignment, and their impact on the environment:

- Kiltiernan / Glenamuck Draft Local Area Plan (2013-2019), Strategic Environmental Assessment, Environmental Report, May 2013, RPS.
- Kiltiernan / Glenamuck Draft Local Area Plan (2013-2019), Strategic Environmental Assessment, Environmental Report, Screening for Appropriate assessment, May 2013, RPS.

Primary Route Options

Following the identification of the study area, a constraints study was undertaken in 2005 identifying the physical, environmental, procedural, and legal constraints that potentially affected the choice and design of a route for the scheme. This study included an overview of:

- Planning Policy;
- Protected Areas – National Heritage Areas (NHA's) and Special Areas of Conservation (SAC's);
- Existing Road Network;
- Water Features (Rivers, Streams, Lakes etc.);
- Landholdings;
- Community Facilities – Sports Grounds, Schools, Churches etc.;
- Landscape Features;
- Cultural Heritage – Archaeology and Architecture;
- OS Mapping showing Development (Dwellings, Farmyards etc.);
- Procurement of Aerial Photography;
- Topography;
- Utilities (Electricity, Communication, Gas, Watermains, Foul and Surface Water); and

- Geology and Hydrogeology.

The Route Selection Report identified three primary route options (1, 2, and 3) to satisfy the scheme objectives, i.e. to cater for the predicted increase in traffic volumes and thereby provide adequate facilities for the different road users.

These routes were identified taking account of the engineering, economic and environmental considerations and having regard to the issues and constraints identified in the Constraints Study. It was considered that due to the length of the scheme (approximately 1.5km) there were a limited number of viable route options available. The three route options commenced at the Carrickmines Interchange Southern Roundabout and extend to meet the Enniskerry Road at various locations. All three route options are shown in Figure 3-1.

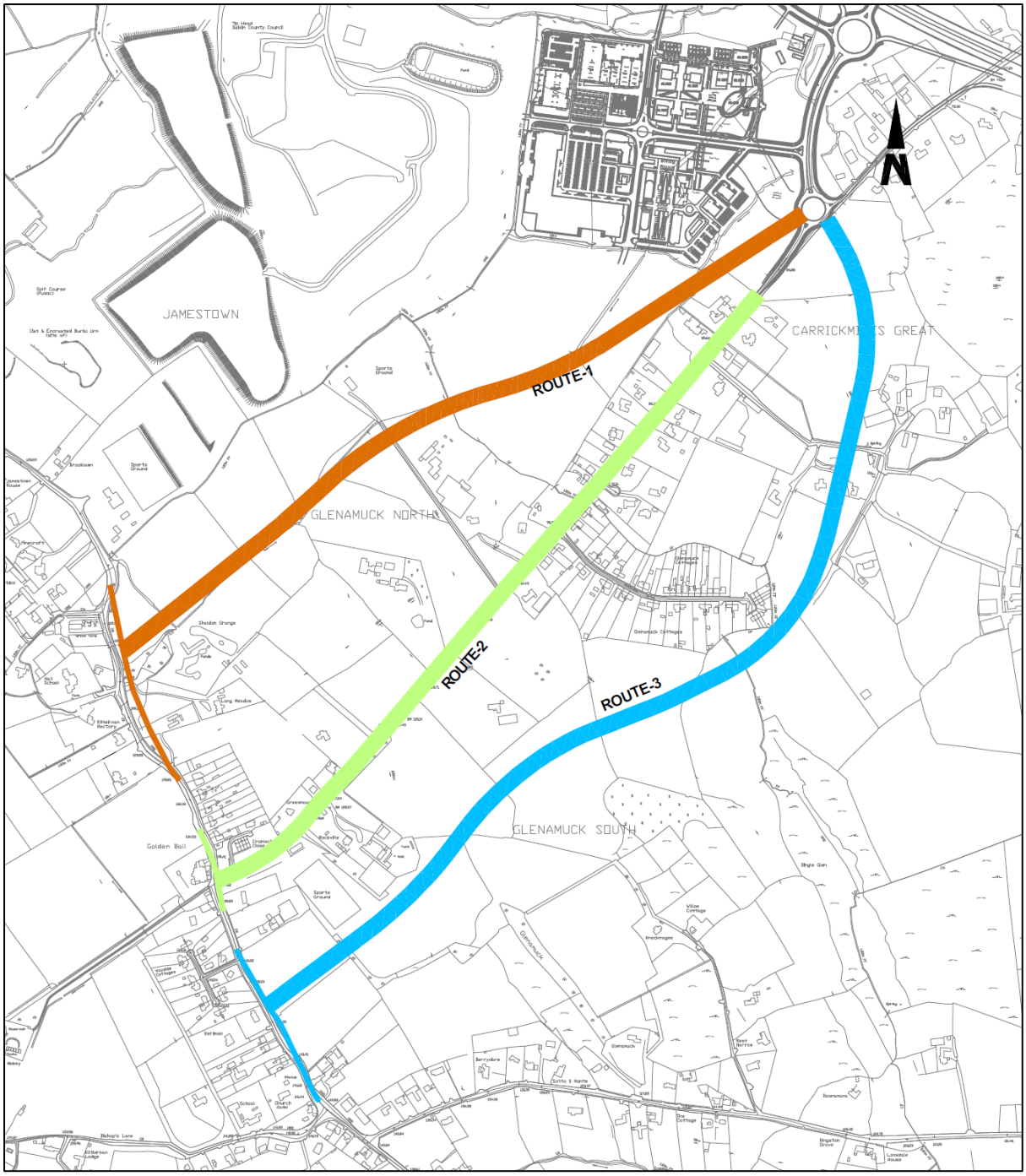

Figure 3-1: Glenamuck District Distributor Road, Environmental Study (Vol 1-3), 2007, RPS Fig. 2.1 Route Options for Proposed Scheme

It was concluded in the Feasibility Report from the Route Selection Analysis that Route Option 1 was the preferred route. Route 1 would reduce traffic in both Kiltiernan Village and on the existing Glenamuck Road. It would also provide quality road infrastructure to link with the M50 and for the future development of local lands. This assessment was based on the Design Manual for Roads and Bridges Volume 5 Assessment and Preparation of Road Schemes.

A summary of the assessment for each category is outlined below: -

- **Users of Facility –** Route Option 1 had the greatest overall benefit to the users of the facility. Route 2 had the least overall benefit to the users of the facility, with no reduction in traffic on the Glenamuck Road. Route Option 3 offered less road safety benefit than Route Option 1 as traffic volumes would not be decreased in both the Kiltiernan Village area and on the existing Glenamuck Road. Route Option 2 resulted in a road carrying mixed traffic with both local traffic and through traffic. This option would have the least impact of the three schemes for local traffic improvements due to the predicted increase in traffic.

- **Material Assets** – Route Option 1 has the least impact on the non-agricultural material assets. Route Option 2 has the greatest impact on the non-agricultural material assets as it directly affected a large number of residential dwellings. Option 2 also resulted in the loss of frontage to a large number of dwellings. Route 3 has a moderate impact on material assets.

- **Environmental Impacts** – Route Option 1 showed the least impact on the environment when compared to the other two routes. The only negative rank arose from the aquatic ecology where the proposed Glenamuck Stream would be directly impacted. Route Option 2, was considered to be the least preferred route. This was directly attributed to the highest number of residential properties situated within 100m of the route. This not only gave rise to physical impact on properties but also to increased exposure to possible environmental impacts such as air, noise and visual impacts etc.

- **Engineering Impact** – Route Option 1 was the best option for engineering requirements attributed to better geometric qualities, a superior cut/fill balance, less impact on utilities and causing significantly less severance to existing access roads and residences. Route Options 2 and 3 had a greater direct impact than Route Option 1.

- **Economic** - Route Option 1 had the lowest overall cost when both construction and land take costs are combined. Route Option 2 incurred higher construction costs due to the extensive traffic management and accommodation works required to allow widening of an existing road, while maintaining access to residents and through traffic during the construction period.

  Route 2 had the highest cost for land take due to the number of residences directly affected by the route and due to the loss of frontage of a large number of residences. Route 3 had higher construction costs (as it is a much longer route). Route Option 3 also had high land take costs as the longest route passes through two areas, which had been zoned for residential development with planning permission already granted.

Subsequent to this report, during the Preliminary Design Stage of the project, further detailed traffic modelling analysis was undertaken which established that a Link Road to Enniskerry (GLDR) would be necessary to prevent traffic congestion within Kiltiernan Village. The Preliminary Design further

developed the Link Road with three link options A, B and C (as shown in Figure 3-2) to tie into the preferred GDDR. Link option C was determined to provide for a high quality bypass of Kiltiernan Village while also significantly reducing congestion and delay on the road network when compared to the alternative options. Route Option 1 (GDDR) and Link Option C (GLDR) were chosen as the preferred route.

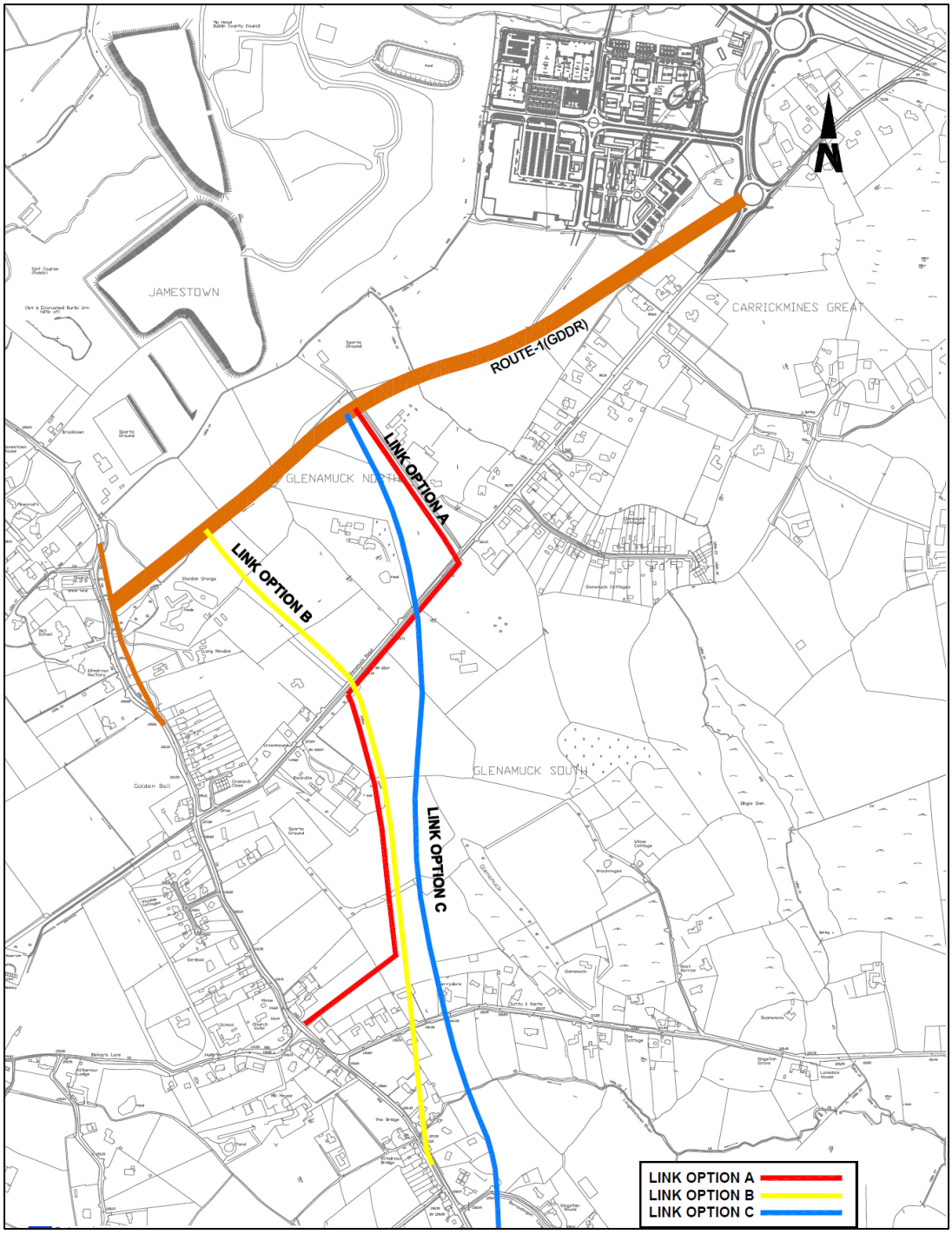

Figure 3-2: Glenamuck District Distributor Road, Environmental Study Vol 1, 2007, RPS Fig. 2.2 Link Options for Proposed Scheme

The preferred route was the subject of the Environmental Report for the GDDR[1]. The Preliminary Design Report[2] proposed that the main collector/distributor section of the overall network would directly connect the roundabout to the south of the Carrickmines interchange to the Enniskerry Road north of Kiltiernan Village. The route was approximately 1.5km long starting at the tie-in to the Enniskerry Road

[1] Glenamuck District Distributor Road Environmental Study Volume 2
[2] Glenamuck District Distributor Road Preliminary Design Report, 2007

north of Kiltiernan Village, running to the existing roundabout junction to the south of Carrickmines M50 Interchange. The GDDR consisted of 500m of single carriageway, a transitional section of 100m from single to dual carriageway at the proposed junction with the Link Road to Enniskerry and approximately 935m of dual carriageway at the Carrickmines roundabout junction. The proposed Link Road was approximately 1.8km long starting at the junction with the GDDR to the tie-in with the Enniskerry Road, south of Kiltiernan Village.

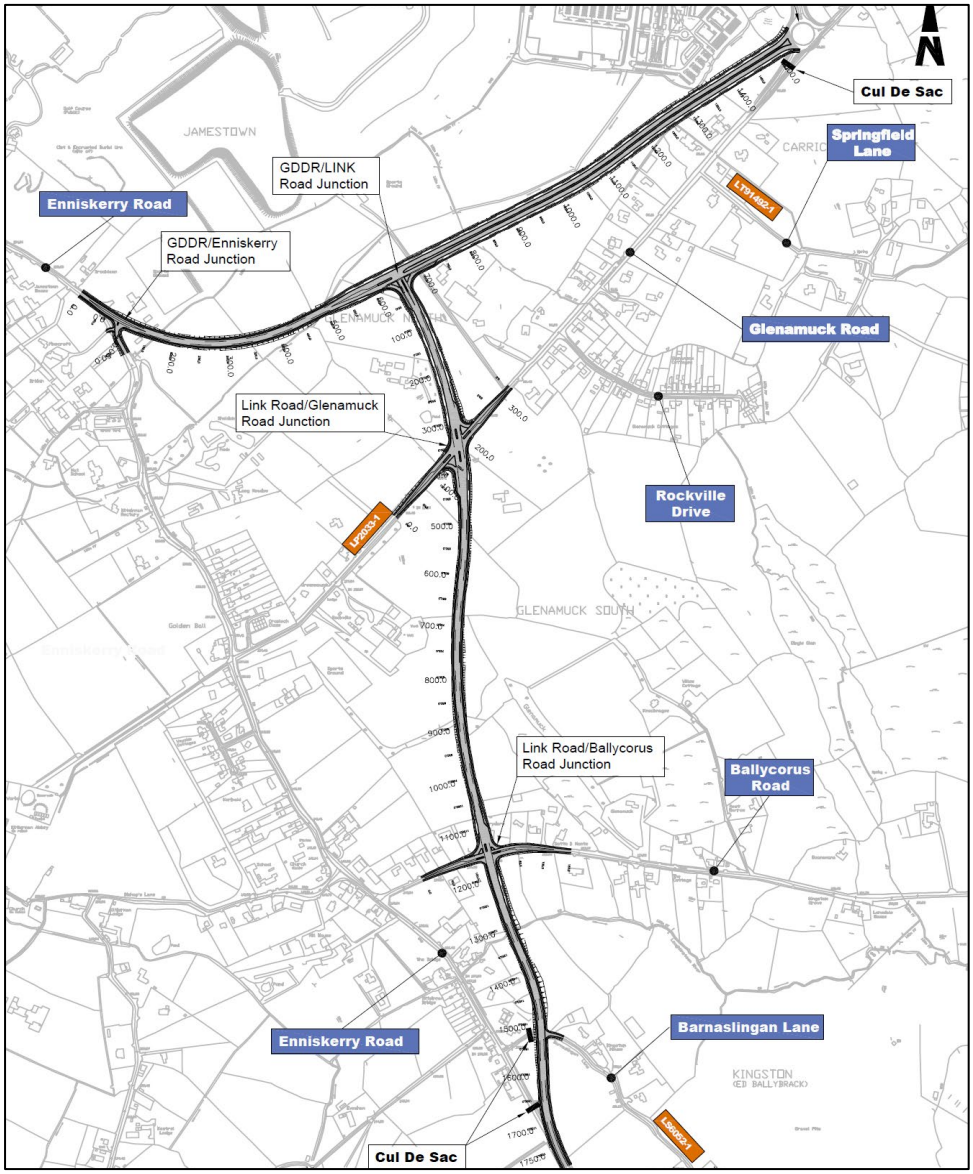

Figure 3-3: Glenamuck District Distributor Road, Environmental Study (Vol 1-3), 2007, RPS Fig. 2.3 Scheme Layout

Environmental Study (2007)

The Glenamuck District Distributor Road, Environmental Study 2007 was carried out according to the principles of an Environmental Impact Assessment (EIA) and followed EPA, DMRB and NRA guidelines. This report assessed all aspects of the receiving environment including:

- Human Environment (Community, Air Quality, Climate, Noise and Vibration);

- Landscape and Visual Impacts;
- Natural Environment (Terrestrial Ecology, Aquatic Ecology, Soils, Geology and Hydrogeology);
- Material Assets (Agricultural Properties, Non-Agricultural Properties, Natural & Other Resources); and
- Archaeological/Architectural and Cultural Heritage.

These issues were initially identified during the constraints study and route selection phases of the proposed scheme. Each characteristic of the proposed scheme, during both construction and operation phases was considered in relation to each aspect of the receiving environment and any potentially significant impacts identified. Where required, specialists were appointed to carry out studies to further identify and quantify such impacts and to propose measures to reduce and eliminate these impacts where possible.

The preliminary engineering design of the proposed alignment was selected to minimise the potential impact by avoiding or reducing the level of impact and where possible avoiding any sensitive areas identified. This was assisted with recommended mitigation measures that were possible to integrate into the proposed scheme design.

Incorporation of Alignment in Statutory Local Area Plans

The Kiltiernan/Glenamuck Local Area Plan (LAP) (2007) was adopted by DLRCC in July 2007 incorporating the GDDR and GLDR alignment into the statutory plan. The objective for the alignment was retained in the Kiltiernan/Glenamuck Local Area Plan 2013. However, Figure 3-4 and Figure 3-5 illustrates that while the alignment adopted in the current LAP is essentially the same alignment that evolved through the strategic options studies summarised above, the 2007 LAP omitted a section of the LDR up until the adoption of the 2009 County Development Plan.

'*Barnasligan Link*'

During the adoption process of the Draft Kiltiernan LAP (2006) LAP, the Council received a number of submissions in respect of the 'Barnasligan Link' which is the section of the GLDR from Ballycorus Road to the Enniskerry Road. The Manager's Report on Submissions (March 2007) noted that alternative alignments were proposed in the submissions including one where the LDR should terminate at a Roundabout at Ballyogan Road and the Ballycorus Road/Enniskerry Road junction should be altered to a Roundabout and to consider the realignment of the LDR under the 220kv wayleave corridor.

The Executive's Report noted the following:

> *The alignment of the LDR between the Enniskerry Road and Ballycorus Road has strategic importance to the LAP and the routing of traffic to/from outside the study area. It also enables the effective by-passing of Kiltiernan Village as Enniskerry traffic is directly routed towards the GDDR. The proposed GDDR and LDR are designed so that all through traffic, i.e. traffic travelling from origins outside the area to destinations outside the area will utilise the new infrastructure, thus freeing up the existing infrastructure, i.e. Kiltiernan Village and Glenamuck Road to cater for locally generated trips. Alternative layouts involving junctions on the Enniskerry Road at the southern end of the scheme will encourage the through traffic to utilise the Kiltiernan*

Village route and thus render a bypass of the village ineffective. Such alternatives were studied and rejected due to the inefficiency of the proposals and the increase in traffic congestion illustrated by the study.

It is thus recommended that the direct link between the Enniskerry Road and the LDR be retained in the LAP"

However, the Barnaslingan link was removed following the Draft stage of the LAP by a Motion in the Council on 16 April 2007. As a consequence, the portion of Enniskerry Road extending from the southern boundary of the Local Area Plan area to the junction of Enniskerry and Ballycorus Roads, and the section of Ballycorus Road to the junction of Ballycorus Road and the proposed Link Distributor Road would have required to be appropriately improved/upgraded (see Figure 3.4 below). It is noted that no engineering assessment of the impact of the motion was carried out and no designs for the Ballycorus/ Enniskerry Road upgrades prepared

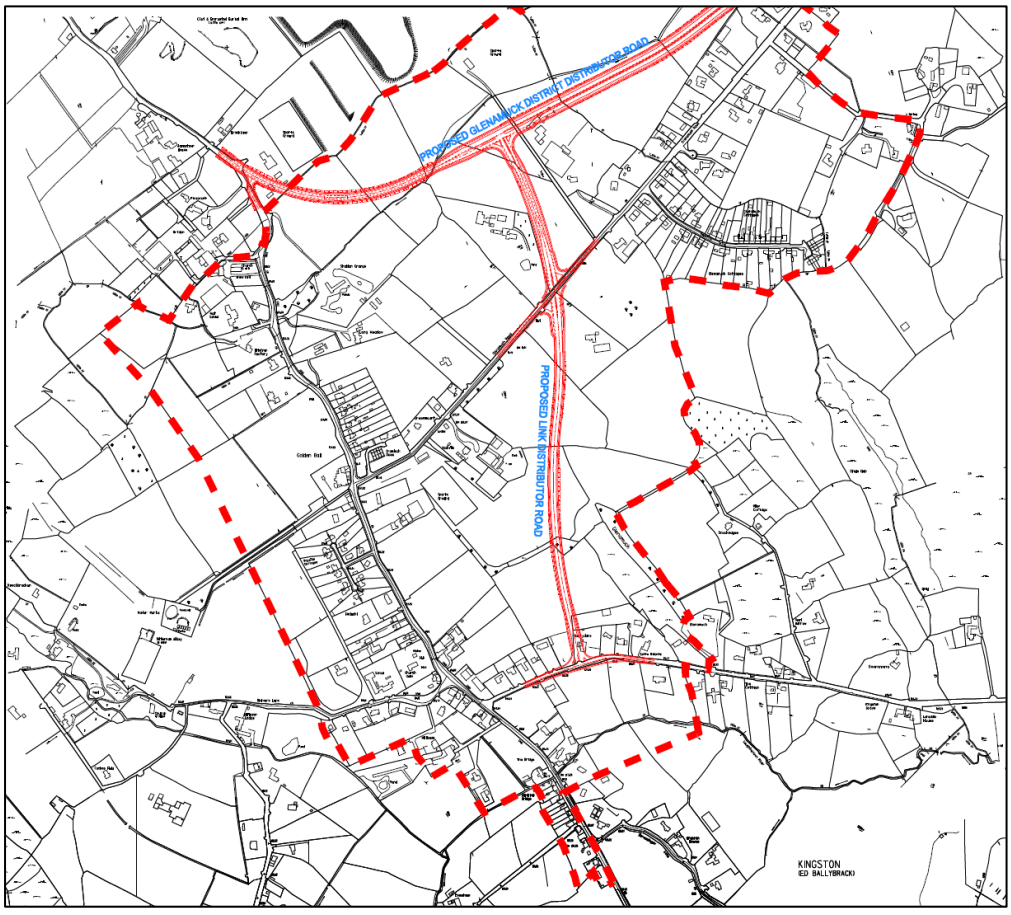

Figure 3-4: Extract from 2006 Kiltiernan/Glenamuck Local Area Plan

As part of the preparation of the Draft County Development Plan (2009), the 'Barnalingan' Section (Ballycorus Road – Enniskerry Road Link))was reintroduced to the 'Draft Plan'. The alignment was this included in adopted County Development Plan (2010).

The preparation of the Draft LAP for the area in 2012 again gave rise to submissions seeking the removal of the "extension" of the Link Distributor Road from the Ballycorus Road to the Enniskerry

Road, on the grounds that the M50 had reduced traffic flow in the locality. The Chief Executive's report noted the following:

> *The proposed route for the GDLR ensures that the most advantageous route to travel from Stepaside/Carrickmines to and from Enniskerry - as a de-facto bypass of Kiltiernan Village - will be to use the new road network. Without the GLDR extension at Ballycorus Road, the available route through the village would be as attractive as the new road network and so the bypass would be less successful. Thus, with the 'GLDR Extension' the proposed network is considered the most efficient and effective Bypass route providing linkages to both the Carrickmines/Cherrywood area, continuing the Enniskerry Road connection towards Stepaside/Lambs Cross avoiding potential traffic congestion at the existing Enniskerry Road/Ballycorus Road junction. Allied to associated future traffic management measures in the Village area, the GLDR as proposed will best support and facilitate the development of the pedestrian-friendly Village Core free from through traffic.*
>
> *The inclusion of the section of GLDR between Enniskerry Road and Ballycorus Road will greatly improve the residential amenity of those properties fronting the Enniskerry Road in the southern part of the Village.*

During the preparation of the 2013-2019 LAP, the GDDR Preliminary Design Report (2007) was reviewed and updated. The LAP notes extensive changes that had occurred since the previous modelling work. The 'Traffic Modelling Review' determined that the main elements of the original design for the GDDR/GLDR (Glenamuck Link Distributor Road) scheme remained robust. Some amendments to the 'Preliminary Design' of 2007 were recommended which included;

- The introduction two 'bus-gates' at two locations, (i) at the junction of the Enniskerry Road and (ii) the GLDR and the junction of the Glenamuck Road East and the GLDR; and
- The removal of the proposed 'Link Road' between the GDDR and existing Glenamuck Road.

The 2012 Review continued to recommend that an essential minimum provision of a new distributor road system will need to be provided for lands to be developed in a sensible and sustainable manner. This minimum essential (core) level of road infrastructure consists of:

- GDDR – Primary Link Road - single carriageway from Enniskerry Road to the Glenamuck Road East/Golf Lane Roundabout;
- GLDR – Primary Link Road - single carriageway from Enniskerry Road to GDDR;
- Junction of GDDR and GLDR;
- Junction between GLDR and the existing Glenamuck Road (East and West side);
- Junction of GLDR and Ballycorus Road;
- Junction of Enniskerry Road and GDDR; and
- Provision of necessary SuDS attenuation ponds.

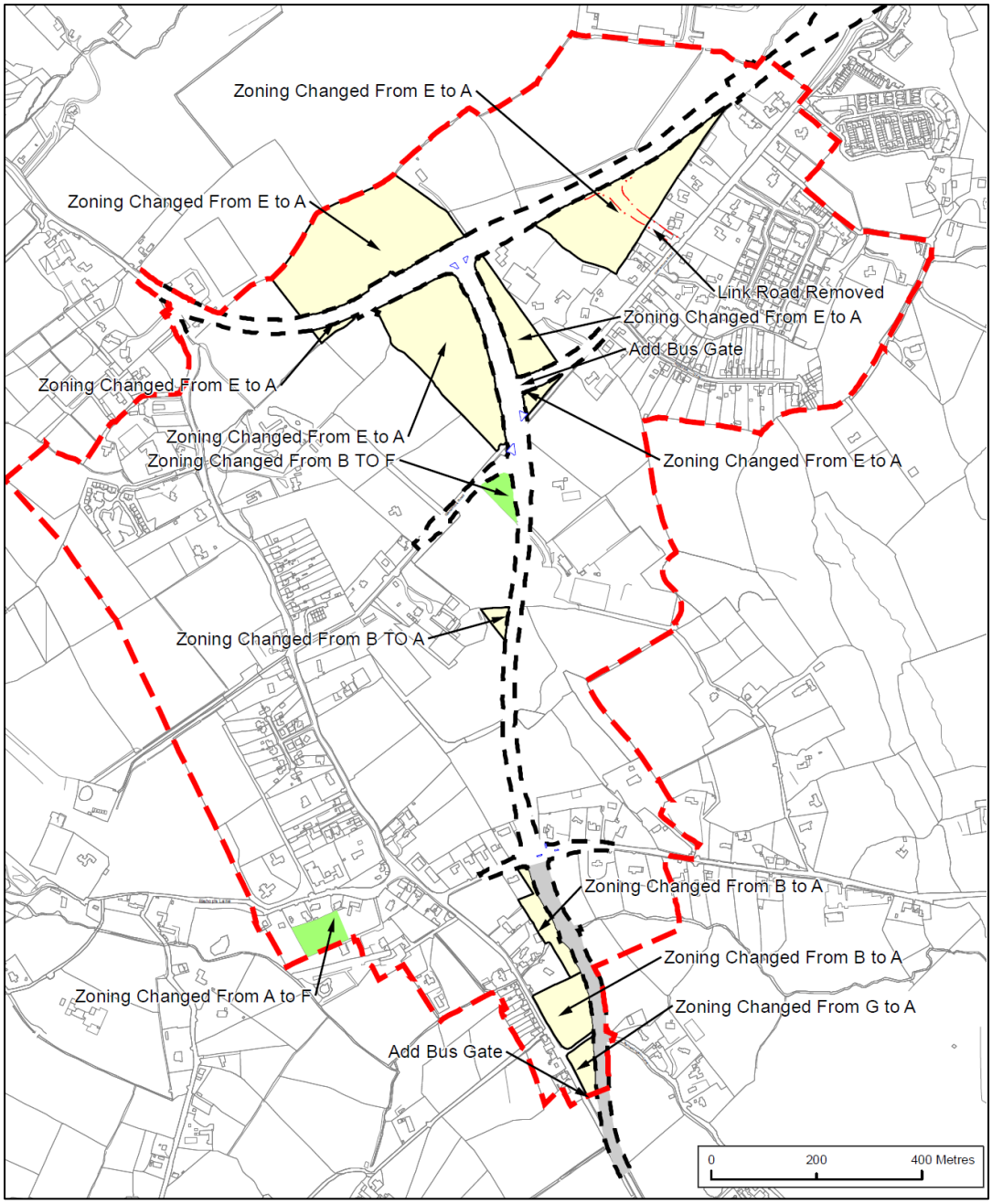

Figure 3-5: Kiltiernan/Glenamuck Local Area Plan 2013 Map 1 Changes to Kiltiernan/Glenamuck Local Area Plan 2007 Adopted

3.3 Do-Nothing Alternative

The do-nothing alternative is a general description of the evolution of the key environmental factors of the site and environs if the proposed project did not proceed.

This examines trends occurring at the site, for example likely land use changes or other interventions, the likely effects of climate change, and the significance of these changing conditions. It can be particularly useful when assessing effects caused by projects which themselves are designed to alleviate environmental or infrastructural problems, e.g. waste treatment facilities, flood relief projects, road building, etc.

This approach considers the effects of projects which already have consent but are not yet implemented. It may also be appropriate to consider other projects that are planned but not yet permitted. For example, it would be prudent to consider a significant project for which a planning application has been lodged even if the consent decision has not been issued. The do-nothing alternative should describe consequences that are reasonably likely to occur.

The potential impacts resulting from the GDRS road relate to the population, economic activity, land use, travel patterns and community services. Under a "Do Nothing" Scenario, the expansion of the area generally and the development of zoned lands would generate huge volumes of traffic and associated nuisances. The existing Glenamuck and Enniskerry Roads would not be able to meet the required capacity and future traffic demands and would impede future development of the area.

This would have a significant negative impact on the aims of the CDP and Local Area Plan. Under a do-nothing scenario, residential development on zoned land with supporting access and road infrastructure would be delivered on a piecemeal basis. The opportunity to deliver an integrated approach to movement in the LAP area would be significantly restricted for cycle and pedestrian infrastructure. Public transport infrastructure serving the area could not be delivered with a potential significant negative impact on sustainable modes of travel.

Given that the alignment of the GDRS is protected under the LAP and the CDP, it is likely this area would remain undeveloped with potential impacts arising from the construction of the GDRS would not occur in respect on all aspects of the receiving environment.

3.4 Design Alternatives

A fundamental factor for the revised GDRS design addressed in this EIAR was the publication in 2013 of the Design Manual for Urban Roads & Streets (DMURS) by the Department of the Environment, Community and Local Government/Department of Transport, Tourism and Sport. This sets out best practice guidance relating to the design of urban roads and streets, setting out a road hierarchy of Arterial, Link & Local Streets, to ensure that the road is not only effective in terms of traffic, but also supports integration with existing and future developments in line with DMURS guidance.

DMURS provides a set of key principles, approaches and standards which aim to secure the implementation of the high-level policies of Smarter Travel at local level and guidance to achieve quality, safe streets and spaces, which balance the needs of all users. This assists the provision and delivery of a greater degree of sustainable transport throughout the Kiltiernan/Glenamuck LAP area and beyond. It will also provide for a clear network of movement and access within a clear street hierarchy to support a best practice approach to integrated placemaking.

An Urban Design Report (Appendix 12_4.) has been prepared in association with the EIAR and Road Design exercise which both highlights how the DMURS guidelines have informed the current GDRS design and reflecting the process that has evolved from the 2007 GDDR road scheme. In line with DMURS, the approach taken for the GDRS has been influenced and guided by the following design principles:

- **Connected Networks**: To support the creation of integrated street networks which promote higher levels of permeability and legibility for all users, and in particular more sustainable forms of transport;
- **Multi-Functional Streets:** The promotion of multi-functional, place-based streets that balance the needs of all users within a self-regulating environment;
- **Pedestrian Focus:** The quality of the pedestrian environment; and
- **Multi-Disciplinary Approach:** Greater communication and co-operation between design professionals through the promotion of a plan-led, multidisciplinary approach to design.

The Glenamuck District Road Scheme Urban Design Report (Appendix12_4.) by Brady Shipman Martin is reflective of a framework for development that is connected, provides multi-functional streets, is pedestrian and cyclist focused and has been created and formulated through a multi-disciplinary approach. Utilising the opportunity afforded by the re-design of the GDRS in accordance with DMURS the approach to Design Alternatives addressed the following issues:

- Receiving Environment
    - A comprehensive EIAR Scoping Report was prepared and issued to Stakeholders in May 2018. This identified important environmental issues to be incorporated in the design having particular regard to Cultural Heritage, Biodiversity, Transportation;
- Drainage and Attenuation

- The approach to road drainage design incorporating SuDS principles and consideration of design alternatives for the location and scale of attenuation ponds as well integration with landscape proposals;

- As part of the EIAR public consultation exercise, several landowners and members of the public submitted that the attenuation pond to the west of the GLDR alignment and south of Ballycorus Road should be moved eastwards. Upon review of this issue, the scheme layout was amended to accommodate the attenuation pond as in a new position to the east.

- Road Design

  - In accordance with DMURS guidance, detailed design of sections of the road progressed to incorporate alternative approaches to servicing public transport and priority (bus gate), and appropriate cross-sections of road to provide for a street-based character (with attention on pedestrian environment and more permeable boundaries, instead of a traditional distributor road (with restricted access points and low integration with adjoining properties);

  - As part of the EIAR public consultation exercise several attendees stated that the scheme should link with the approved Part 8 Proposed Enniskerry Road / Glenamuck Road Junction Upgrade scheme in order to deliver complete pedestrian and cycle facilities along this portion of the Glenamuck Road. Upon review of this issue, the scheme was extended slightly to form a tie in with this scheme.

- Power Lines and Masts

  - The juxtaposition of the GDRS with strategic electric power infrastructure including reservations for high-voltage cables and supporting masts has implications for land use in the LAP area. Alternative development has included the detailed review of the road alignment and junctions in locations where the road reservation and power infrastructure interact. Given the national strategic importance of the 220kv power infrastructure in the area designs were optimized to remove the requirement for diversion of this infrastructure. Diversions of this line would have introduced significant environmental impacts to the local area; and

- Material Assets - Property

  - Localised options for access to development sites, formation of land development parcels, consolidation of boundaries with road alignment and mitigate potential for community severance.

Each of the above alternative issues were addressed as part of the EIAR process and are referred to in the relevant section of this EIAR.

3.5 References

- Design Manual for Urban Roads & Streets (DMURS) by the Department of the Environment, Community and Local Government/Department of Transport, Tourism and Sport, 2013;
- Kiltiernan/Glenamuck Local Area Plan, Dún Laoghaire-Rathdown County Council, 2013;
- Kiltiernan/Glenamuck Local Area Plan, Dún Laoghaire-Rathdown County Council, 2007;
- Glenamuck District Distributor Road, Environmental Study (Vol 1-3), RPS, 2007;
- Glenamuck District Distributor Road, Preliminary Design Report, RPS, 2007;
- Glenamuck District Distributor Road, Feasibility Study & Route Selection Report, RPS, 2007;
- Glenamuck District Distributor Road, Constraints Study, RPS, 2007;
- Review of Glenamuck Local Area Plan, Traffic Modelling Report, RPS, 2013.

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4 Consultations

4.1 Introduction

The Design and EIAR team have carried out extensive consultation in relation to the Proposed Project with members of the public, including residents, businesses, institutions, representative individuals and organisations and statutory bodies. The purpose of the consultation was to inform consultees of the Proposed Project and provide them with an opportunity to offer feedback. It also enabled the project team to take account of issues raised and consider them as part of the design and EIAR processes.

This chapter outlines the consultation activities undertaken in advance of the lodgement of the planning application for the Proposed Project. It also summarises the main issues identified during this process and identifies the main modifications to the Proposed Project arising from the consultation process.

4.2 Consultation Methods

Consultation took place via;

- Contact with Key stakeholders during the scoping process of the EIAR which are detailed below;
- Contact with affected landowners during design process;
- Contact with key stakeholders i.e. utilities companies for information relating to the area; and
- With the public during a consultation evening held in Dún Laoghaire Rathdown County Council offices (Ballyogan Operations Depot).

Submissions from all of the above stakeholders received were reviewed by the EIAR team and informed the environmental assessment as part of this EIAR.

4.3 EIAR Screening Consultation

The need for an EIAR was determined following the preparation of an EIAR Screening Report in December 2017 pursuant to Section 50 of the Roads Act, 1993. The relevant EIAR trigger thresholds as set out in the Roads Act under Article 8 of the Roads Regulations, 1994 refers to *the construction of a new road of four or more lanes. 500 metres or more in length in an urban area.* The GDRS scheme exceeds the threshold (with some 890m of four lane carriageway) where it becomes necessary and mandatory to prepare an EIAR and submit an application to An Bord Pleanála.

4.4 EIAR Scoping Consultation

An informal EIAR scoping exercise was undertaken as part of the EIAR process. During this process information on the Proposed Project and an outline of the proposed EIAR was provided to consultees requesting comment/input on the final scope and content of the EIAR.

In May 2018, the EIAR Scoping Report (FAC, 2018) was issued to the following bodies;

- An Taisce;
- Bat Conservation Ireland;
- Birdwatch Ireland;
- Coras Iompair Éireann (Irish Rail);
- Cycling Ireland;
- Department of Agriculture, Food and the Marine;
- Department of Arts, Heritage, Regional, Rural and the Gaeltacht;
- Department of Communications, Climate Action and Environment;
- Department of Housing, Planning and Local Government;
- Department of Transport, Tourism and Sport;
- Eastern and Midland Regional Assembly;
- Eastern River Basin District Project Office;
- Eirgrid Plc. (Electrical Supply Bord);
- Environmental Protection Agency (EPA);
- Fáilte Ireland;
- Geological Survey Ireland;
- Inland Fisheries Ireland;
- Irish Georgian Society;
- Irish Water;
- National Monuments Service;
- National Transport Authority (NTA);
- Southern Regional Assembly;
- The Heritage Council;
- The Office of Public Works (OPW);
- Transport Infrastructure Ireland (TII); and
- HSE.

Submissions on the basis of the scoping report were received from a number of consultees. Each of the issues are addressed in detail in the relevant chapters of this EIAR. Key points raised in the submissions received are summarised in Table 4-1 below:

Table 4-1 Summary of submissions received

Consultee	Key Issues Raised
An Taisce	• Comments on Biodiversity ○ Further study required for location of the Glen at Glenamuck in relation to wildlife; ○ Greenway link needs to be included in assessment; and ○ Distinctive Sylvan character needs to be retained by use of hedge/small trees separating cycle/walkway from the road.
Cycling Ireland	• Mitigation at construction phase to be provided for cyclists and pedestrian; and • National Cycle Manual & Smarter Travel Policy Document should be used.
Health Service Executive	• Due consideration to be given to Glebe House Care Centre/Kiltiernan Nursing Home for noise, vibration and air quality; and • No disruption to access.
Transport Infrastructure Ireland	• A graphical depiction of the road scheme required in the traffic and transportation section; • Specific documents are outlined for the traffic and transportation section to refer to in the study; • The EIAR should demonstrate that the development can proceed complementary to safeguarding the capacity, safety and operational efficiency of the M50 and its critical interchange at junction 15; and • Inclusion of travel plan/mobility management planning at design stage.
Iarnród Éireann	• No Comments
Department of Culture, Heritage and the Gaeltacht	• Refers to both Archaeology and Ecology issues ○ Need to provide additional information related to Archaeology in EIAR document; ○ Bird Survey dates; ○ Hedgerows, Trees and Scrub Mitigation to be referred to ○ Consider loss of Riparian Habitat and impacts on aquatic species; ○ Bat survey required and mitigation measures to be included in EIAR; ○ Concern expressed (at scoping stage) that no badgers were found; ○ Number of documents recommended for EIAR; and ○ Need to have regard to licence requirements.

4.5 Consultation with Public

Prior to the submission and completion of the EIAR, a public consultation exercise was undertaken at DLRCC Operations Depot (Ballyogan Depot), 84a Ballyogan Rd, Sandyford, Dublin 18 between 4pm and 8pm on Wednesday 17th October 2018. The event was advertised on DLRCC's websites, and a mail drop of notices was delivered to properties in the vicinity of the proposed scheme approximately two weeks in advance. Comments relating to potential environmental impacts of the proposed development were invited on the evening, by post and by email. Members of the EIAR team, design team and Council representatives facilitated the evening to discuss the various elements of the proposed scheme with those attending.

The following submissions were received on the evening or before the 26th October 2018. Submissions were made up until the 8th of November. 23 Submissions were received. The names of the submissions are anonymized in the table below to maintain the individuals or groups privacy. All pertinent comments were reviewed by the EIAR consultants.

Table 4-2: Summary of submissions received from the public consultation

Consultee	Key Issues Raised
Submission 1	• One comment was received from a public representative in regards to the roads scheme, which stated that the Glenamuck Road should not be closed off, but a traffic light system put in place where the new road intersects the Glenamuck Road, to help traffic issues in the area.
Submission 2	• Concerns regarding lack of public transport in the area in relation to further creation of homes, the high levels of traffic the road will bring to the area, lack of local shops and the need for more recreational areas within walking distance; • That the area east of the 110KV restriction corridor be made an area of high amenity; • A link road should be created for residents to Tiknock Park via the Carrickmines Equestrian centre; • That the access route be made a greenway; and • Associated works at the Ballycorus Road should allow safe access over the road as well as access routes for wildlife.
Submission3	• Proposed road is completely unnecessary due to the fact that the Ballycorus Road is being widened and the visual impression is that the valued flow does not justify it; • The cost including the bridge does not justify it; • An exit beside the garage could be considered which is believed would be more practical and much more cost efficient; • The field is part of a small farm and will affect a family house on the land; • Usage of the farm during the year for livestock will be affected by the proposed road; • Old trees will need to be removed by the river; • Scenic view in the area was meant to be protected; and • Attenuation pond should be moved by agreement.
Submission 4	• The design of the road (including the bus gate) will lead to longer travel times for locals which is not environmentally friendly and assumption that access by walking or cycling only is not acceptable; • No undergrounding of pylons in green/open space; • Lack of public green/open space in the area with private land parcels currently set for open space. Also, one land parcel currently identified for green/open space has an attenuation tank which is believed to be unacceptable by the local residents; and • The 'two tranches of public open space' and the 'centrally-located major public open space' should be identified and committed to before the GLDR continues from an environmental perspective as stated in the LAP as a primary objective.

Consultee	Key Issues Raised
Submission 5	• Increased traffic movements and congestion will cause concern at the location of the De La Salle playing field due to increased congestion and the effects on the egress for both the mini and youth teams at the club; • The impact of onsite radical parking reduction, mentioned below, will lead to the inevitability of increased on-street parking; • The management of the attenuation pond from the new elevated section and potential impact on club grounds is of a concern to the club at present; • Fear of disrupted access as well as undue noise, dust and debris pollution during the construction phase of the proposed project; and • The loss of mature trees bounding the current Enniskerry Road is a most unfortunate environmental consequence of the project.
Submission 6	• Concern in relation to under-grounding the high-tension power cables. They would like the issue revisited as besides sterilizing a large swathe of land there is also the visual aspect as well as the underlying health risk.
Submission 7	• Though the benefits of the road can be seen there are problems with the road crossing the Ballycorus Road (bisecting the Barnaslingan Lane); • The road is based on historic and inaccurate traffic flow information which they believe lead to inaccurate extrapolations of future traffic projections; • They believe that the construction of this portion of the bypass would be counter active trying to create a Village Centre in Kiltiernan and will have effects on local householders and landowners, splitting the community and dividing families (point raised earlier in relation to Ballycorus Road); • Believe a junction should be made placed elsewhere in the area like beside the Circle K garage to create a natural junction; and • The wind direction (north westerly) would affect the noise pollution to the adjoining household on Ballycorus Road.
Submission 8	• Diminution in Struan Glen value and sandwich effect between two roads; • Elevation and Overpass: Concerns with height and damage to views caused by the overpass and elevation; • Protective Wall Finish: Inclusion of a granite wall and tree line between the road and Struan Glen; • Artist Impression: A better quality image should be provided other than the "Southern Gateway artist drawing" presented on 17th October; • Street Light Location, head light and noise pollution information asked for. Brings back idea of tree line and granite wall should mitigate against this; • Enniskerry Road aesthetic could be affected; • Is the Glenamuck proposal in its current form now outdated to cope with the needs of the future M50 traffic growth from proposed development in Carrickmines, Kiltiernan and Cherrywood? • Is there need for traffic restrictions at Barnaslignan Bus Gate. Concerns with illegal use of bus lane as a rat run. Also, the low frequency of buses mentioned; and • OSI mapping issue with houses not shown on map sent out for public consultation.
Submission 9	• The houses within Struan Glen are not on the OSI map issued; • The road appears larger/wider than anticipated causing concern in relation to noise and light pollution; • The road is closer to Struan Glen than originally planned posing noise and light pollution concerns and also safety risks for children; and • Elevation of the road is aesthetically displeasing and seems unnecessary.
Submission 10	• Same submission as Submission 9

Consultee	Key Issues Raised
Submission 11	• Same submission as no. 9 with additional point that alternative route could have entered Kiltiernan Village at petrol station location.
Submission 12	• Same submission as no. 11
Submission 13	• Same submission as no. 11
Submission 14	• Same submission as no. 11
Submission 15	• Same submission as no. 9
Submission 16	• In order to retain the nature of the Glenamuck Road, strong support towards the installation of a bus gate at the proposed junction of the GLDR and Glenamuck Road, ensuring a safe environment for walkers and cyclists.
Submission 17	• Does not want this scheme to go ahead.
Submission 18	• After previous meetings with Engineers and DLR, raised points from the past in relation to placement, protected views, splitting-up of land which can all damage and affect those along the Ballycorus road; • Splitting of land holding will affect not just the agricultural side for the family, but also the recreational use of the land; • Omission of built property from OSI maps noted; • Rather than creating a community within Kiltiernan, it will split up people further; and • Movement of the road alignment to Circle K where a natural junction occurs would suit this development better.
Submission 19	• Same submission as no.9
Submission 20	• Concerned that traffic travelling from Stepaside towards Enniskerry will still take the old road through Kiltiernan rather than queue to take the right hand turn as shown off the east bound road (even if there are traffic lights); • Suggestion made to redesign road to incorporate a flyover when travelling east and an underpass from west bound lanes; and • Overall in favour of the scheme and looking forward to its completion.
Submission 21	• Suggestion of controlled junction as concerned with Roundabout at Golf Lane.
Submission 22	• Overall development looks really good and would be of benefit to developing the long-term community within Kiltiernan.
Submission 23	• Same submission as no. 9 and no. 11

4.6 References

- Environmental Protection Agency (2017) Draft Guidelines on the information to be contained in Environmental Impact Assessment Reports

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5 Description of the Proposed Scheme

5.1 Introduction

This chapter provides a detailed description of the proposed Glenamuck District Roads Scheme (GDRS), ancillary drainage and landscape works. The construction methodology employed for the proposed scheme is outlined thereafter. Overall policy and scheme objectives are set out at Chapter 2 of this EIAR.

5.2 The Proposed Scheme

An overview layout drawing of the proposed Glenamuck District Roads Scheme is shown in Figure 5-1. Detailed drawings are included within Volume 3.

The Glenamuck District Distributor Road (GDDR) connects from the Enniskerry Road adjacent to De La Salle Palmerstown Rugby Club to a tie in at the Glenamuck Road East/Golf Lane Roundabout. The Glenamuck Link Distributor Road (GLDR) connects from the approximate midpoint of the GDDR to the Enniskerry Road south of Kiltiernan and will connect the new distributor road with the existing Glenamuck Road, Ballycorus Road and Barnaslingan Lane providing an alternative to the Enniskerry Road for north-south travel.

The Glenamuck District Distributor Road has a total length of approximately 1.5km. The road consists of approx. 660 m of two lane single carriageway from the Enniskerry Road tie in to the GDDR / GLDR junction and approx. 890 m of four lane dual carriageway from this junction to the Golf Lane Roundabout. The Glenamuck Link Distributor Road consists of approximately 1.8km of predominantly two-lane single carriageway road. Both roads have additional turning lanes as required at junctions along the route.

The location of the proposed GDRS is to the east of the R117 and southwest of the M50 Motorway, between Carrickmines and Kiltiernan in the central part of Dún Laoghaire-Rathdown County Council area. This rural location is situated at the urban fringes of Dublin City and County with access onto the M50 motorway, which provides linkages to the majority of the national road schemes in the country. The proposed roads scheme will link with the existing road network. New junctions to be formed include

- GLDR & R117 (Enniskerry Road South) – Enniskerry Road to be diverted onto the GLDR at this location with bus-gated connection and pedestrian/cycle connections to the existing road route to Kiltiernan Village
- GLDR & Barnaslingan Lane – Barnaslingan Lane to terminate at GLDR at new 3 arm junction. All turning movements accommodated. Short section of Barnaslingan lane to be Cul de saced between GLDR and Enniskerry Road
- GLDR & R116 (Ballycorus Road) – New 4 arm Junction with turning lanes. All turning movements accommodated.
- GLDR & Glenamuck Road. New 4 arm junction with turning lanes. Vehicle movements between GLDR and Glenamuck Road East of the GLDR to be bus-gated. A small roundabout has been

provided to accommodate turning movements for vehicles reaching the end of the Bus-gated section of the Glenamuck Road

- GDDR & GLDR – New 3 arm Junction with turning lanes. All turning movements accommodated.
- GDDR & Glenamuck Road at Golf Lane Roundabout. Additional arm to be added to existing roundabout
- GDDR & Enniskerry Road (North)-Enniskerry Road to be diverted onto the GLDR at this location. New three arm junction with turning lanes. All turning movements accommodated.

The proposed scheme will also include:

- Surface water drainage including a number of significant attenuation ponds
- Public lighting
- Traffic signals
- Road marking and signage
- Diversion of existing utilities and provision of new utilities
- Accommodation works to existing properties
- Walls, retaining walls, fencing and other boundary treatments
- Associated landscaping works
- Miscellaneous ancillary works

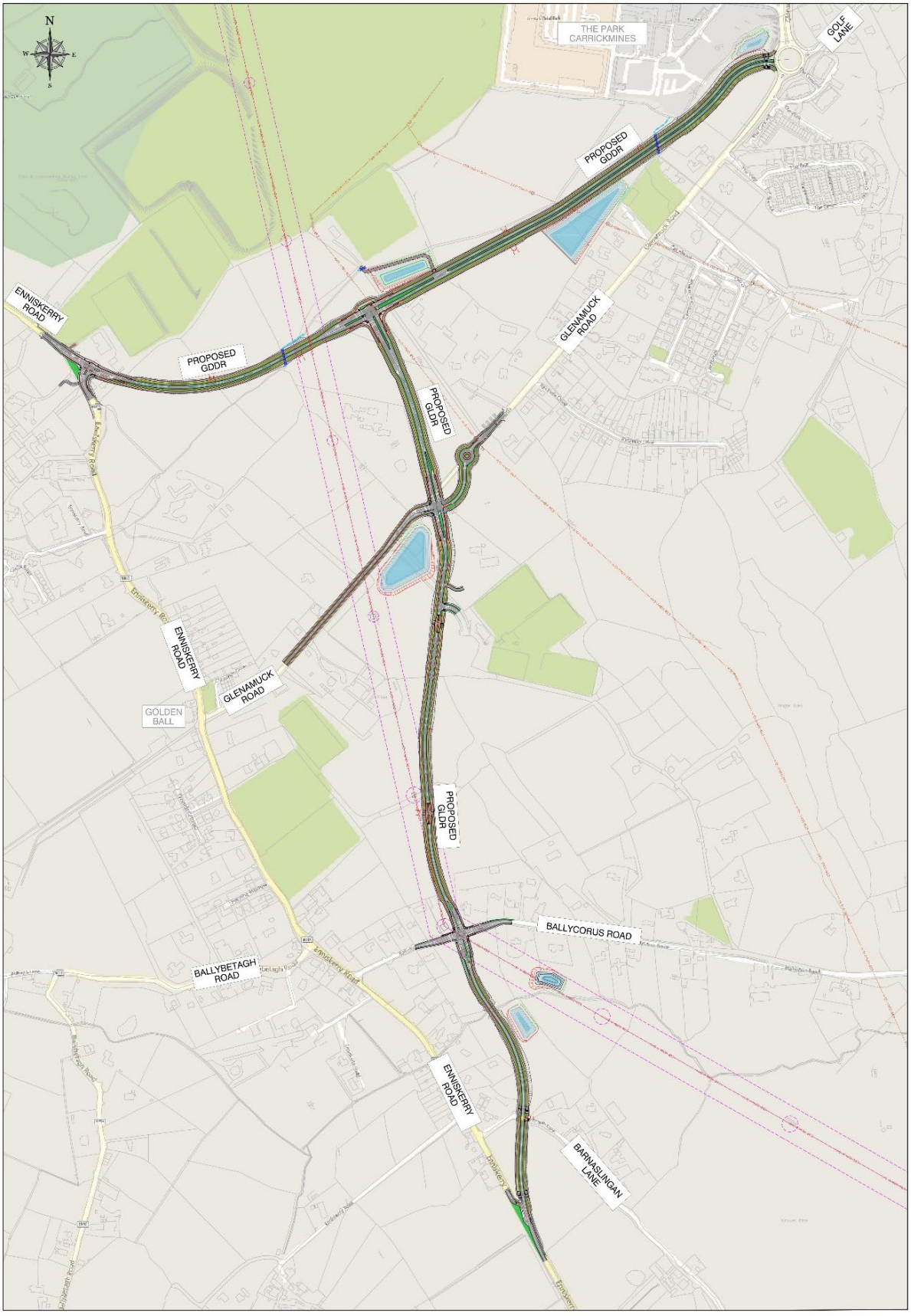

Figure 5-1: Overview Layout

5.2.1 Design Standards

The following key guidance documents have been used to set design criteria for the Scheme design.

- Design Manual for Urban Roads & Streets (DMURS) - Department of the Environment Community and Local Government / Department of Transport Tourism and Sport
- Design Manual for Roads and Bridges (DMRB) – *Transport Infrastructure Ireland,*
    - [DN-GEO-03031] - Rural Road Link Design
    - [DN-GEO-03044] - The Geometric Layout of Signal Controlled Junctions and Signalised Roundabouts
    - [DN-GEO-03060] - Geometric Design of Junctions (priority junctions, direct accesses, roundabouts, grade separated and compact grade separated junctions)
- National Cycle Manual – National Transport Authority
- Greater Dublin Strategic Drainage Study [GDSDS]
- Taking in Charge Policy Guidance Document, Dún Laoghaire-Rathdown County Council - 2011
- The SuDS Manual (c753), CIRIA - 2015
- DLRCC – Public Lighting Installations in Residential & Industrial Areas

It should be noted that the design as outlined in this report will be subject to alteration and enhancement as the proposed scheme is progressed through subsequent phases of development.

5.2.2 Road Hierarchy

Best practice guidance relating to the design of urban roads and streets is contained in the Design Manual for Urban Roads and Streets (DMURS). DMURS sets out a road hierarchy of Arterial, Link & Local Streets. This hierarchy is set out relative to other relevant documents in Figure 5-2 below.

DMURS Description	Roads Act/NRA DMRB	Traffic Management Guidelines	National Cycle Manual
Arterial	National	Primary Distributor Roads	Distributor
Link	Regional (see note 1)	District Distributor Local Collector (see Notes 1 and 2)	Local Collector
Local	Local	Access	Access

Notes

Note 1: Larger Regional/District Distributors may fall into the category of *Arterial* where they are the main links between major centres (i.e. towns) or have an orbital function.

Note 2: Local Distributors may fall into the category of *Local* street where they are relatively short in length and simply link a neighbourhood to the broader street network.

Figure 5-2: DMURS Street Hierarchy (DMURS)

The proposed GDDR & GLDR are considered Link Streets in line with the hierarchy above.

5.2.3 Urban Design Integration

It is noted that the surrounding zoning and land usage varies over the length of the road route. It is therefore important the road design reflects the characteristics of the surrounding land and facilitates effective integration with existing and future developments in line with DMURS guidance.

It is also acknowledged that the road is being designed and delivered in isolation as an infrastructural project and the designers have no control over the phasing, layout, frontage or future boundary treatments of surrounding private developments.

In order to ensure that the road design does not preclude the implementation of high quality urban design in the area, an urban design exercise has been carried out to support the road scheme design and is documented in the "GDRS Urban Design Report" which is included in Appendix 12.4.

The analysis has resulted in variations in road cross sections, landscaping, and junction arrangement over the scheme to respond the surrounding characteristics and development types and better address pedestrian and cyclist integration with the road layout. A summary of cross sections is presented in Section 5.2.9.

5.2.4 Traffic Flows

The road cross sections, pavement build-up, junction layout, traffic signals and other design elements have been informed by the predicted traffic flows. A detailed transport modelling exercise has been undertaken to establish these flows. The modelling methodology and resultant forecasted demand are detailed separately within Chapter 7 – Traffic and Transportation and associated appendices.

5.2.5 Design Speed

The proposed design speed for new roads is to be 50 km/hr.

5.2.6 Carriageway Widths

DMURS recommends a standard lane width of 3.25m for Link Streets. This has been applied as the standard for all single carriageway sections of the GDDR & GLDR.

The minimum lane width to be applied to new carriageway surfaces shall be 3.0m. Lane widths of 3.0m will be applied at junctions and along any sections of dual carriageway.

It is noted that there are a variety of cross sections proposed along the road routes as set out in the Urban Design Document. In addition the road cross section changes at all junctions to accommodate the required turning lanes, pedestrian and cyclist facilities and traffic signals. A commentary on the proposed cross sections is included in Section 5.2.9.

5.2.7 Parking Provision

The provision of on street parking at suitable locations is recommended in DMURS. The GDRS Urban Design Report has identified a number of locations along the road route where parking provision would be suitable with regard to surrounding land use/zoning. All spaces proposed are parallel parking and are to have standard size of 2.4m (W) x 6m (L). Minimum size is to be 2.1m (W) x 6m (L)

In line with DMURS guidance parking shall be split into banks which will be separated by kerb build-outs (typically containing a street tree or street light).

Where parking is proposed adjacent to cycle paths a minimum buffer space of 0.75m is to be provided between the parking and the edge of the cycle path to prevent potential impacts between car doors and cyclists.

In many cases the proposed parking will not be required in the current rural setting but may be appropriate in conjunction with future street frontage developments. In these cases, the roadside verge will be sized to accommodate the provision of parking/buffer at a future stage. Parking is to be provided along a section of the GLDR alongside the open space/amenity zoning area south of Glenamuck Road. This parking will offset the loss of parking along the existing Wayside Celtic access road and will provide parking provision for use of any future parks/amenity area.

5.2.8 Pedestrian and Cyclist Infrastructure

A key aim of the scheme is to improve provisions for cyclists, pedestrians and other vulnerable road users. Generous path and cycle track widths are to be provided to encourage and maximise sustainable transport. The requirements for pedestrians and cyclist have been considered from the outset for all junction designs.

Best practice guidance from the National Cycle Manual has been implemented on the scheme including

- Determination of minimum cycle track widths based on edge conditions and route features in accordance with the width calculator
- Provision of segregated cycle tracks along the majority of the route

- Provision of Advance Stacking Locations, Box Turn Markings, Turning Pockets and Push button units for cyclists
- Provision of ramped transitions from on-road cycle lanes to segregated cycle tracks
- Provision of on-road cycle infrastructure and markings through junctions and alternative shared surface routes with toucan crossings for less confident cyclists

The design standard width for footpaths is 2.0m with a minimum of 1.8m provided at constrained locations

The design standard width for cycle tracks/cycle lanes is 2.0m which is applied to all new cycle infrastructure along the GDDR & GLDR. Cycle lane width along realigned road approaches will be in accordance with the National Cycle Manual.

It is noted that no cyclist infrastructure is in place along the majority of adjoining exiting roads, in such cases cycle provision is to be provided on the realigned roads in the vicinity of the junction only before road cross sections transition to match existing conditions

5.2.9 Road Cross Sections

As detailed in the Urban Design Report a variety of road cross sections are applied over the length of the scheme to ensure the street responds to the surrounding land use and environment. A schematic of the cross sections applied is presented in Figure 5-3.

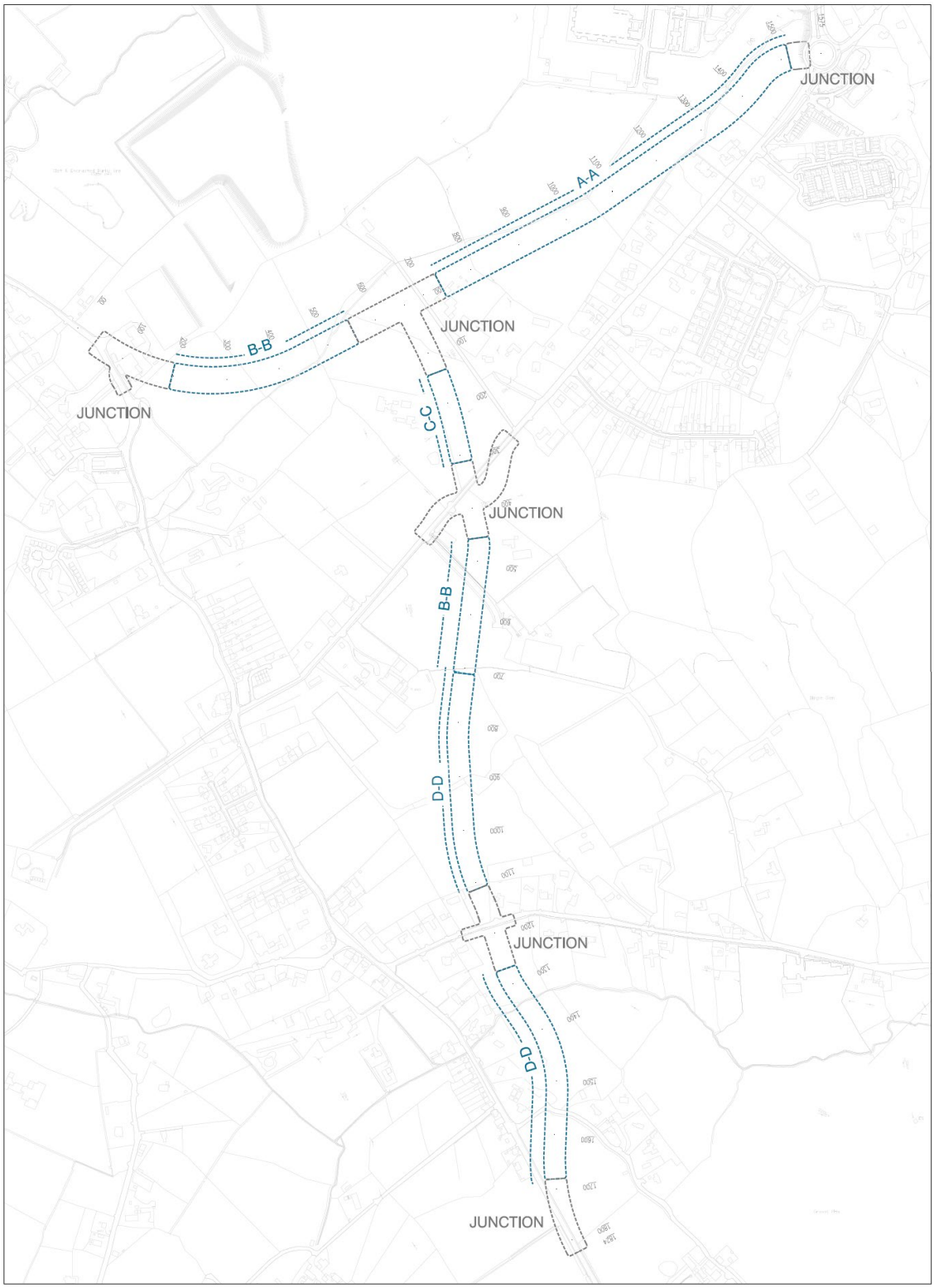

Figure 5-3: Schematic Road Cross Sections Applied

Section A-A	
Urban Design Reference	Eastern Gateway
Approx Areas Applied	GDDR - STA 730 – STA 1520
Carriageway Elements	• 3.0m – Central Boulevard • 2 x 3.0m Lanes – Both Directions • 2.0m Verge – North Side • 3.15m Verge – South Side [Provision for future 2.4m parking plus 0.75m Buffer to cycle track] • 2m Segregated Cycle Track – Both Directions • 2m Footpath – Both Directions
Variations	• RHS Verge reduced to 1.35m adjacent to pond as parking demand will be reduced and significant landscaping will be present adjacent to road edge

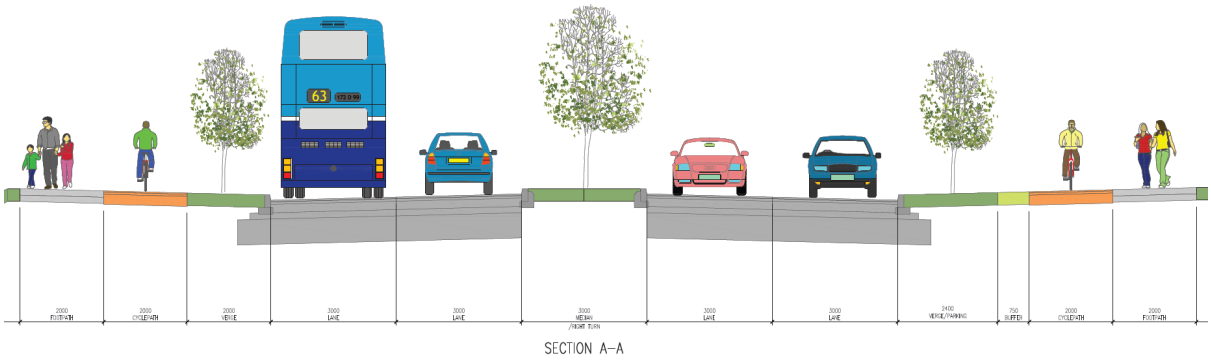

Figure 5-4: Section A-A Schematic

Section B-B	
Urban Design Reference	Western Gateway, Central Gateway
Approx Areas Applied	GDDR - STA 200 – STA 550 GLDR - STA 450 – STA 700
Carriageway Elements	• 3.25m Lanes – Both Directions • 3.15m Verge – Both Sides [Provision for future 2.4m parking plus 0.75m Buffer to cycle track] • 2m Segregated Cycle Track – Both Directions • 2m Footpath – Both Sides
Variations	• A raised table pedestrian crossing is provided (GLDR approx. STA 600). Crossing includes central vegetated island. • On GLDR section parking will be constructed at initial construction stage. On GDDR this will be development driven

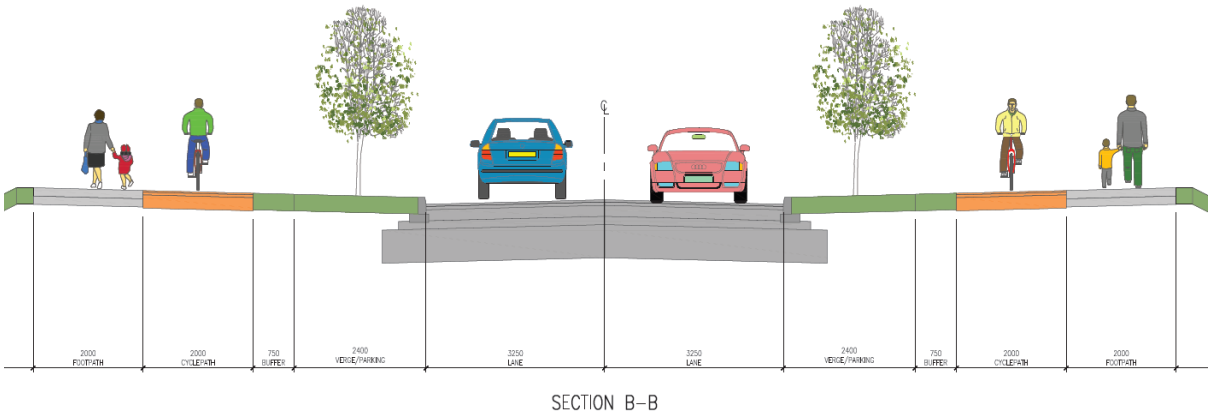

Figure 5-5: Section B-B Schematic

Section C-C	
Urban Design Reference	Western Gateway, Central Gateway
Approx Areas Applied	GLDR - STA 140 – STA 310
Carriageway Elements	• 3.25m Lane – South Bound • 2 x 3.0m Lane - Northbound • 3.15m Verge – RHS & LHS [Provision for future 2.4m parking plus 0.75m Buffer to cycle track] • 2m Segregated Cycle Track – Both Directions • 2m Footpath – Both Sides
Variations	

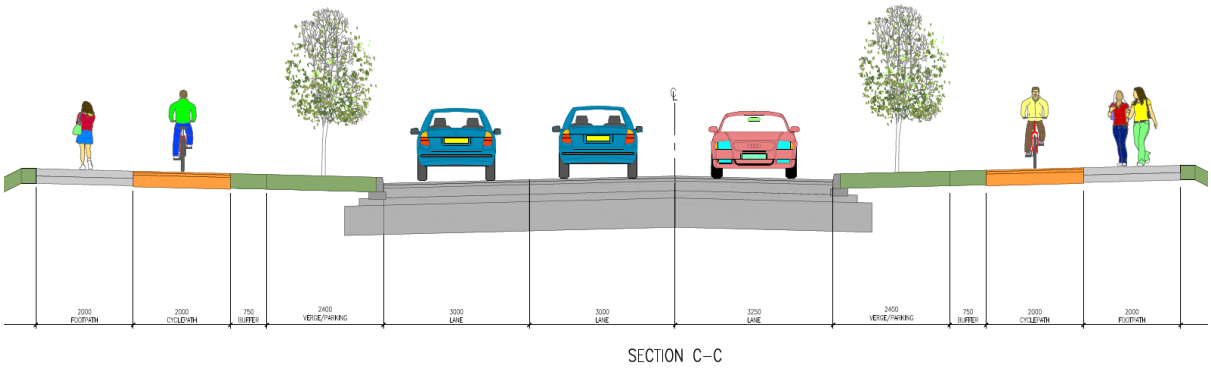

Figure 5-6: Section C-C Schematic

Section D-D	
Urban Design Reference	Southern Gateway, Central Gateway
Approx Areas Applied	GLDR - STA 700 – STA 1150 GLDR - STA 1250 – STA 1700
Carriageway Elements	• 3.25m Lanes – Both Directions • 2.2m Verge – Both Sides • 2m Segregated Cycle Track – Both Directions • 2m Footpath – Both Sides
Variations	• A raised table pedestrian crossing is provided (approx. STA 950). Crossing includes central vegetated island. • Verge omitted along proposed Loughlinstown River bridge to minimise bridge width

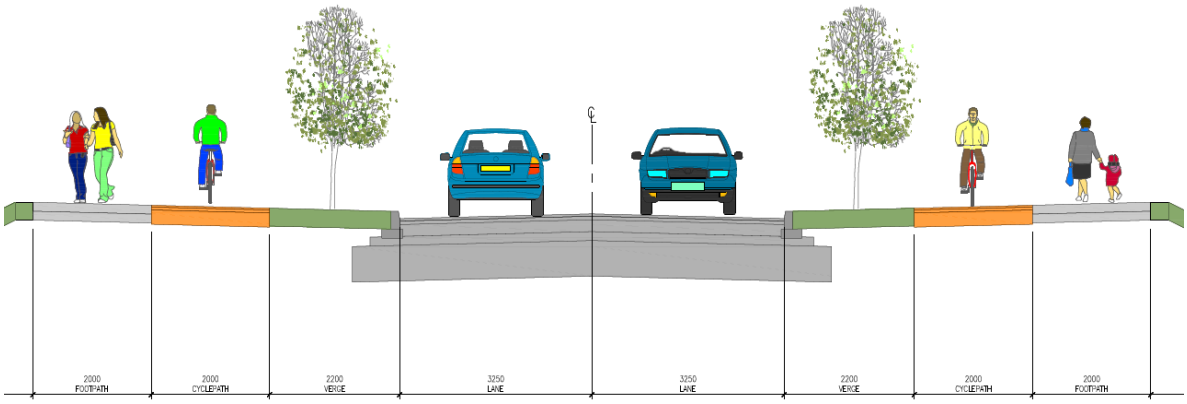

Figure 5-7: Section D-D Schematic

5.2.10 Public Transport Provision

The road design facilitates all existing public transport routes continuing in their current arrangement. Consultation has been carried out with Dublin Bus to ensure the road design incorporates any current or future requirements which have been identified.

The scheme also incorporates "bus-gates" at the GLDR / Enniskerry Road junction and on the east arm of the GLDR / Glenamuck Road.

In order to achieve a good 'modal share' for public transport and walking /cycling in the LAP area, appropriate priority measures at junctions are necessary. Connectivity with the Luas Green Line offers a high quality public transport option linking with major employment centres such as Sandyford and Cherrywood as well as the City Centre. In order to achieve a high quality bus feeder service to the Luas, a level of priority in the local road network for bus users is required. The bus gates also prevent high levels of through traffic on the Enniskerry Road though Kiltiernan and along the eastern section of the Glenamuck Road and will have significant traffic calming effects on Glenamuck Road East and in Kiltiernan Village with corresponding decreases in air and noise pollution. The bus gates are considered to be a critical traffic management provision necessary when the zoned lands have developed. Significant planning /construction activity is currently underway in the area and significant increases are likely to follow closely following the road construction.

The bus gates are intended to be implemented by signage, lanes, traffic signals and road markings and are not intended to include physical barriers. Physical barriers require significant and ongoing technical integration with public & private bus operators, can cause accidents due to driver error or equipment malfunction and require ongoing maintenance.

In order to integrate with the proposed traffic signals, lane and junction arrangements, and to effectively influence driver behaviour in the area the bus gates will be required to operate at all times. It is noted that all bus gates facilitate pedestrian and cycle movement and affect vehicular movement only. In all cases alternative vehicle routes are maintained.

5.2.11 Junctions

Refer to the traffic modelling report in Appendix 7-1 for detailed information on Junction layouts and capacities.

5.2.12 Structures

The Roads Scheme incorporates 4 watercourse crossing structures. Crossings of the Glenamuck Stream and minor watercourse are intended to be concrete box culverts and a crossing of the Loughlinstown /Shanganagh River is intended to be a bridge. Details of watercourse crossing (WX) structures are detailed in Chapter 14 – Water and Hydrology

5.2.13 Earthworks and Pavement

The proposed scheme has been designed to minimise earthworks by matching design elevations to existing levels where possible. Preliminary quantities have been determined and are set out in Chapter 13 - Land and Soils.

Pavement & Foundation Design will be in accordance with DMRB guidance contained in DN-PAV-03021

5.2.14 Scheme Lighting

For the safety and convenience of vehicular road users, pedestrian and cyclists; road lighting will be provided along the proposed route. The standard of lighting will be in accordance DLRCC's 'Public Lighting Installations in Residential and Industrial Areas - Guidance Document – February 2017'. Additional guidance will be taken from British Standards BS5489 & EN13201-2015 – Road Lighting & C.I.E. 115-2010 Recommendations for the Lighting of Roads for Motor and Pedestrian Traffic. Where necessary the existing public lighting will be upgraded at junctions with existing roads.

5.2.15 Traffic Signs

Scheme signage will be provided to ensure that clear directional and regulatory messages are transmitted to drivers and other road users. The design of signage will be based on the Traffic Signs manual issued by the Department of the Environment, the legal framework for which is contained in the Roads Traffic Act.

5.2.16 Utilities

The infrastructure of a number of service providers is likely to be impacted by the Glenamuck District Roads Scheme. The provision of the proposed scheme shall ensure that there are no permanent disruptions to services provided by these bodies and that all temporary disruptions must be kept to a minimum. Any diversions or modifications to existing infrastructure will be agreed with the relevant provider and will be completed in line with their procedures and code of practices

The following statutory bodies and service providers were consulted to identify interfaces between their service and the proposed road development.

- Dun Laoghaire Rathdown County Council
- Irish Water
- Electricity Supply Board (ESB)
- Gas Networks Ireland
- Eir
- Virgin Media

Utility providers will also be notified of the proposed works and offered the opportunity to incorporate new strategic infrastructure into the new road construction.

5.2.17 Irish Water

Provision of new strategic foul and potable water infrastructure within the new roads will be determined by Irish Water. DLRCC have nominated the area as a network extension project and Irish Water have engaged a consultant to complete a preliminary design for the area.

5.2.18 High Voltage ESB Lines

There is significant high voltage ESB infrastructure in the vicinity of the road scheme. This consists of the Arklow – Carrickmines 220kV Double Circuit Route and the Carrickmines – Fassaroe 110 kV line.

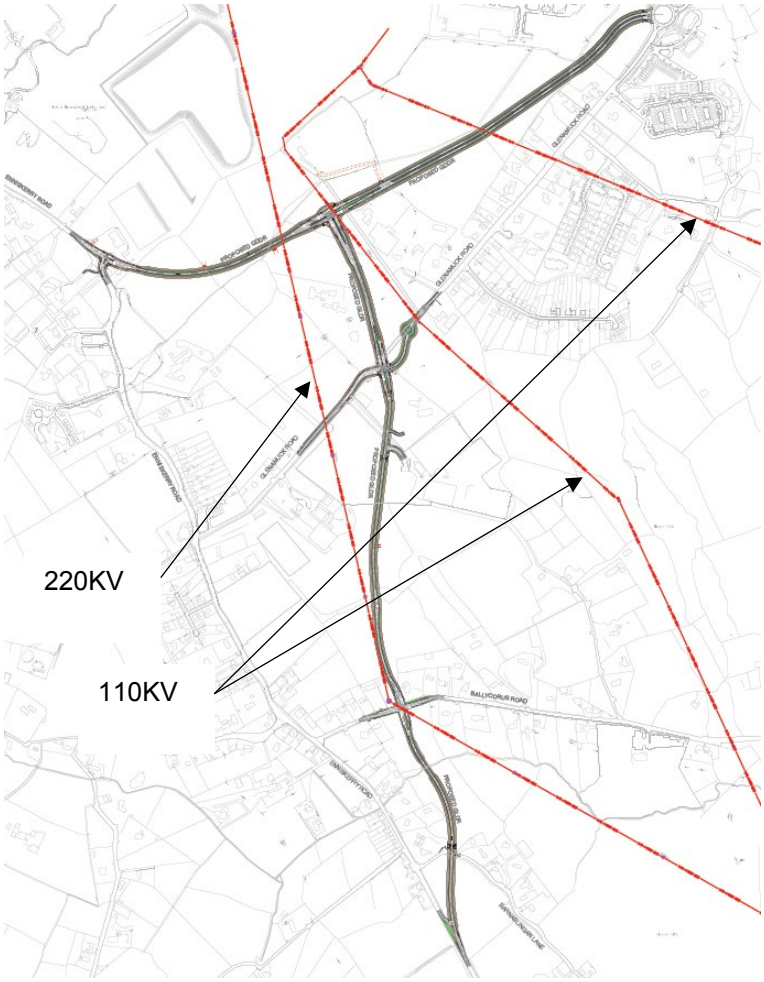

Figure 5-8: HV ESB Overhead Lines

Objective EI13 of the LAP states a desire to underground high voltage transmission lines in the area. Eirgrid (Transmission System Operator) have confirmed that undergrounding of the 220KV line is technically infeasible and only overhead diversions would be considered.

Diversion of the 220KV line at Ballycorus Road was proposed as part of the original scope of the roads scheme. This would require the addition of at least two new 220KV angle plyons and would result in significant cost and visual impact as well as serious disruption to the regional electrical transmission network.

A solution has been developed which delivers the road while maintaining the existing pylons in place. This is subject to final agreement with Eirgrid (Transmission System Operator), ESBN (Transmission Asset Owner) and ESBI (Consultant to Eirgrid and ESBN) however it has been confirmed that the preliminary design is acceptable.

The feasibility of undergrounding 110KV in the vicinity of the scheme has been explored with relevant stakeholders. It has been confirmed that current policy is for undergrounding of 110KV infrastructure to commence or terminate at a substation. The closest substation is located on the Ballyogan Road approximately 1.2km west of the scheme extents. The lines cannot therefore be undergrounded as

part of the current scheme. It is intended that DLRCC will lay underground ductwork along the scheme which would facilitate the future undergrounding of the line(s) along the route of the proposed roads.

5.2.19 Land and Property Considerations

Land Acquisition

The provision of the Glenamuck District Roads Scheme requires the acquisition of land for the construction and operation of the asset. DLRCC and DBFL undertook a series of meetings with affected landowners and the general public during the design phase. Requests/suggestions were evaluated and included where they were deemed possible and beneficial to the scheme. The area of land required has been determined by a number of related parameters, including:

- Road construction & earthworks cuttings/embankments
- Pedestrian and cycling facilities
- Structures and channel diversions
- Surface Water Attenuation
- Landscaping and boundary treatments
- Working Space for construction
- Construction materials & soil storage requirements
- Acquisition of severed plots

In addition to the permanent land requirements for the operational scheme there is a requirement for an additional temporary landtake beyond the permanent road extents to facilitate construction, plant movements, construction compounds, spoil and material storage, landscaping and other works. This land will be temporarily acquired for the duration of construction and then reinstated and returned to the use of the relevant landowner on completion of construction works.

In general all lands which will contain permanent infrastructure associated with the road (pavements, embankment/cutting slopes, drainage/attenuation) will be permanently acquired. Through consultation with affected landowners DRLCC have identified that a number of landowners wish to minimize the land take to better facilitate the integration of land use or future developments with the proposed streets. Within these landholdings the permanent land take line will be at the back of footpath. Lands affected by earthworks slopes or drainage which extend beyond this will only temporarily acquired and will revert to the relevant landowner on completion of works. This will allow the landowners to better incorporate future frontage developments or landscape treatments into the streetscape.

The approximate areas to be acquired as part of works is detailed below in Table 5-1. These values include lands which are already occupied by public roads and lands already owned by DLRCC.

Table 5-1 Land Acquisition

Permanent Land Acquisition	Temporary Land Acquisition
14.6 ha	7.4 ha

5.2.20 Existing Accesses & Accommodation Works

Where an existing access is affected by the proposed road it will modified to suit the road proposals or replaced with a suitable alternative. Accesses affected which require significant works are set out in the table below.

Table 5-2 Access Works

Location	Description	Proposal
Enniskerry Road N Approx CH 35	Existing Residential Driveway incompatible with new junction layout	Replacement driveway to be provided from Enniskerry Road N tying in to existing
Glenamuck Road E Approx CH 170	Access to Bective Ranger Sports Grounds. Existing lane access from Glenamuck Road severed by GDDR	Replacement access from GDDR tying in to existing.
Glenamuck Road W Approx CH 10	Access to DLRCC traveller accomodation. Existing road access from Glenamuck Road severed by GLDR	Replacement access from GLDR tying in to existing.
Glenamuck Road W Approx CH 110	Access to Wayside Celtic Sport grounds. Existing road access from Glenamuck Road severed by GLDR	Replacement access from GLDR tying in to existing.

A number of other accesses or existing boundary treatments along existing roads may require minor works to the access or boundaries as a result of road widening. These works will be completed to replicate the existing conditions as far as is practicable and will be agreed with affected landowners as accommodation works. A more detailed assessment of accommodation works required is presented in Chapter 17.

Accesses will be provided to all land parcels which are segregated by the road. These will take the form of field accesses generally per NRA SCD-02754. Exact locations of field accesses will be determined in conjunction with the affected landowners with due regard to engineering constraints.

5.2.21 Future Accesses

A number of future accesses are shown indicatively on the scheme drawings for context. These represent conceptual access points to the road from future development on the adjacent zoned lands. All accesses to future developments will be required to secure all relevant statutory and planning permissions and may differ from those shown depending on the final layouts of future developments.

5.2.22 Structures Affected

No permanent structures or residential structures are proposed to be demolished by the proposed scheme. There are existing temporary educational cabin structures within the De La Salle Rugby club grounds which will require relocation and a small timber agricultural shed adjacent to Barnaslingan Lane will also need to be relocated

5.2.23 Boundary Treatments

A preliminary indication of boundary treatments is included within preliminary landscape designs in Volume 3. Final boundary treatments will be determined at detailed design stage in conjunction with

affected landowners. It is anticipated that boundary treatment will take the form of fences, hedgerows or walls.

5.2.24 Surface Water Drainage Design

Sections 5.2.24 to 5.2.29 should be reviewed in conjunction with Chapter 14 Water & Hydrology. Surface Water drainage design will be further developed at detailed design phase.

5.2.25 Surface Water Network

A new surface water network will be constructed to collect and convey all runoff from the proposed project to suitable discharge points. The proposed road scheme lies entirely within the catchment of the Loughlinstown River (Also known as the Shanganagh River). There will be a number of surface water outfalls from the proposed road drainage network to the Loughlinstown River and its tributaries in the area.

Prior to each discharge point from the road drainage network a flow control (Hydrobrake or similar) will be installed to limit the discharge to the watercourse to 2l/s per hectare of contributing catchment.

Attenuation storage will be provided upstream of each hydrobrake. This will generally take the form of open ponds. Design considerations for ponds are presented in Section 5.2.29. Indicative drainage infrastructure is shown in Volume 3 Figure 14.6

5.2.26 Existing Drainage

Existing drainage networks affected by the road construction will be diverted around/through the road corridor or will be incorporated into the road drainage network as appropriate. No road runoff will be discharged to existing networks without attenuation to a rate of 2l/s/ha.

Where the road corridor intercepts drainage flow paths from upslope agricultural lands interception drainage will need to be provided. It is anticipated that this drainage will take the form of filter drains generally per NRA SCD/500/20. The filter drains will discharge to existing watercourses or into the road drainage network as appropriate. These drains may become redundant where upslope development occurs. Interception drainage intakes would not generally be considered suitable as discharge points for future developments.

5.2.27 Contributing Catchment

In addition to receiving flows from the proposed road, it is anticipated that the road drainage network will receive flow from some additional lands within the LAP once they are developed/redeveloped. An analysis has been carried out to determine the lands outside the road extents which it is anticipated will drain to the road network. These will be referred to as "External Lands" within this report. DLRCC have indicated that all future developments discharging to the road drainage network will have to provide on-site flow control and attenuation in line with GDSDS requirements prior to discharge to the road drainage network. The ponds will therefore provide primary attenuation for the road and will serve as secondary/regional attenuation for the external lands

The key factors considered when determining the contributing catchments were;

- Topography
- Land Ownership Parcels & access from parcel to potential discharge points

- Available Planning documentation
- Consultation with Landowners/Developers

5.2.28 Attenuation Volumes

Runoff rates from the new paved road surfaces will exceed the 2l/s/ha restricted outflow, in addition it is likely that restricted outflows from connected development lands will be a greenfield rate which exceeds 2l/s/ha (4.5l/s/ha assumed for preliminary design as directed by DLRCC). Therefore the incoming flow will exceed the allowable outflow and a storage volume will be required to accommodate the retained water volumes. The ponds are designed to accommodate the 1 in 100 year storm event volume. The required attenuation volumes in the pond are determined from drainage modeling software.

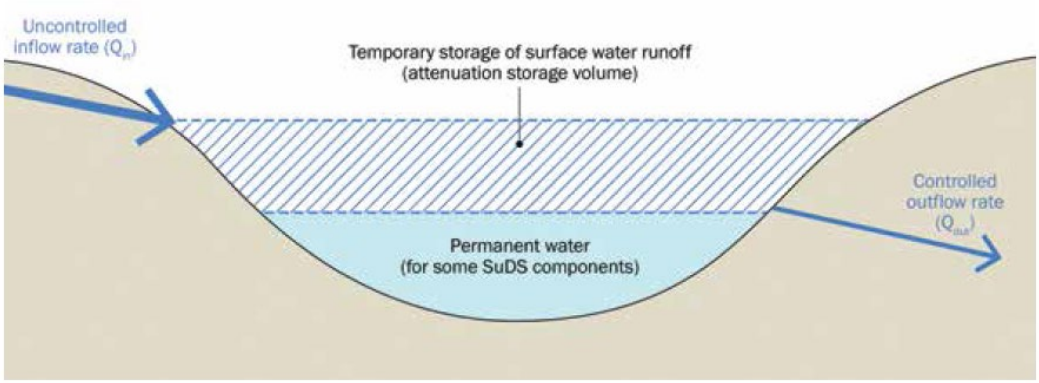

Figure 5-9: Attenuation Storage (The SuDs Manual)

5.2.29 Pond Design

The implementation of Regional Attenuation Storage is recommended in the SuDS Manual and The GDSDS and forms an effective part of a Suds Management Train for the area.

In particular the provision of ponds is encouraged as it provides both attenuation and treatment of the runoff. Ponds can also provide amenity value and encourage biodiversity. The provision of well-designed ponds can achieve the four pillars of SuDS design as set out in the Suds Manual.

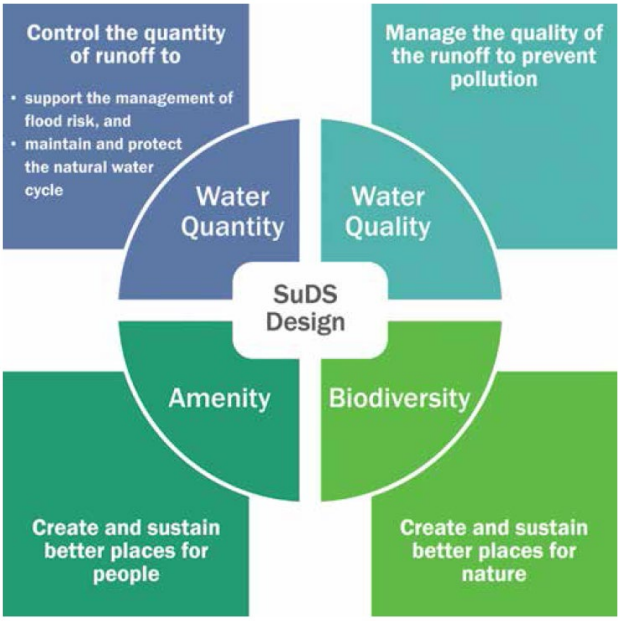

Figure 5-10: Four Pillars of SuDS Design (The SuDS Manual)

The pond bank profiles have been carefully designed in order to maximise the safety, amenity & biodiversity of the ponds. To minimise safety and accessibility issues and to increase habitat potential the pond banks will be required to be reasonably shallow slopes and be broken up with a variety of habitat, safety and maintenance benches. A typical pond bank profile which has been created in general accordance with the requirements of the Suds Manual (Ciria C753). An extract is presented in Figure 5-11 below..

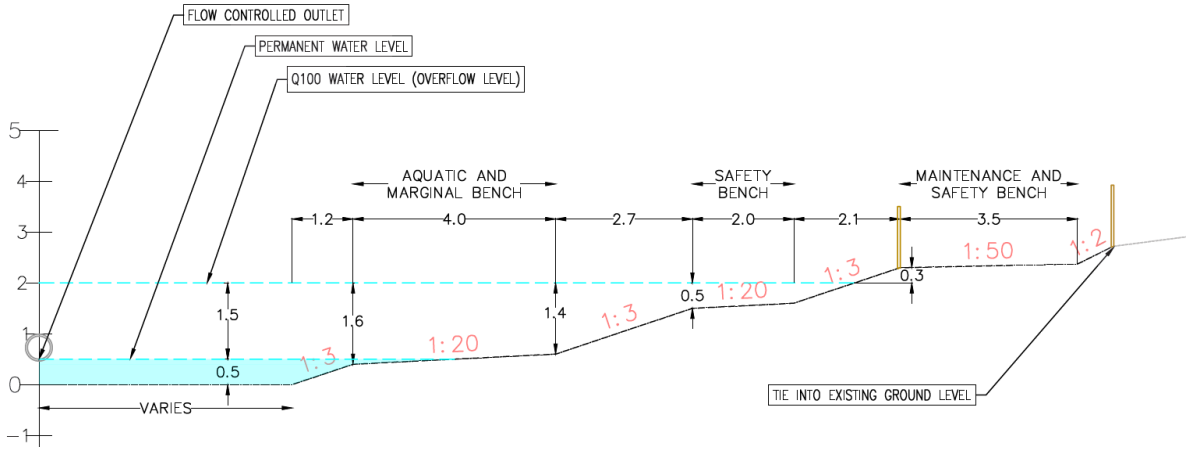

Figure 5-11: Typical Bank Profile

Key aspects which are incorporated into the bank design

- Maintenance Bench – A gently sloping bench is to be provided around the perimeter of the pond to facilitate access for maintenance. This is situated above the peak water level. No slopes between the maintenance bench and the permanent pool exceed 1(V) to 3(H). The maintenance bench may be used as a pedestrian path where appropriate

- Safety bench - Below the maintenance bench another safety bench is provided where peak water levels would not exceed 0.5m
- Aquatic and Marginal Bench - This is the zone of shallow water along the edge of the permanent pool that supports wetland planting, acting as a biological filter. This also represents a clearly visible edge to the permanent pond and would tend to be boggy and discourage access to the permanent pond
- Forebay – In larger ponds a berm will be provided across the permanent pond to create a forebay. This will allow coarse sediments to settle in the forebay before the runoff enters the permanent pool.
- Permanent Depth – A typical depth of 500mm will be provided below the outlet to create a permanent pond volume
- Attenuation Storage – The maximum depth of attenuation for the 100 year event is to be 1.5m above the permanent water level. A controlled overflow will be placed above this level
- Freeboard – A minimum 300mm freeboard is provided above the design top water level and the crest of the maintenance bench

Ponds will also have a permanent "treatment volume". The concept of Treatment Storage is to provide a body of water in which dilution and partial treatment (by physical, chemical and biological means) of the road runoff can take place.

At detailed design phase a comprehensive planting and landscaping plan will be determined for the ponds with the aim of maximising the amenity & biodiversity of the ponds.

Pond treatments will have input from a multidisciplinary team including landscape architect, ecologist, & engineering professionals to implement a best practice design.

DLRCC parks department will also be consulted to ensure a coordinated approach to delivering high quality open space in the area.

5.3 Construction

This section outlines significant factors affecting the construction phase of the Glenamuck District Roads Scheme. Construction of the scheme is dependent on planning approval. Detailed construction information and methodologies will not be available until appointment of a main contractor however the following sections provide general approach and considerations.

5.3.1 Potential Form of Contract

It is anticipated that following the successful attainment of planning permission the scheme would progress to detailed design with the current design team maintained to ensure continuity of the knowledge of the scheme and planning/landowner requirements. On completion of detailed design it is envisaged that the construction of the scheme will be tendered under a "Public Works Contract for Civil Engineering Works Designed by the Employer" contract.

5.3.2 Duration of the Works

Following award of the Tender to the successful contractor it is anticipated that the construction duration for the scheme would be approximately 18-24 months. It is anticipated that the scheme would be progressed as a single construction contract. 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

5.3.3 Hours of Working

Normal working times will be 07:00 to 19:00hrs Monday to Saturday. Works other than emergency works, pumping out of excavations and security activities will not be undertaken outside these working hours without the written permission of the Contracting Authority.

5.3.4 Pre -Construction works

Pre-construction works may involve diversion of existing services by utility providers however the majority of diversions would be progressed during the main construction works. It is anticipated that a fencing contract to delineate the temporary scheme extents would be carried out. Advance tree and hedgerow clearance and clearance of any invasive plant species is also likely to be carried out subject to environmental mitigation set out in complementary chapters. It is also anticipated that some advance archaeological testing and site investigation works would be completed

5.3.5 Construction Works

An overview of the main construction works is set out below which will be further developed as part of contract documentation for the scheme post planning. All works are to be in accordance with the mitigation measures set out in complementary chapters and in accordance with best practice and contract documentation. Preliminary material quantities are provided in Chapter 13 Land and Soils.

- Fencing of construction areas and establishment of site compound(s)

- Traffic management measures
- Creation of construction stage surface water management measures
- Stripping of topsoil from the road corridor as required by construction phasing. All stripped topsoil to be stockpiled on site for re-use with excess removed off-site.
- Earthworks to road formation level, will involve excavation of on site materials and placement of either excavated or imported material to form road profile. Will also involve export of unsuitable/surplus materials and import of road capping gravels.
- Construction of watercourse crossing structures (culverts/bridge)
- Excavations and surplus soil export for surface water attenuation ponds
- Installation of services and service diversions. Trenching and laying works for all services including ducting, watermains and drainage.
- Import, placement and compaction of pavement foundation gravels, concrete surfaces and kerbs and bituminous surfacing
- Environmental mitigation such as mammal pass structures, noise barriers and compensation planting.
- Ancillary roadworks such as placing signage, public lighting, road markings & traffic signals
- Accommodation works for affected properties such as access roads, fences gates, walls.
- Landscaping of verges, slopes and ponds. Placement of trees, scrubs, surfacing, soils seeding etc. Construction of permanent boundary treatments

5.3.6 Temporary Traffic Management

The scheme shall be constructed in a manner to minimise disruption to road users, local residents and businesses. 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 DLRCC and the appropriate emergency services. Key considerations to be included in the traffic management plan include

- All construction works to be undertaken in a clearly delineated site area which will have specific entry and exit points for construction traffic
- Local roads to be maintained as minimum 1 way alternating traffic during works with the exception of short term closures for critical works. 2 way traffic flow to be achieved where practicable with durations of one way systems to be minimised
- In particular closures of the Glenamuck road are to be minimised given the traffic flows conveyed and distance of diversion routes prior to the delivery of the GDDR.
- Phasing of construction is to be staggered to minimise works on separate local roads coinciding.

- In order to minimise the impact on local residents, landowners and the public, access to existing residential areas, premises and sports facilities must be maintained during construction with the exception of short term closures for critical works. In particular temporary measures will be required to facilitate access to Wayside Celtic, Bective Rangers and DLRCC traveller accommodation. Contractor to liaise with affected parties to establish usage pattern of affected parties and schedule construction activities accordingly

- Temporary diversion routes may be required to facilitate construction works on local roads without road closures

- All temporary diversions, lane closures, one way systems, signage and temporary safety measures to be on accordance with the Traffic Signs Manual

5.3.7 Construction Compounds

Temporary construction compound space will be required to provide stores, offices, material storage, parking and welfare facilities for the contractor and employers representatives. The exact location layout and size of the compound(s) will be at the discretion of the contractor with the agreement of DLRCC. It is initially envisioned to have two construction compounds at the indicative locations shown in Figure 5-12.

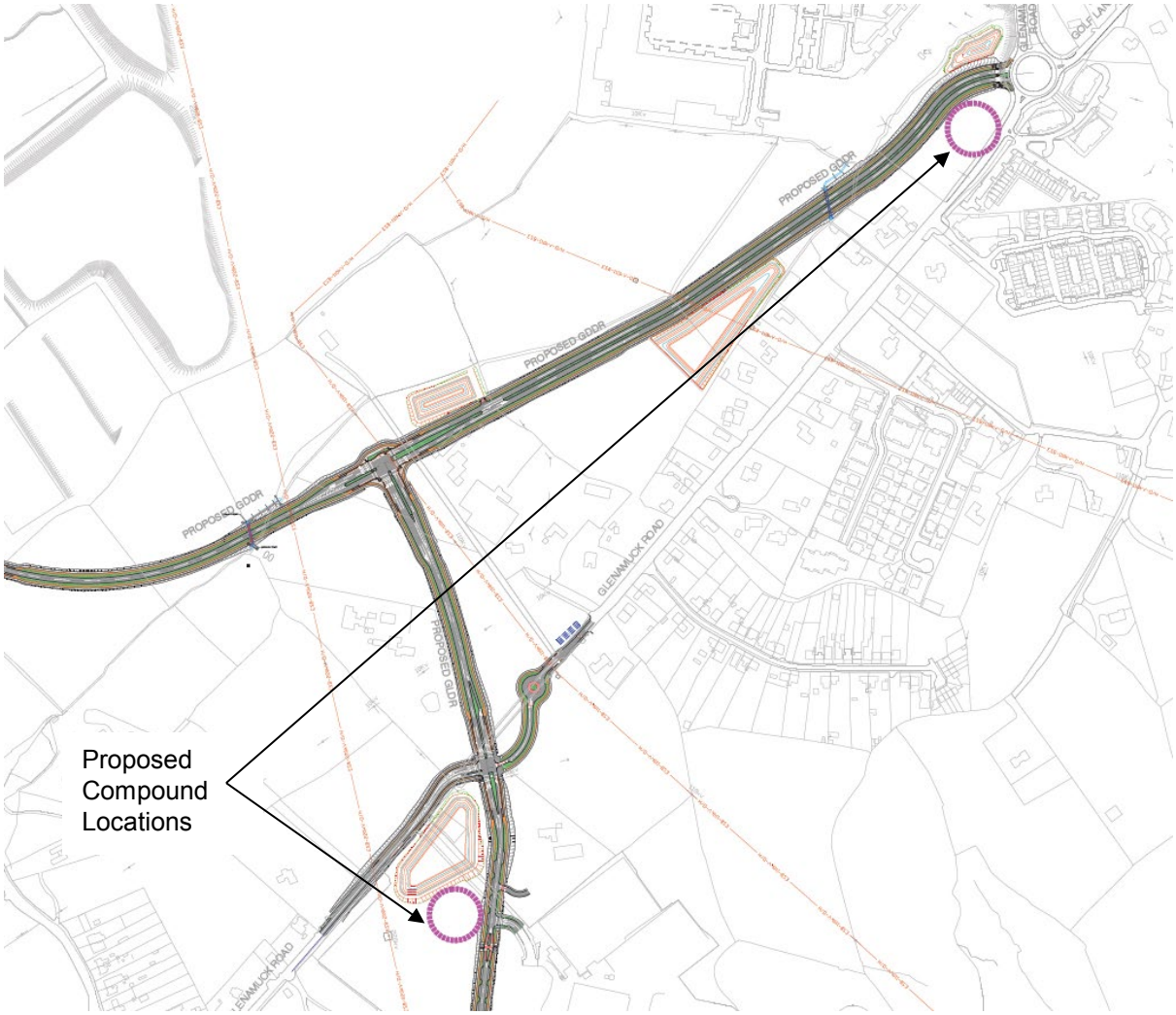

Figure 5-12: Indicative Compound Locations

The compound locations shown provide convenient access from the key arterial M50 route. The locations are staggered north and south of Glenamuck Road allowing access from compounds to northern and southern portions of the scheme separately without requiring construction plant crossings of Glenamuck Road. Any compound locations chosen will be required to be within the identified land take and be compliant with EIAR mitigation measures and agreed construction management documents.

Following completion of construction these areas will be cleared and reinstated and all construction materials will be removed.

5.3.8 Construction Traffic Routing

To construct the scheme there will be a requirement for significant import /export of materials from the site in addition to movement of material within the site extents. Construction and delivery routes and all exit /entry points should clearly be delineated and be specified within the traffic management plan.

In general construction traffic should use public arterial routes suitable for heavy goods traffic for deliveries to/from the site. Within the vicinity of the site, haul routes should be formed along the

proposed road routes to facilitate material movements around the site without affecting local routes. Use of onsite haul routes to be prioritised over use of public roads to minimise disruption to local traffic. Temporary crossing points will be required at any points where construction traffic will cross existing roads. Construction traffic should not use Barnaslingan Lane with the exception of necessary works on the lane as the width and alignment of this road is not suitable for use by heavy construction traffic

Suitable traffic management measures will be required at exit/entry points and at crossing points in accordance with the agreed traffic management plan, the Traffic Signs Manual and the Safety, Health and Welfare at Work (Construction) Regulations.

5.3.9 Construction Management Plan

Prior to any demolition, excavation or construction, a Construction Management Plan (CMP) will be produced by the successful contractor to detail how the project is to be executed in accordance with all project, statutory and environmental requirements. The CMP should detail at a minimum;

- Working hours and days and construction schedule;
- Details of emergency plan - in the event of fire, chemical spillage, cement spillage, collapse of structures or failure of equipment or road traffic incident within an area of traffic management. The plan must include contact names and telephone numbers for: Local Authority (all sections/departments); Ambulance; Gardaí and Fire Services;
- Details of chemical/fuel storage areas (including location and bunding to contain runoff of spillages and leakages);
- Details of construction plant storage, chemical and fuel storage, temporary toilet
- Traffic management plan (to be developed in conjunction with the Local Authority Roads Section) including details of routing of network traffic; temporary road closures; temporary signal strategy; routing of construction traffic; programme of vehicular arrivals; on-site parking for vehicles and workers; road cleaning; other traffic management requirements;
- Site Compound locations & layouts.
- Erosion and Sediment Control Plan for surface water runoff and in stream works
- Truck wheel wash details (including measures to reduce and treat runoff);
- Dust management to prevent nuisance (demolition & construction);
- Noise and vibration management to prevent nuisance (demolition & construction);
- Landscape management;
- Stockpile locations;
- Temporary hoarding & lighting plans;
- Method Statements for diversion of services;

- Method Statements for Construction of pipelines;
- Method Statements for Storage, Treatment and transport of soft soils;

The production of the CMP will also detail areas of concern with regard to Health and Safety and any environmental issues that require attention during the construction phase.

5.3.10 Environmental Operating Plan

In order to facilitate the integration of environmental issues into road scheme planning, construction and operation, an Environmental Operating Plan (EOP) shall be produced implemented and maintained by the contractor. This represents a best practice guide for considering the environment for the construction life cycle of a road scheme project.

The EOP shall be designed to assist the main contractor in preventing, managing and/or minimising significant environmental impacts during the construction phase. To achieve this objective the EOP shall:

- Comprehensively incorporate all Environmental Commitments set out in the Contract documents, Planning Documents (including EIAR), any conditions and/or modifications imposed by An Bord Pleanála or the local authority
- Provide a method of documenting compliance with these Environmental Commitments and conditions/modifications;
- Itemise relevant environmental legislative requirements and best practice guidance. The EOP should also provide a method of documenting compliance with these requirements, and
- Outline methods by which construction work will be managed to prevent, reduce or compensate for potential adverse impacts on the environment
- Incorporate procedures for communicating with the public, statutory consultees, local authority and relevant site-personnel;
- Incorporate procedures for Environmental Awareness Training for the main contractor's staff;
- Incorporate monitoring procedures and responses to monitoring results, where contractually required, and
- Provide for a system of audit with regard to the effectiveness of the EOP during the construction life cycle of the project.
- Include an Emergency Response Plan (ERP) detailing the procedures to be undertaken in the event of a spillage of chemical, fuel or hazardous wastes, fires or flood events.

TII have published "Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan" which should be used as a basis for the creation of the EOP.

The EOP shall be co-ordinated with all other environmental procedural documents required which may include a Construction Management Plan, Erosion and Sediment Control Plan, and a Pollution Prevention Plan.

5.4 References

- EPA (2017) Draft Guidelines on preparation of Environmental Impact Assessment Reports;
- Department of the Environment, Community and Local Government (DoECLG), (2018) Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment;
- National Roads Authority (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide (Transport Infrastructure Ireland (TII), (formerly);
- TII (2004) Environmental Assessment and Construction Guidelines;
- EPA (2002) 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 (2015) Draft Revised Guidelines on the Information to be contained in Environmental Impact Statements;
- EPA (2015) Draft Revised Advice Notes on Current Practice in the Preparation of Environmental Impact Statements;
- EPA (2015) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;

- EPA (2017) Draft Guidelines on preparation of Environmental Impact Assessment Reports;
- Department of the Environment, Community and Local Government (DoECLG), (2018) Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment;
- National Roads Authority (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide (Transport Infrastructure Ireland (TII), (formerly);
- TII (2004) Environmental Assessment and Construction Guidelines;
- EPA (2002) 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 (2015) Draft Revised Guidelines on the Information to be contained in Environmental Impact Statements;
- EPA (2015) Draft Revised Advice Notes on Current Practice in the Preparation of Environmental Impact Statements;
- EPA (2015) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;

- Design Manual for Urban Roads & Streets (DMURS) by the Department of the Environment, Community and Local Government/Department of Transport, Tourism and Sport, 2013;
- Dún Laoghaire-Rathdown County Council (2013) Kiltiernan/Glenamuck Local Area Plan; and
- Dún Laoghaire-Rathdown County Council (2007). Kiltiernan/Glenamuck Local Area Plan.

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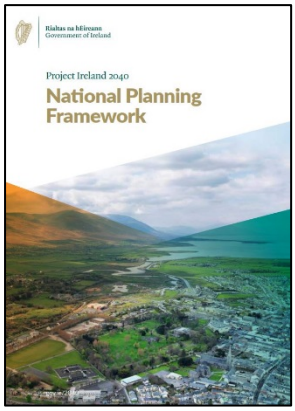
6 Planning and Policy

6.1 Introduction

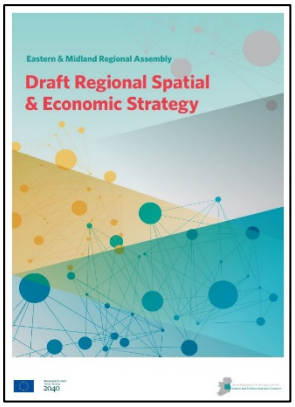
The GDRS is included in the Dún Laoghaire-Rathdown County Development Plan 2016-2022 (CDP) as a 'six-year roads objective' and is further detailed in the Kiltiernan/Glenamuck Local Area Plan 2013 (LAP). The scheme was also included in the 2007 Kiltiernan/Glenamuck LAP. It is notable that a number of national and regional transport planning and policy documents play an important part in the development of this proposed scheme. An outline of the relevant planning and policy issues relating to the study are set out below.

Figure 6- 1: Irish Planning System – An Overview Extract from the National Planning Framework-Ireland 2040.

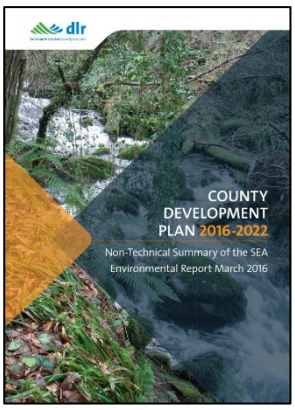
National Planning Framework



Draft Regional Planning Guidelines



Dún Laoghaire Rathdown County Development Plan



Kiltiernan-Glenamuck LAP

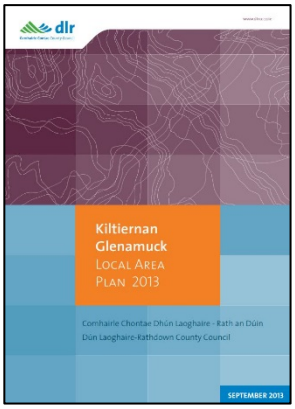


Figure 6- 2: The hierarchy of National, Regional and Local planning policy documents supporting the proposed developed.

6.2 Irish National Policies, Guidance and Objectives

6.2.1 National Planning Framework

The National Planning Framework 2040 (NPF) was published in February 2018 and now sets the strategic vision for the spatial development of Ireland for the period from 2018-2040. On foot of the completion of the NPF the Midlands and Eastern Regional Authorities will prepare their own strategy in accordance with the Framework set by the NPF. This will be completed by early 2019 and will be known as a Regional Spatial and Economic Strategy. The EMRA have released their draft RSES on the 5th of November 2018. Public consultation will take place into January 2019. Metropolitan Area Strategic Plans will also be prepared in due course.

According to the NPF, the National Strategic Outcomes (including Compact Growth and Sustainable Mobility) are supported by Strategic Investment Priorities where Housing and Sustainable Urban Development and National Road Networks are the first and second priorities (see Table 6-1 below). These concepts are central to the proposed GDRS.

Figure 6- 3: Strategic Investment Priorities for Ireland according to the NPF

Section 1.3 of the NPF describes these two **National Strategic Outcomes** as follows:

> ***Compact Growth:*** *Carefully managing the sustainable growth of compact cities, towns and villages will add value and create more attractive places in which people can live and work. All our urban settlements contain many potential development areas, centrally located and frequently publicly owned, that are suitable and capable of re-use to provide housing, jobs, amenities and services, but which need a streamlined and co-ordinated approach to their development, with investment in enabling infrastructure and supporting amenities, to realise their potential. Activating these strategic areas and achieving effective density and consolidation, rather than more sprawl of urban development, is a top priority.*

The NPF further explains **National Strategic Outcome 1** 'Compact Growth' at p. 139 of the document:

> *From an urban development perspective, we will need to deliver a greater proportion of residential development within existing built-up areas of our cities, towns and villages and ensuring that, when it comes to choosing a home, there are viable attractive alternatives available to people. Combined with a focus on infill development, integrated transport and promoting regeneration and revitalisation of urban areas, pursuing a compact growth policy at national, regional and local level will secure a more sustainable future for our settlements and for our communities.*
>
> ***Sustainable Mobility:*** *In line with Ireland's Climate Change mitigation plan, we need to progressively electrify our mobility systems moving away from polluting and carbon intensive propulsion systems to new technologies such as electric vehicles and introduction of electric and hybrid traction systems for public transport fleets, such that by 2040 our cities and towns will enjoy a cleaner, quieter environment free of combustion engine driven transport systems.*

The NPF further explains **National Strategic Outcome 4** 'Sustainable Mobility at p. 142 of the document:

> *The provision of a well-functioning, integrated public transport system, enhancing competitiveness, sustaining economic progress and enabling sustainable mobility choices for citizens, supports the overall Framework objectives. Dublin and other cities and major urban areas are too heavily dependent on road and private, mainly car-based, transport with the result that our roads are becoming more and more congested. The National Development Plan makes provision for investment in public transport and sustainable mobility solutions to progressively put in place a more sustainable alternative.*

It is also pertinent to note the NSO for **Enhanced Amenities and Heritage** which seeks to *"ensure that our cities, towns and villages are attractive and can offer a good quality of life. It will require investment in well-designed public realm, which includes public spaces, parks and streets, as well as recreational infrastructure*".

Section 9.0 of the NPF highlights the commitment to **Environmental and Sustainability Goals**. **National Policy Objective 52** encapsulates this stating:

> *"The planning system will be responsive to our national environmental challenges and ensure that development occurs within environmental limits, having regard to the requirements of all relevant environmental legislation and the sustainable management of our natural capital".*

National Policy Objective 75 seeks to "*Ensure that all plans, projects and activities requiring consent arising from the National Planning Framework are subject to the relevant environmental assessment requirements including SEA, EIA and AA as appropriate".*

The new NPF supports the creation of three new regional assemblies to replace the smaller eight regional authorities. This is seen as an effective measure of making the development of Ireland compact and sustainable. In relation to the development and creation of roads in the Eastern and Midlands region of the NPF, enhanced regional accessibility is of importance.

6.2.2 National Development Plan 2018-2027

The National Development Plan 2018-2027 (NDP) forms a key part of the initial development that the NPF aims to achieve over the next 20+ years. On foot of the completion of the NPF the Midlands and Eastern Regional Authorities will prepare their own strategy in accordance with the Framework set by the NPF. This will be completed by early 2019 and will be known as a Regional Spatial and Economic Strategy. Metropolitan Area Strategic Plans will also be prepared in due course.

The NDP sets out a significant level of investment, almost €116 billion, which will underpin the NPF and drive its implementation over the next ten years. From reviewing the document there are a number of key points made about transport which relate to the GDRS. In section 2.3 *'Infrastructure Demand and Capacity Analysis'*, Transport was identified as a priority area for future public capital investment stating the following;

> *"'Transport: maintenance and upgrading of the road network and public transport to protect asset quality and value, meet demand forecast, ease congestion and to meet climate action objectives'(NDP, 2018)".*

The aim of the GDRS is to service the Kiltiernan-Glenamuck expansion area. The GDRS will provide better public transport routes which will improve transport overall in the area as well as providing cycle lanes each side of the development. The NDP states that with over 50% of housing to be provided in our cities and 30% elsewhere to be provided within existing built up areas, this urban compact growth, 'will be supported through investment in high quality integrated public and sustainable transport systems' (NDP, 2018).

Increased investment will be provided by the NPF and NDP for Roads Programmes with the NDP stating;

> *'New roads will be built to connect communities and encourage economic activity' (NDP, 2018).*

The proposed scheme aims to create a new community either side of the development as well as providing a better-connected community and encouraging economic activity through the development of houses in the area.

6.2.3 Transport Strategy for the Greater Dublin Area 2016-2035 (NTA 2016)

The Transport Strategy for the Greater Dublin Area 2016-2035, has been prepared and published by the National Transport Authority in accordance with Section 12 of the Dublin Transport Authority Act, 2008. It sets out how transport will be developed across the region, covering Dublin, Meath, Wicklow and Kildare, over the period of the strategy and has been approved by the Minister for Transport, Tourism and Sport in accordance with the relevant legislation. Under the relevant legislation development plans and local area plans across the region are required to be consistent with the Transport Strategy.

The relationship between the city centre and suburban areas is examined in detail in the strategy given the importance of origin and destinations for various modes and purpose of trips. This has regard to land use characteristics, trends and changes.

6.2.4 Other Documents

EIAR requirements derive from Council Directive 85/337/EEC (as amended by Directives 97/11/EX, 2003/35/EC and 2009/31/EC) and as codified and replaced by Directive 2011/92/EU of the European Parliament and the Council on the assessment of the effects of certain public and private projects on the environment (and as amended in turn by Directive 2014/52/EU).

This EIAR has been undertaken having regard to the following policy and guidance documents;

- Guidelines on information to be Contained in Environmental Impact Assessment Reports (Environmental Protection Agency, 2017);
- Environmental Impact Assessment of National Road Schemes – A Practical Guide (National Roads Authority, 2008);
- Environmental Impact Assessment (EIA), Guidance for Consent Authorities regarding Sub-Threshold Development (Environmental Protection Agency, 2003); and

- Guidelines on the Information to be Contained in Environmental Impact Statements (Environmental Protection Agency, 2002).

6.3 Regional Policy and Guidelines

Regional Planning Guidelines for the Greater Dublin Area 2010-2022 (Dublin Regional Authority, Mid-East Regional Authority, 2010)

The Regional Planning Guidelines set out the planned direction for growth within the Greater Dublin Area up to 2022. These Guidelines also have a crucial role in supporting regional important infrastructure and the investment priorities of the NDP and Transport 21.

Eastern and Midlands Regional Assembly: Regional Spatial and Economic Strategy (Draft)

On the 5th of November 2018, the Eastern and Midlands Regional Authority (EMRA) released their Draft Regional Spatial and Economic Strategy (RSES). The consultation period has begun and will continue until the 23rd January 2019.

In relation to the proposed scheme, the following points from the document are of importance;

> "*Regional Policy Objectives: Integration of Transport and Land Use Planning*
>
> *RPO 8.1: The integration of transport and land use planning in the Region shall be informed by the guiding principles expressed in the transport strategy of the draft RSES.*
>
> *RPO 8.2: The capacity and safety of the Regions strategic land transport networks will be managed and enhanced, including through the management of travel demand in order to ensure the optimal use.*
>
> *RPO 8.3: That future development is planned and designed in a manner which maximises the efficiency and protects the strategic capacity of the metropolitan area transport network, both existing and planned and to protect and maintain regional accessibility.*
>
> *RPO 8.4: Land use plans within the GDA shall demonstrate a consistency with the NTA's Transport Strategy for the Greater Dublin Area and plans outside of the GDA shall be informed by the guiding principles expressed in the draft RSES."*

The proposed scheme remains consistent with the following objectives stated above. The development will aid in the development of a road scheme which will help open up lands in the area for the development of housing while providing an improvement to the roads scheme to drivers, cyclists and pedestrians.

Guidelines for Planning Authorities on Sustainable Residential Development in Urban Areas

These guidelines set out the key planning principles which should be reflected in development plans and local area plans, and which should guide the preparation and assessment of planning applications for residential development in urban areas. Chapter 4 Planning for Sustainable Neighborhoods sets a framework approach to development for the overall LAP area.

Urban Design Manual A best practice guide (May 2009)

This Guide provides best practice advice on the practical implementation of the policies contained in the Sustainable Residential Development guidelines.

Draft Urban Development and Building Heights - Guidelines for Planning Authorities (August 2018)

These guidelines are at consultation stage and have limited relevance to the scheme as composed. However, depending on the final format when adopted, the scale and height facilitated by less restricted development controls may have implications for long-term development of the LAP area, in terms of form, building height and phasing/speed of implementation.

The Design Manual for Urban Roads & Streets (DMURS) by the Department of the Environment, Community and Local Government/Department of Transport, Tourism and Sport.

DMURS sets out best practice guidance relating to the design of urban roads and streets, setting out a road hierarchy of Arterial, Link and Local Streets, to ensure that the road is not only effective in terms of traffic, but also supports integration with existing and future developments in line with DMURS guidance. This guidance is referenced in more detail in Chapter 3 Alternatives and Chapter 5 Description of Development.

6.4 Local Policy and Guidelines

6.4.1 Dún Laoghaire-Rathdown County Development Plan 2016-2022

The CDP is the statutory development plan for the area and presents the primary framework for development within the County area.

The strategic approach to transport in the CDP is based on the following objectives set out in Chapter 2 Section 2.2.3;

- An increased travel mode share for walking and cycling. This increase will be mainly related to local trips to work, schools, retail and leisure within the larger urban areas;
- An increased travel mode share for public transport for work trips to the main employment zones of Sandyford, Cherrywood and Dublin City Centre and between the other larger urban centres. There may be scope to improve public transport mode share to larger urban centres along the main bus and rail corridors, particularly where this improves access and interchange between bicycle and rail;
- Enhanced safety for all modes – especially for vulnerable road users; and
- The delivery of major strategic transportation projects and infrastructural improvements such as, the Council Cycle Network, an expanded Bus Network, Luas Line B2 from Brides Glen to Fassaroe and the package of interventions to realise the full potential of the Sandyford Business District.

Under Table 2.2.5 of the CDP, six-year road objectives, the following relevant objectives are cited;

- Enniskerry Road (Stepaside to Glenamuck District Distributor Road);
- Glenamuck District Distributor Road;

- Glenamuck Local Distributor Road (including Ballycorus Link); and
- Glenamuck Road South.

The CDP goes on to state in Section 2.2.10.2 Policy ST25 Roads;

> *'It is Council policy, in conjunction and co-operation with other transport bodies and authorities such as the TII and the NTA, to secure improvements to the County road network-including improved pedestrian and cycle facilities.*
>
> *To support the National and Regional economy, requires that strategic roads in the Greater Dublin Area be managed or developed to ensure timely, reliable journeys for business traffic and freight.*
>
> *The specific principles that will underpin decisions made in relation to the development of road schemes within Dún Laoghaire Rathdown will aim to be consistent with the objectives contained within the NTA's 'Greater Dublin Area Draft Transport Strategy 2016-2035'.*
>
> *The 6-Year and Long-Term Road Objectives proposed by the Council are listed in Table 2.2.5 and Table 2.2.6 below and displayed graphically on the related 14 no. Development Plan Maps and also Map 13 (Refer to Supplementary Mapping Booklet). It should be noted that the roads shown on the Maps are purely diagrammatic with regard to location and dimensions. Variations and/or adjustments may be necessary as projects progress.'*

The CDP goes on to state;

> *'All roads, streets and footbridges, including footpaths and cycle tracks, will be designed in accordance with the best practice guidelines and will consider the needs of all road users. To secure the implementation of the Policy, it is the intention of the Council to reserve any necessary lands free from development and to designate building lines, where required. Where possible and appropriate, existing roads in the County may be improved by the setting back of building or frontage lines and by the setting back of proposed new structures at road junctions to improve sightlines in the interests of traffic safety, subject to maintaining visual amenities and sound urban design principles.*
>
> *Appropriate high-quality landscaping (soft and hard) will be included on relevant Roads Objectives projects to soften the visual impact of the scheme and enhance its appearance.'*

Section 1 of the CDP Core Strategy refers to the Kiltiernan/Glenamuck Local Area Plan under Section 1.2.5 Phasing, Prioritisation and Infrastructure Delivery, stating that this is one of the primary growth nodes from which a significant portion of the supply of residential units will derive up to the 2022 horizon and potentially beyond. Section 1.3.4.2 of the CDP refers to Kiltiernan/Glenamuck in detail as follows;

> *The Kiltiernan/Glenamuck LAP was initially adopted in 2007. As Local Area Plans have a six-year lifespan, a revised version of the Plan was subsequently adopted by the Council in 2013. The Plan covers an area of approximately 100 hectares – bounded to the north-west by the Stepaside Golf Course and the decommissioned Ballyogan Landfill, to the north-east by the*

M50 Motorway corridor, to the west by the high amenity foothills of the Dublin Mountains and to the south by a relatively fertile agricultural plain stretching to the Scalp. It is anticipated that the Plan area will ultimately accommodate circa 2,500-3,000 residential units, a neighbourhood centre, two tranches of public open space and a large employment node adjacent to the established mixed-use development at The Park, Carrickmines.

The key elements of the overall planning framework for the area include the proposal to provide a bypass road of the Village Core of Kiltiernan, the implementation of a Neighbourhood Framework Plan to consolidate the Village Core, the graduation of residential densities – from higher densities adjacent to the LUAS line lower densities further removed from this main public transport artery – and the implementation of a centrally-located major public open space/school site.

A number of changes to the Plan were made as part of the revision in 2013 – a reduction in the width of the proposed new bypass roads to single carriageway in each direction (with cycle lanes), some revised junction layouts, removal of proposed 'Link Road' and the inclusion of the 'Neighbourhood Framework Plan' to help guide the eventual development form of the Primary and Secondary Neighbourhoods Centres – with particular emphasis on such matters as proposed urban form, urban design features, architectural style and materials.

…. While some infrastructural servicing objectives in the area have been achieved in recent years, none of the major development objectives of the Local Area Plan have been realised to date. The Local Area Plan is due for review in 2018 (extended until 09/09/2023) and it is recommended that this review be carried out during the lifetime of this County Development Plan.

6.4.2 Kiltiernan Glenamuck Local Area Plan 2013

It is noted that The Kiltiernan Glenamuck Local Area Plan was adopted in September 2013. In June 2018 it was extended for a further period up to and including September 2023.

Under Section 1.4 of LAP, the key elements of the overall planning framework for the area are;

- The proposal to provide a bypass road of the Village Core of Kiltiernan;
- The implementation of a Neighbourhood Framework Plan to consolidate the Village Core;
- The graduation of residential densities, from higher densities adjacent to the Luas line. To lower densities further from the main public transport artery;
- The implementation of a centrally-located major public open space/school site.

In the Core Strategy, the LAP lands at Kiltiernan/Glenamuck are allocated an estimated residential 'yield' of approximately 2400 units. This approximate figure is consistent with the provisions of the LAP, which estimates a range of 2500 to 3000.

Under Section 2 of the LAP, the stated Primary Objectives are;

V01 To accommodate a sustainable level of residential and other ancillary development to ensure the wider strategic objectives of the 2010-2016 County Development Plan are realised.

V02 To establish an obvious identity/sense of place for Kiltiernan.

V03 To establish a focal point/civic node for Kiltiernan.

V04 To guide sustainable development in order to establish the character of the two component areas that comprise the LAP namely, Glenamuck and Kiltiernan.

V05 Ensure that all projects in the LAP which could, either individually or in combination with other plans and projects, have a significant effect on a Natura 2000 site (or sites) will be subject to Appropriate Assessment Screening.

V06 The overarching policies and objectives of the Dún Laoghaire Rathdown County Development Plan will equally apply to any development and any associated works, individually or in combination with other plans or projects within the LAP boundary.

V07 The EU Directives for Environmental Impact Assessment (EIA), the Water Framework Directive, the Floods Directive and the Strategic Environmental Assessment (SEA) are the fundamental policy framework of environmental protection measures and legislation for the for the delivery of the policies within this document and full compliance with the EIA and SEA Directives shall be provided.

Chapter 5 of the LAP addresses movement in the plan area. Section 5.3.1 considers the Primary Road Network. Specific transport objectives, including those which will directly relate to the Proposed Road Scheme are set out below:

MT04 To establish the function, shape and usage of the strategic road network generally within the LAP area.

MT05 To establish the future function of Glenamuck Road in terms of providing local access (including cars, bus, pedestrian and cycle) to the wider strategic road network.

MT06 To establish the appropriate functions of Enniskerry Road in terms of minimising through movements wile accommodating locally generated movements (Car, pedestrian and cycle) from future developments, and also potential future movements associated with the planned neighbourhood centre facility.

MT07 To introduce appropriate traffic calming measures and to divert through traffic away from the future LAP civic node in order to address issues such as safety, noise and air pollution, and the potentially negative severance of the component parts of the LAP area.

MT08 In acknowledgment that some car usage is inevitable, to stipulate maximum car parking provision for differing development types on a demand management basis with appropriate restrictions on on-street parking in order not to undermine that objective.

MT09 To have regard to the EU Ambient Air Quality Directive, the EU Ozone Directive, the EU guidance documents Greening Transport (EU, 2008) and A Sustainable Future for Transport (EU, 2009) and the National Transport Strategy Smarter Travel: A Sustainable Transport Future (DTTS, 2009) to develop strategies which better reflect the real costs that transport volumes and emissions impose onto society, environment and economic efficiency.

MT10 New developments shall provide noise mitigation measures (e.g. boundary walls and/or double/triple glazing) to reduce noise caused by new roads to within acceptable levels.

MT11 To ensure implementation of the Dublin Agglomeration Environmental Noise Action Plan.

The LAP policies and objectives map is included in Figure 6-2 below. This map also indicates the approximate route of the proposed roads.

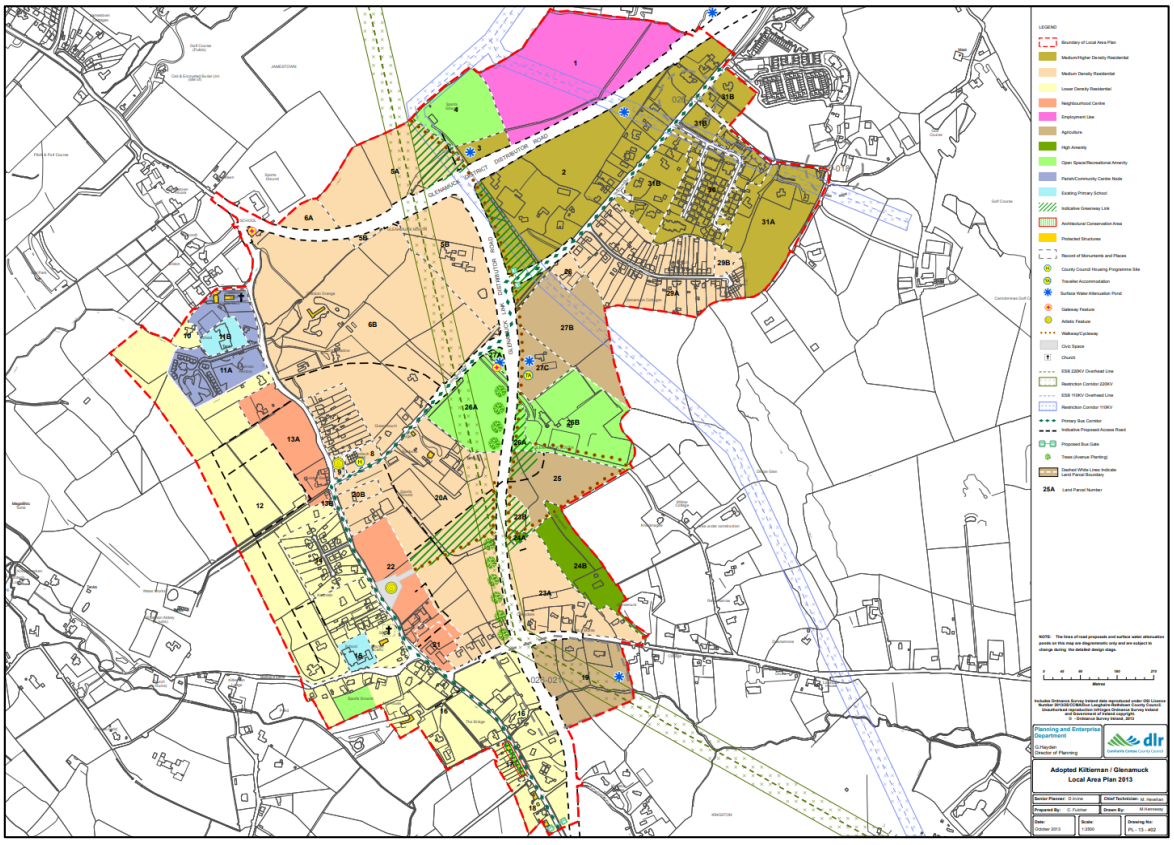


Figure 6- 4: Map of the Kiltiernan/Glenamuck Local Area Plan (Source: Kiltiernan/Glenamuck LAP 2013)

Framework and Principles of Development

The LAP sets out more detailed guidance on the Broad Framework and Principles of Development in Section 2.2. It states:

> Medium/higher density residential development (45-55 dwelling units/net ha) will be supported within this 'Glenamuck' node. These lands fall within the catchment of the Section 49 LUAS Contribution Scheme and are proximate to employment zoned lands and permitted higher density residential developments previously approved. Heights permitted would generally range from 3-5 storeys, which would be comparable to and compatible with existing permitted heights in the area. There are three residential density bands proposed for the LAP lands, measured as dwelling units per hectare (dph): 35-40dph, 40-45dph and 45-55dph.

The LAP seeks to set out a coherent vision on the integrated and sustainable development of the area. This development is also framed in the context of constraints of the receiving environments for policy areas including: flora and fauna, heritage and conservation, landscape and views. These policy objectives are addressed in each of the pertinent chapters of this EIAR as appropriate.

Urban design guidance

The Glenamuck development framework is further articulated with urban design guidance (p.33), which defines particular development parcels (see Figure 6-3 below).

> *Within the Medium-Higher Density Res. zone, while 3-4 storeys would generally be encouraged, up to five storeys will be acceptable but these elements should be focussed primarily on the proposed distributor road, and as corner elements at road junctions. Within the Medium Density Res. zone 2-3 storeys would be encouraged with four storey elements to be concentrated along the proposed main and link distributor roads, and/or at key entrances to sites. Note: With regard to Parcel Nos. 6a, 5a, 3 and 1, the introduction of 5 storeys fronting the Main Distributor Road, subject to qualitative criteria in terms of building design, and elevation, shall be considered. Heights on these Parcels shall range from 3-storeys stepping up to 5-storeys, but having regard for topography, surrounding existing developments, any adjacent residential development and the retention of views to the Dublin Mountains. Within the Low Density Res. node, 2-3 storeys will be encouraged with the 3-storey element along the interface with Enniskerry Road only.*

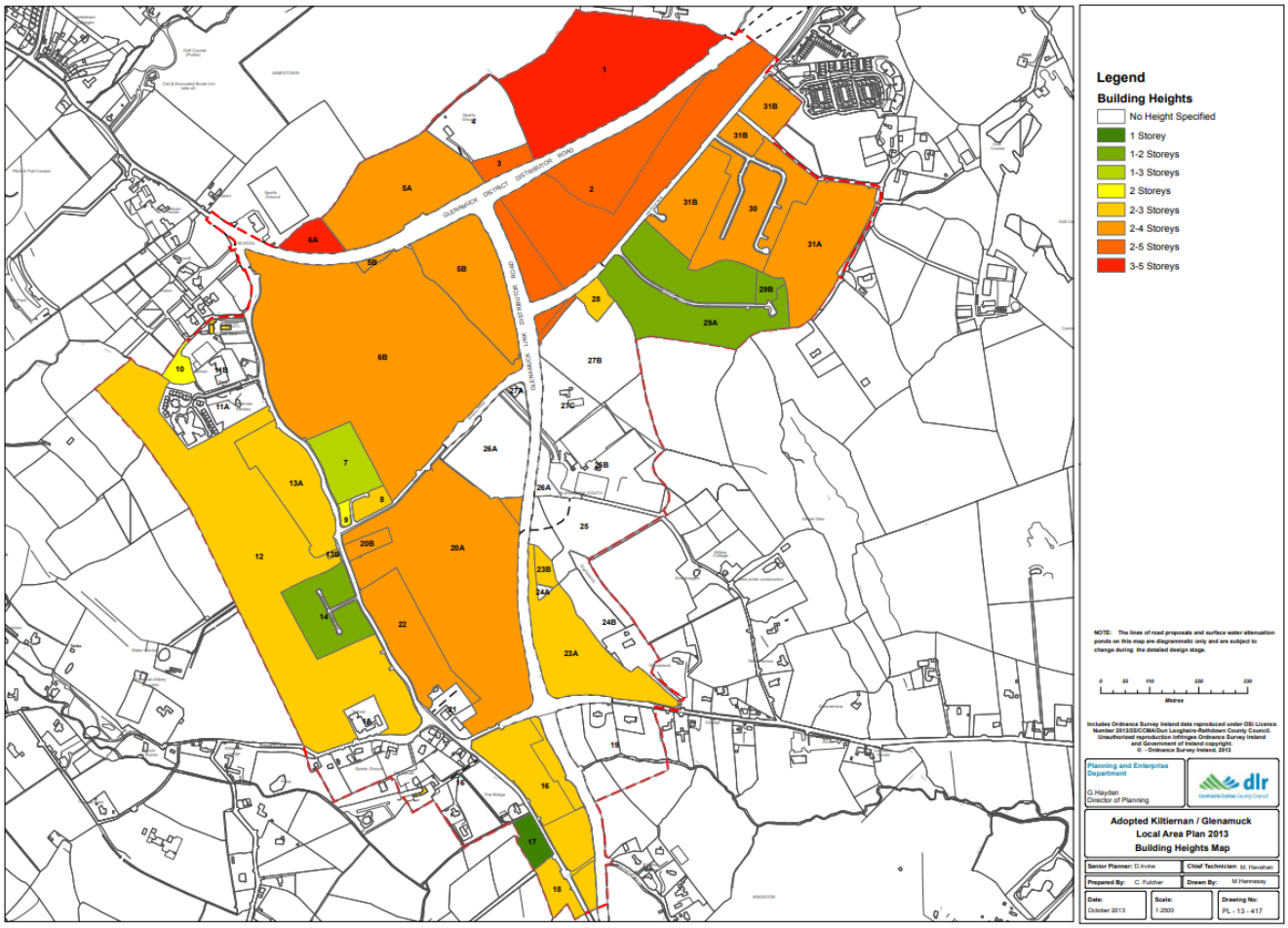


Figure 6- 5: Defined development parcels for development guidance in the LAP (Source: Kiltiernan/Glenamuck LAP 2013)

6.4.3 GDRS Urban Design Report

The Urban Design Report by Brady Shipman Martin was developed to assist the design process for the GDRS and further articulate the interaction between land use, movement and livability/amenity of the area. It is reflective of a framework for development that is connected, provides multi-functional streets, is pedestrian and cyclist focused and has been created and formulated through a multi-disciplinary approach in accordance with the DMURS principles. This is a standalone report provided for information for An Bord Pleanála and the public.

6.5 References

- National Planning Framework. (2018) Ireland 2040: National Planning Framework.;
- National Development Plan. (2018) Ireland 2040: National Development Plan 2018-2027;
- National Transport Authority. (2016) Transport Strategy for the Greater Dublin Area 2016-2035;
- Greater Dublin Area Regional Assembly. (2010) Regional Planning Guidelines for the Greater Dublin Area 2010-2022;
- Department of Environment, Heritage and Local Government (2009) Urban Design Manual A best practice guide;
- Department of Housing, Planning and Local Government (2018) Draft Urban Development and Building Heights - Guidelines for Planning Authorities ;
- Department of the Environment Community, and Local Government/Department of Transport Tourism and Sport (2013) The Design Manual for Urban Roads & Streets (DMURS);
- Dún Laoghaire Rathdown County Council (2016) Dún Laoghaire Rathdown County Development Plan 2016-2022;
- Dún Laoghaire Rathdown County Council (2013) Kiltiernan/Glenamuck LAP 2013; and
- GDRS Urban Design Report, Brady Shipman Martin, 2018.

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7 Traffic and Transportation

7.1 Introduction

This chapter of the EIAR assesses the potential traffic and transportation impacts of the Glenamuck District Roads Scheme. It outlines the development of the traffic models used to analyse the Glenamuck District Roads Scheme and the future year traffic growth factors used to generate projected Annual Average Daily Traffic (AADT) on all key roads in the study area. Existing and projected traffic figures are presented for both the Do-Nothing and Do-Something scenarios. These figures provide a basis for the engineering design presented in Chapter 5 and the air quality and climate and the noise and vibration assessments presented in Chapters 8 and 9 respectively. An overall commentary on the predicted changes in traffic, public transport, pedestrian and cyclist environmental conditions are all discussed in this chapter and provide a setting for all the other assessments undertaken in this EIAR.

The Glenamuck District Roads Scheme is a cited objective of the Dun Laoghaire-Rathdown County Council Development Plan 2016-2022 under the Plan's '6-year roads objectives' and the proposed scheme forms part of the Kiltiernan-Glenamuck Local Area Plan (LAP) (2013) as road infrastructure to support the development of LAP lands for between 2,600-3,000 residential units and bypass road for the Village Core of Kiltiernan. In the absence of the proposed scheme the existing road infrastructure which is largely rural in nature would be required to convey the flows from increased development in the area.

7.2 Methodology

7.2.1 Assessment Framework Methodology

The Glenamuck District Roads Scheme required transport modelling and assessments to be undertaken at three levels of modelling, from strategic macro-modelling, local area micro-simulations and to local junction models. This transport modelling approach has been developed in accordance with; -

- Transport Infrastructure Irelands' (TII's) Project Appraisal Guidelines (PAG) 2016;
- National Roads Authority's (NRA, now TII) Traffic and Transport Assessment Guidelines (May 2004);
- NRA's (now TII) Environmental Impact Assessment of National Road Schemes – A Practical Guide (November 2008); and
- industry best practices.

The National Transport Authority's (NTA) Eastern Regional Model (ERM) which is part of the NTA's Regional Modelling System provides a multi-modal forecasting capability that is particularly well suited for the assessment of large-scale developments such as the proposed Glenamuck District Roads Scheme. Section 7.2.2 gives a brief summary of the NTA's Regional Modelling System (RMS), however a more detailed outline of the RMS is given in **Section 4** of the Modelling Report in **Appendix 7-1**. For the strategic modelling, the ERM was used to develop a comprehensive understanding of Glenamuck / Kiltiernan local area encompassing mode share and trip origin / destination analyses and the impact on strategic road and public transport infrastructure.

For a more detailed assessment within the area, a Local Area Model (LAM) was developed for each assessment year to build on the zonal detail provided by the ERM inside the Glenamuck local area (which is too coarse for detailed assessment) and to provide the required means of testing a high number of scenarios (since the ERM run times are impractical when testing many options and scenarios as is required for Glenamuck at a local level).

This LAM acted as an *Assignment Model*, which replicated demand responses where they might be expected as a direct result of a scheme. The demand responses considered here comprise changes in trip rates, choice of destination and travel mode. Section 5 of the Modelling Report in **Appendix 7-1** outlines the overall Local Area Model approach and methodology further.

The final part of the transport modelling approach was deriving traffic flows from the LAM and applying them to TRANSYT junction models to optimise junctions designs and geometry, refinement and junction operation. Section 6 of the Modelling Report in **Appendix 7-1** summarises the junction modelling methodology. Figure 7.1 summarises the overall transport modelling approach to be undertaken for the Glenamuck District Roads Scheme.

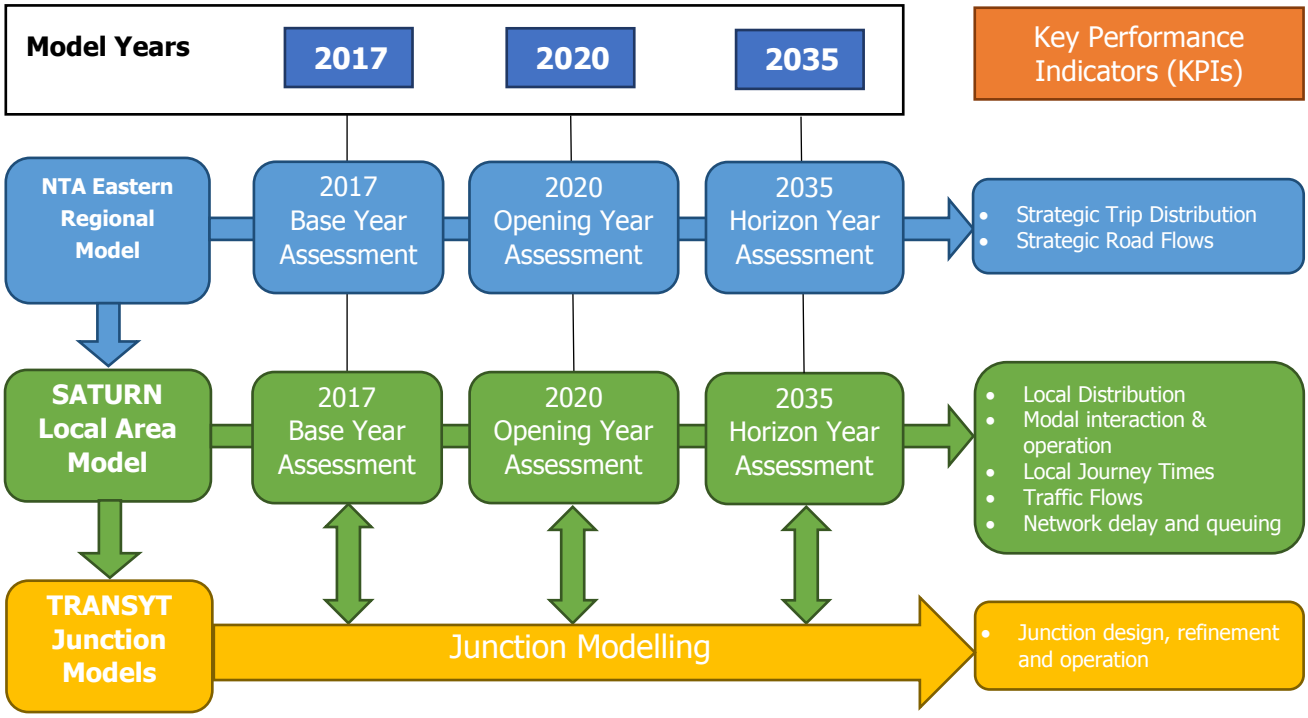

Figure 7.1: Proposed Glenamuck District Roads Scheme Transport Modelling Approach

7.2.2 Regional Modelling System - Eastern Regional Model

The Regional Model System (RMS) was developed by the National Transport Authority (NTA) to support its transport functions and to provide a consistent framework for transport assessment and appraisal nationally. The RMS has a hierarchical structure with three main components. These are the National Demand Forecasting Model (NDFM), the five Regional Multi-modal Models and the Appraisal Modules. The National Demand Forecasting Model provides consistent demand forecasts for input into each Regional Multi-modal Model. The Regional Multi-modal Models are strategic multi-modal, network-based transport models and include all the main surface modes of travel (including travel by car, bus, rail, Luas, walking, and cycling). They are complemented by the Appraisal Modules, which provide a full suite of appraisal tools in line with national guidance.

The National Demand Forecasting Model

The NDFM's function is to estimate levels of trip making to/from Census Small Areas (circa 10,000 nationally) as a function of a set of 63 planning variables associated with population, schools, and employment locations. Trip making estimates are produced for an average 24-hour weekday, so journeys (or tours) which involve leaving and returning home for some purpose (e.g. going to work) are represented as two trip legs in (usually) separate time periods. The NDFM includes car ownership models to segment trip making by car availability, which has a strong bearing on mode choice.

The NDFM's outputs are expressed as Trip Ends which may be at the Tour level (as described above) or at the One-Way level, which would generally mean the trip starts and ends at non-home-based locations. The Trip End outputs produced by the NDFM are then used by the regional models, including the East Regional Model, to estimate what associated travel takes place on the road, public transport, and active modes networks. That then allows conditions on those transport networks to be assessed.

The East Regional Model

A regional model is comprised of the following key elements:

- **Trip End Integration:** The Trip End Integration module converts the 24-hour trip ends output by the NDFM into the appropriate zone system and time period disaggregation for use in the Full Demand Model (FDM)

- **The Full Demand Model (FDM):** The FDM processes travel demand and outputs origin-destination travel matrices by mode and time period to the assignment models. The FDM and assignment models run iteratively until an equilibrium between travel demand and the cost of travel is achieved.

- **The Assignment Model:** The Road, Public Transport, and Active Modes assignment models receive the trip matrices produced by the FDM and assign them in their respective transport networks to determine route choice and the generalised cost for origin and destination pair. The Road Model assigns FDM outputs (passenger cars) to the road network and includes capacity constraint, traffic signal delay and the impact of congestion. The Public Transport Model assigns FDM outputs (person trips) to the PT network and includes the impact of capacity restraint, such as crowding on PT vehicles, on people's perceived cost of travel. The model includes public transport networks and services for all PT sub-modes that operate within the modelled area.

- **Secondary Analysis:** The secondary analysis application can be used to extract and summarise model results from each of the regional models.

Figure 7.2 below provides an overview of the structure of the NTA Regional Modelling System, including the above components.

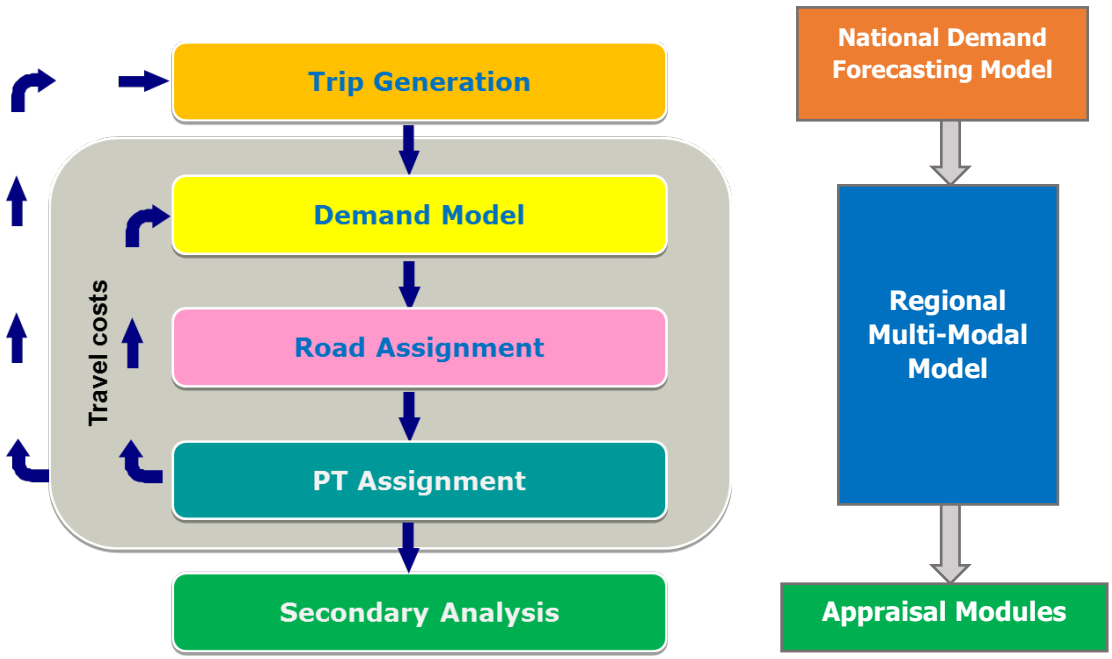

Figure 7.2: Basic Model Structure of Regional Model System

Application of ERM & Network Assumptions

As shown in Figure 7.1 this assessment was tested for the years 2017, 2020 and 2035 by inputting the relevant planning data for each plot into the NTA National Demand Forecasting Model. Within each forecast year, the appropriate transport network were also input to the model based on the NTA Greater Dublin Area Strategy for 2035.

Table 7.1 below shows the main infrastructural items (which would have a potentially significant impact within the Glenamuck-Kiltiernan LAP lands). Although the table only shows the main measures, it should be noted that all other schemes such as road and bus services changes and a fully realised cycle network are included by 2035. In 2020, committed infrastructure such as Luas Cross City and Phoenix Park Tunnel are in place. In 2035 the complete suite of GDA Strategy measures and infrastructure are in place.

Table 7.1 Transport Network Measures Assumptions by Year

Transport Measures by Year	2020	2035
Luas Cross City	✓	✓
Phoenix Park Tunnel Link	✓	✓
Luas Green Line Enhancement		✓
Bus Connects: Core Radial Bus Network		✓
Bus Connects: Core Orbital Bus Network		✓
Bus Connects: Core Regional Bus Network		✓
N11 Widening		✓
New Metrolink		✓
DART Expansion Programme		✓
DART Frequency of 5 Minutes		✓
M50 Widening		✓
M50 Demand Management Strategy		✓

The ERM acted as a donor model for the more detailed LAM, supplying strategic trip distributions and roads flows at the LAM boundary extents which is explained further in Section 7.4.3.

7.2.3 Key Performance Indicators (KPIs)

Both ERM and LAM models were used to provide Key Performance Indicators (KPIs) to inform on the performance of the transport network for all modes at a strategic and local level.

The following KPIs were assessed in the ERM:

- Strategic Trip Distribution; and
- Strategic Road Flows.

The following KPIs were assessed in the LAM:

- Local Distribution;
- Modal Interaction & Operation;
- Local Journey Times;

- Traffic Flows; and
- Network Delay and Queuing.

The following KPIs were assessed in the TRANSYT Models:

- Degree of Saturation (%);
- Total Junction Delay;
- Max. Mean Queue Lengths; and
- Optimised Traffic Signal Timing.

Table 7.2 summarises the various KPIs and their proposed uses in the transport modelling assessment for the proposed Glenamuck District Roads Scheme.

Table 7.2 Summary of Key Performance Indicators in Assessment

Modelling Stage:	Key Performance Indicator	Purpose in Assessment
ERM	Strategic Trip Distribution	- LAM Calibration
	Strategic Road Flows	- LAM Calibration - Wider Area Effects
LAM	Local Distribution	- Trip Distribution - Turning Proportions
	Modal Interaction	- Scheme's effects Bus Routes
	Local Journey Times	- LAM Validation - Scheme Appraisal
	Traffic Flows	- Demand Flows for TRANSYT
	Network Delays and Queuing	- Scheme Appraisal - Problem Junction Identification for TRANSYT
TRANSYT	Degree of Saturation	- Junction Design - Junction Operation
	Total Junction Delay	- Junction Design - Junction Operation
	Max. Mean Q. Lengths	- Junction Design - Junction Operation
	Signal Timing	- Junction Design - Junction Operation

7.2.4 Data Collection

In order to develop a traffic model, a significant level of traffic data is required to ensure that the model replicates existing traffic patterns and volumes. This section outlines the collection of data for the construction of the Base Year (2017) Glenamuck LAM.

A summary of the traffic surveys data that were collated to inform the development of the Base Year (2017) LAM are outlined in Table 7.3 below. Figure 7.3 to Figure 7.8 illustrate the location of the traffic surveys.

Table 7.3 Traffic Survey Data

Survey Type	Description
Traffic Counts	**Automatic Traffic Counts** (ATC) surveys were carried out at 7 sites in Carrickmines / Glenamuck / Kiltiernan area 24 hours a day over a one-week period from Monday 6th to Monday 13th November 2017.
	Junction Turning Movement Count (JTC) surveys were carried out at 9 locations from 07:00 to 19:00 on Tuesday 7th, Thursday 9th and Saturday 11th November 2017.
	Junction Turn Counts – Pedestrian Counts (JTC – PED) were carried out at 9 locations from 07:00 to 19:00 on Tuesday 7th, Thursday 9th and Saturday 11th November 2017.
	Data from 4 Transport Infrastructure Ireland **Permanent ATC's** for 2017.
Queue Length Surveys	**Queue Length** surveys were carried out at 9 JTC locations from 07:00 to 19:00 on Tuesday 7th, Thursday 9th and Saturday 11th November 2017.
Journey Time	**Journey Time** survey data was collected through the Bluetooth methodology. A minimum sample rate of 20% was required as part of these surveys.

Automatic Traffic Counts

The Automated Traffic Counts (ATCs) captured the traffic flows passing given points on the road network and classified the flow into different vehicle classifications, such as Cars, Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV). Traffic flow data, extracted from the ATC survey sites (7 ATC survey sites indicated in Figure 7.3) undertaken over the one-week period from Monday 6th to Monday 13th November 2017, is presented in Table 7.4 below.

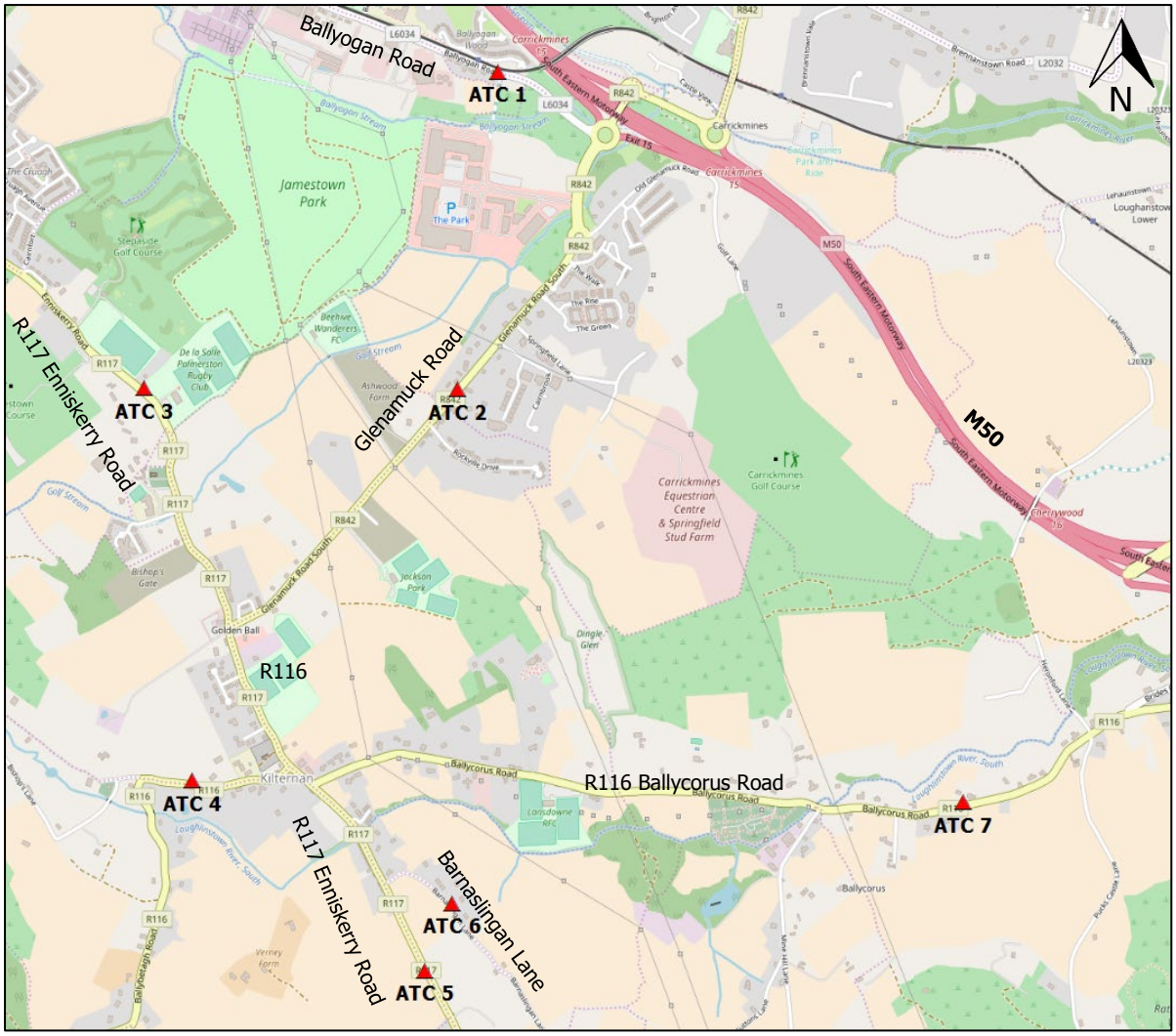

Figure 7.3: Overview of ATC Survey Locations

Table 7.4 also provides annual average estimates of both weekday (Mon – Fri) and 7-day traffic flow based on the ATC Surveys. The following estimates are presented:

- 2017 Annual Average Weekday Traffic (AAWT); and
- 2017 Annual Average Daily Traffic (AADT).

It should be noted that a seasonality factor of 0.99 for the month of November has been applied to the collected data in line with guidance provided in TII PAG Unit 16.1: Expansion Factors for Short Period Traffic Counts. A graphical summary of the AAWT and AADT information presented in Table 7.4 below is shown in Figure 7.5.

Table 7.4 Automatic Traffic Counter Data 2 Way Flow (2017)

Site	Location	Vehicle per Hour (Two-way Flow)		Vehicles per Day	
		AM	PM	AAWT	AADT
ATC 1	Ballyogan Road	981	940	11,169	10,387
ATC 2	Glenamuck Road	779	734	8,373	7,908
ATC 3	Enniskerry Road	873	818	8,116	7,633
ATC 4	R116	178	139	1,898	1,865
ATC 5	Enniskerry Road (South of Barnaslingan junction)	434	886	6,967	6,504
ATC 6	Barnaslingan Lane	21	26	323	359
ATC 7	Ballycorus Road	202	280	2,374	2,209

ATC survey helped in establishing the AM and PM peak hour periods as seen in Figure 7.4. Below the following time peak hours were determined:

- AM Peak Hour (08:00 – 09:00); and
- PM Peak Hour (17:00 – 18:00).

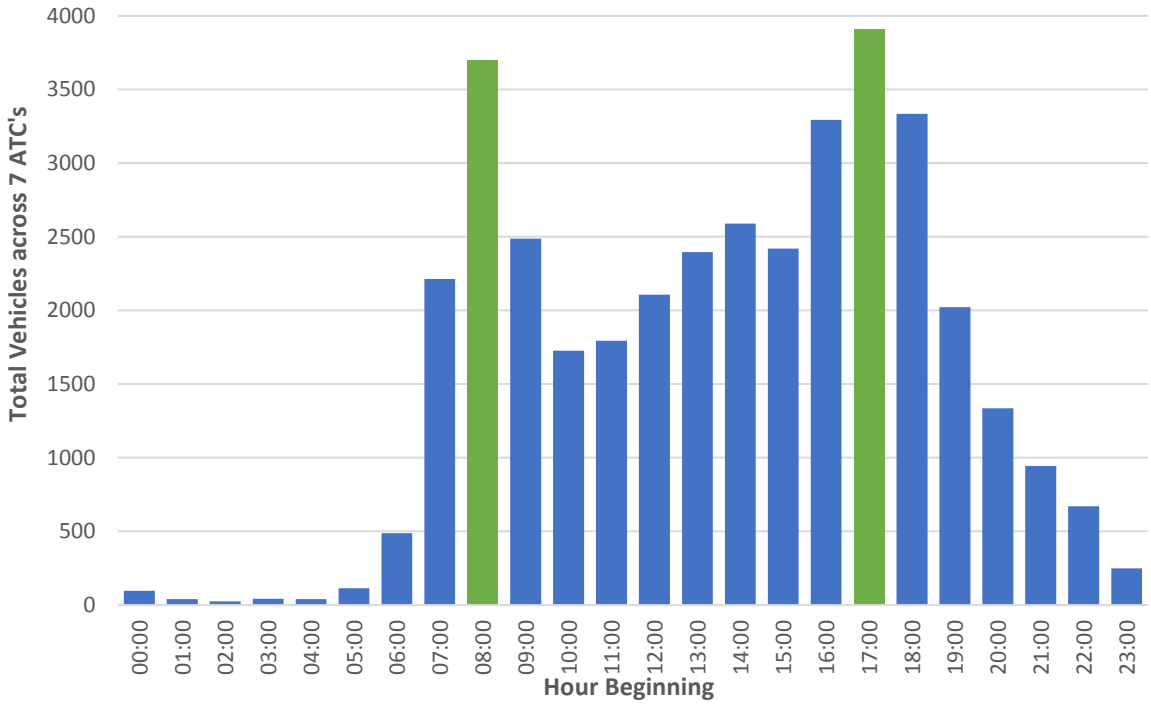

Figure 7.4: Peak Hour Selection

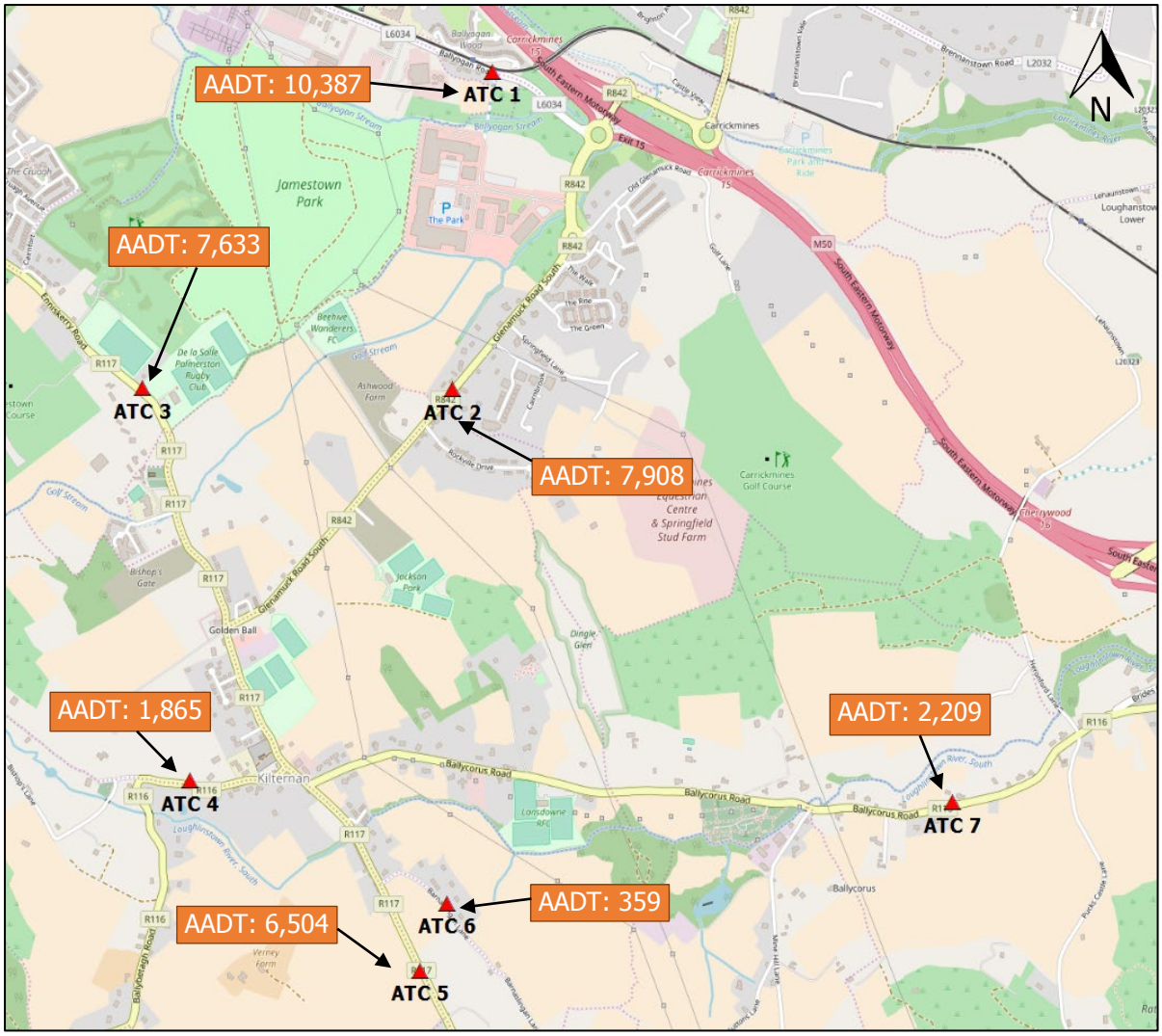

Figure 7.5: Estimated AADT's from ATC surveys within the Study Area

Junction Turning Counts

The Junction Turning Count (JTC) captured the number of vehicles turning at a given junctions and observed which turn movement they took. As with the ATCs they classified the traffic into different vehicle categories. JTC surveys were undertaken at 9 junctions from 07:00 to 19:00 on Tuesday the 7th, Thursday the 9th and Saturday the 11th November 2017. Traffic flows were classified by vehicle type and recorded in 15-minute time intervals. The junctions listed in Table 7.5 below were surveyed (refer to Figure 7.6).

Table 7.5 Junction Turning Movement Counts (2017)

Site	Location
JTC 1	Glenamuck Road North / M50 Roundabout (East)
JTC 2	Glenamuck Road North / M50 Roundabout (West)
JTC 3	Glenamuck Road / M50 / Ballyogan Road Roundabout
JTC 4	Glenamuck Road / The Park Carrickmines
JTC 5	Glenamuck Road / Golf Lane Roundabout
JTC 6	Glenamuck Road / Enniskerry Road
JTC 7	Enniskerry Road / R116

JTC 8	Enniskerry Road / Ballycorus Road
JTC 9	Ballycorus Road / Rathmichael Road / Brides Glen Road

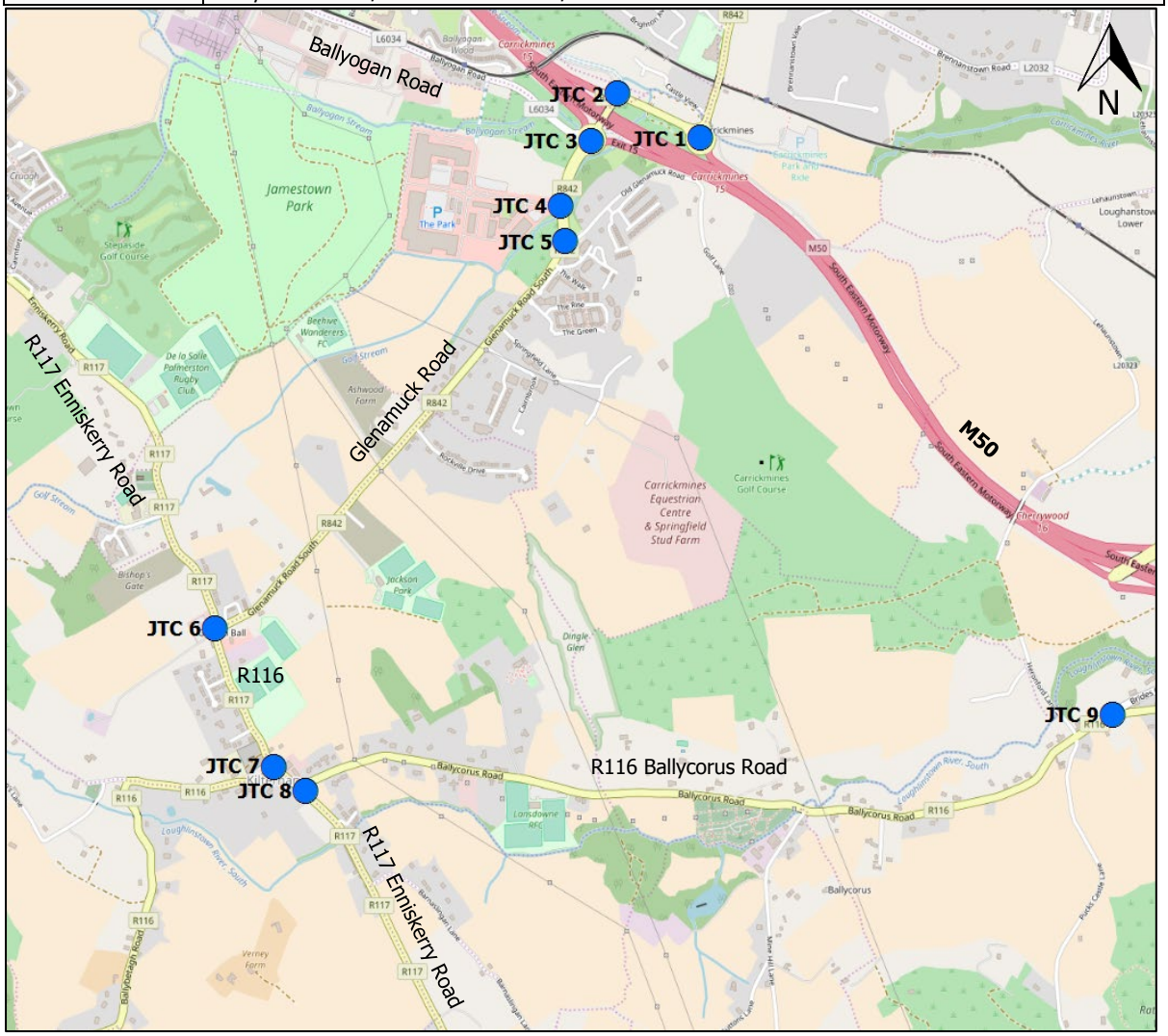

Figure 7.6: Overview of JTC/PED and Queue Length Survey Locations

Bluetooth Surveys

Journey time information was collated from the Bluetooth data in order to ensure that the travel time on existing roads was properly reflected within the base models, thereby ensuring that a robust assignment could be undertaken. These journey times represent an average of journey time surveys captured on Tuesday the 7th, Thursday the 9th and Saturday the 11th November 2017.

The journey times between five Origin-Destination points, these key routes are shown graphically in Figure 7.7. Details of the resultant journey times for the AM and PM periods are presented in Tables in Section 3 of the Modelling Report in **Appendix 7-1**. Journey time data was used to validate the base year models.

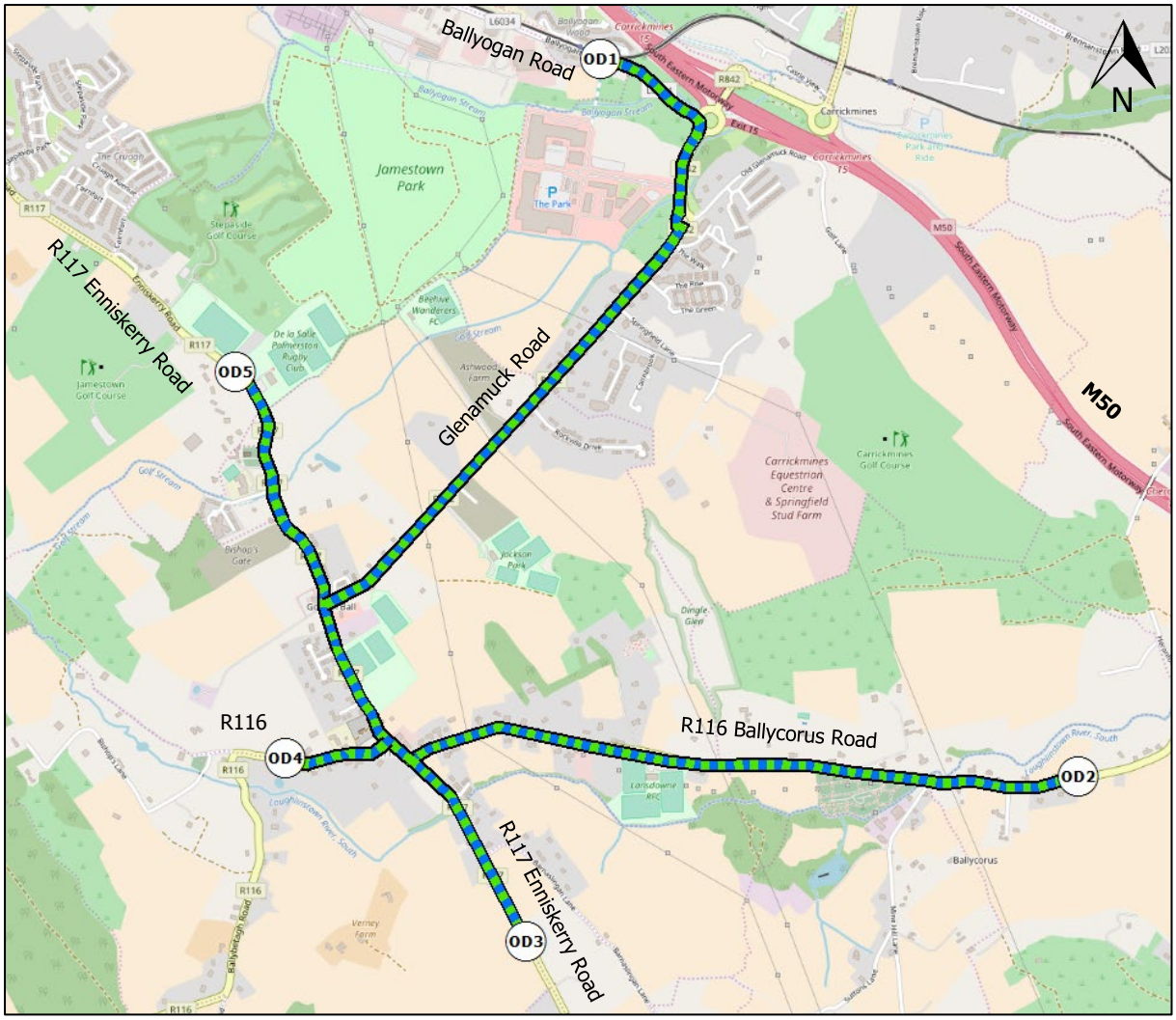

Figure 7.7: Overview of Bluetooth OD Locations & Journey Time Paths

Transport Infrastructure Ireland Traffic Counts

TII has a large number of permanent ATC traffic counts across the national and motorway road network. These Automated Traffic Counts (ATCs) captured the traffic flows passing given points on the road network and classified the flow into different vehicle classifications, such as Cars, Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV). AADT traffic flow data, were extracted from 4 traffic count sites near the proposed scheme, as illustrated in Figure 7.8.

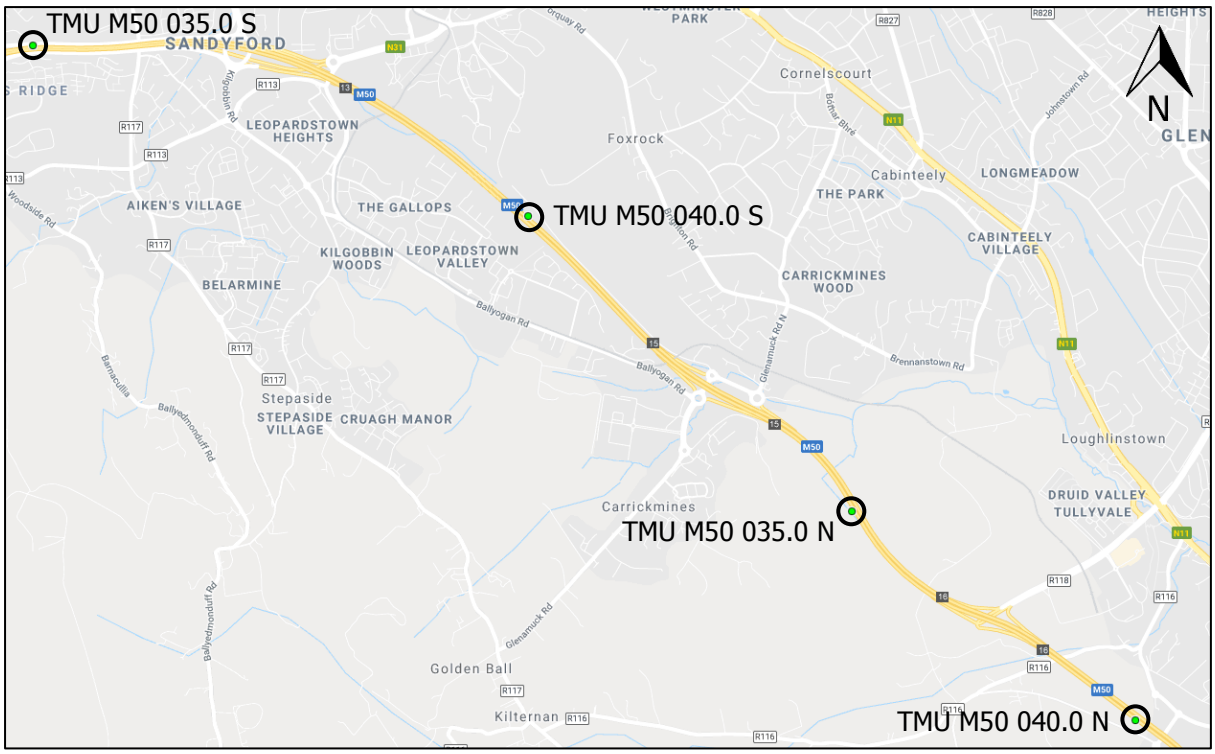

Figure 7.8: Location of TII Permanent ATC's Used in this Assessment

7.2.5 Scenarios Tested

Firstly, the assessment years that were tested as part of this assessment as per TII guidelines:

- Base Year – 2017;
- Opening Year – 2020; and
- Future Horizon Year (15+ years) – 2035

The following is a list of scenarios undertaken as part of this traffic assessment:

Base

- A1 – 2017 Base Traffic Flows (Existing Network)

Do Nothing

- B1 – 2020 Base Traffic Flows (No Glenamuck District Roads Scheme)
- B2 – 2035 Base Traffic Flows & Local Area Plan Lands Traffic Flows & Committed Developments Traffic Flows (No Glenamuck District Roads Scheme)

Do Something

- C1 – 2020 Base Traffic Flows (With Glenamuck District Roads Scheme + Bus Gates)

- C2 – 2035 Base & Local Area Plan Lands Traffic Flows & Committed Developments Traffic Flows (With Glenamuck District Roads Scheme+ Bus Gates)

- C3 – 2035 Base & Local Area Plan Lands Traffic Flows & Committed Developments Traffic Flows (With Glenamuck District Roads Scheme + Bus Gates) + Proposed Complementary Road Infrastructure

An additional scenario was assessed solely in the assessment for a sensitivity test to investigate the efficiency of the Bus Gate. Then the bus gates were removed and compared to modelling results with the Bus Gates still in place. For clarity, each of the 'Do Something' scenarios above (C1 – C3) include for the provision of 24/7 bus gates at the locations illustrated in Figure 7.9 below.

Figure 7.9 illustrates all relevant complementary infrastructure applicable to scenarios undertaken as part of this assessment which are not part of the proposed scheme but planned infrastructure outside the immediate remit of the proposed GDRS. As part of this assessment complementary road infrastructure measures were included into a separate 2035 Do Something scenario in both the Eastern Regional Model and Local Area Model. These additional complementary measures were:

- The Park Development infrastructure to connect the Glenamuck District Roads Scheme with the Ballyogan Road;

- The Golf Lane Link to connect Cherrywood over the M50 to the Glenamuck District Roads Scheme; and

- The roundabout junction at the Glenamuck Road / Golf Lane intersection upgraded to a signalised junction.

For all Do Something scenarios in this assessment a new bus gate was provided on the existing Enniskerry Road where it joins with the Glenamuck Link Distributor Road. This will only allow public transport vehicles, cyclists and pedestrians access to and from Kiltiernan Village from the Enniskerry Road at the bus gate. All other vehicles will not be allowed to make this movement. The junction at the existing Glenamuck Road and the Glenamuck Link Distributor Road will facilitate the movement of public transport from Glenamuck Road (West) and the Glenamuck Link Distributor Road to Glenamuck Road (East), via another bus gate. Public transport vehicles, cyclists and pedestrians will be able to access and egress from Glenamuck Road (East) onto the Glenamuck Link Distributor Road. All other vehicles will not be allowed to access or egress from Glenamuck Road (East) onto the Glenamuck Link Distributor Road. This was again included in all Do Something scenarios.

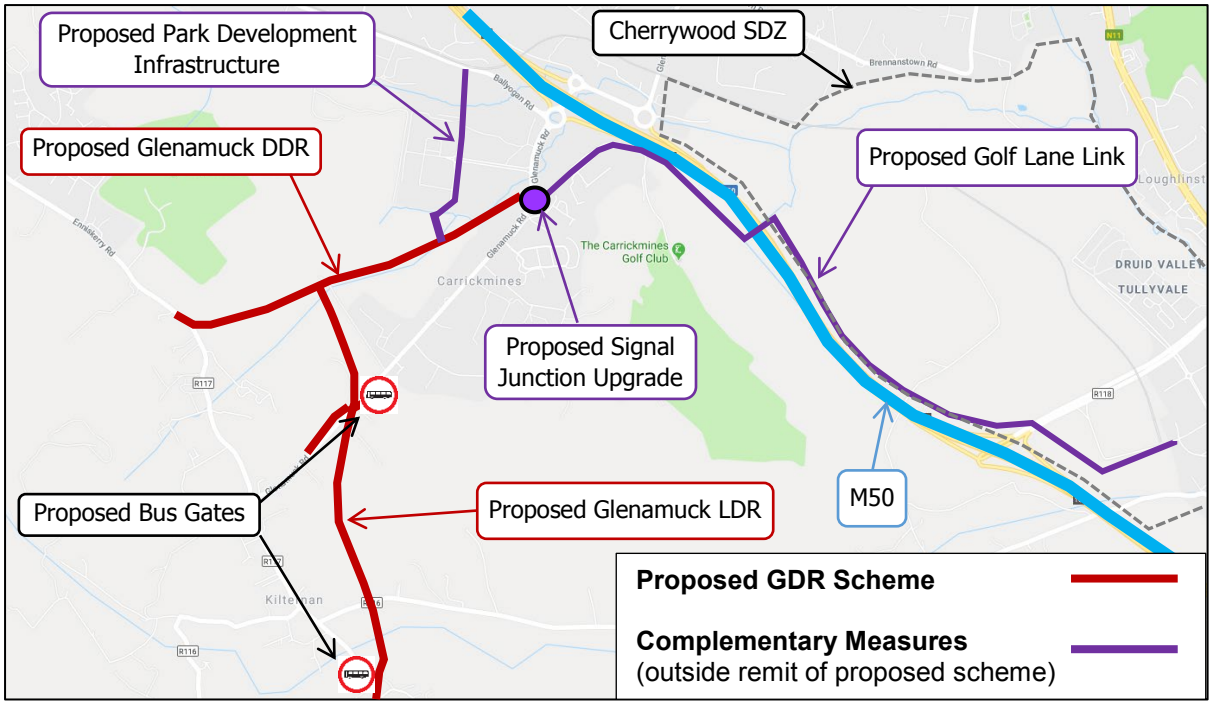

Figure 7.9: Proposed Bus Gates & Complementary Road Infrastructure

7.3 Baseline Environment

7.3.1 Model Development Overview

This section of the report describes the methodology and development of the 2017 Base Year Local Area Model (LAM). As a starting point for the LAM, the SATURN modelling of the local area highway model used in the RPS 2013 Glenamuck transport modelling work was used. The RPS Base, option 4 (network with GDRS) models and demand were used as the basis for the new models.

The same network cordon as the 2013 model was used in the current LAM as shown in Figure 7.10, so as to include the Kiltiernan-Glenamuck LAP area, Junction 13, 14, 15, 16 and 17 of the M50/M11 that traffic may use to access the LAP area, and the routes between the LAP area and these junctions. The model was extended slightly to the south-east, to include routes to and from the M11 via the Loughlinstown roundabout.

Following the extraction of key external flows and growth rates from the NTA's Eastern Regional Model (ERM) the development and refinement progressed towards this assessment's updated Local Area Models. This section summarises the development of the Base and Forecast Model in the AM (08:00-09:00) and PM (17:00-18:00) periods in all scenarios and the assessments to be carried out. Section 7.3.4 details the Calibration and Validation of the Base Models.

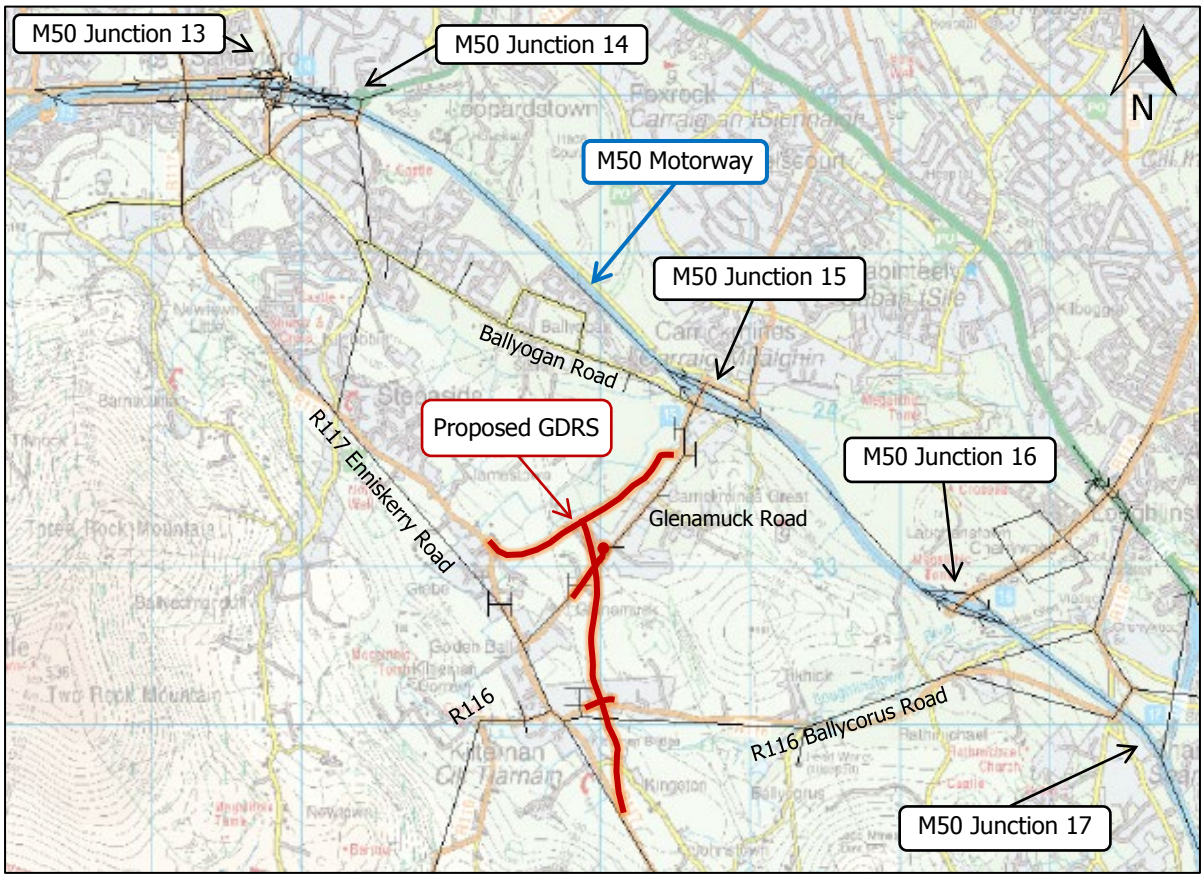

Figure 7.10: Network Extent – Base Year Model
(Scheme not included in Base or Do-Nothing Models)

7.3.2 Network Development

As mentioned previously, the former SATURN modelling of the local area highway model from the RPS 2013 Glenamuck transport model was used as a starting point for developing the updated 2017 LAM. Having adopted the previous extent of the study area, new additional links were required to be coded into the updated network.

The road network was refined to a level of detail that included updating all National Primary, Secondary and Regional roads and all significant local roads throughout the study area to match and reflect existing conditions. This information was collected through site visit observations, topographical surveys, 2017 google street view and aerial mapping where necessary. The information on each link included:

- Link Length;
- Link type, for example, National Regional Road, Local Urban, Local Rural etc.;
- Link capacity;
- Speed limit and free flow speed; and
- Reference to an appropriate speed flow curve.

7.3.3 Matrix Development

Following the refinement and update of the previous 2013 RPS transport model network and zoning system, the development of the Base demand matrices was undertaken. Based on the traffic surveys (Section 7.2.4), the following time periods were required for the LAM demand matrices:

- Morning peak from 08:00 – 09:00 (AM Peak Hour); and
- Evening Peak from 17:00 – 18:00 (PM Peak Hour)

The previous 2013 RPS transport model was used with donor flows and growth rates for external zones from the Dublin Transportation Office's (DTO now NTA) ERM. As a starting point an AM Prior matrix was developed by applying zoned-based growth rates to all internal zones in the LAM for the period from 2012 to 2017. Growth Rates were based on TII's PAG for 'National Roads Unit 5.3 – Travel Demand Projections'. Table 7.6 and Table 7.7 summarises the annualised growth rates for internal zones in the LAM. For external zones flows and growth rates from the cordon ERM were used to match 2017 conditions. The resultant 'Prior' matrices were then adjusted during the calibration process using matrix estimation methods to reflect 2017 demand.

As there was no PM Peak Hour from the older 2013 RPS transport model an alternative approach to generate the PM Peak Hour 'Prior' matrix was adopted. The calibrated AM Peak Hour matrix was transposed to give a 'Prior' PM matrix as a starting point for the calibration process. Each of these matrices were modified during the calibration process using the 2017 traffic survey data ascertained for each peak, using select link analysis and matrix estimation tools.

Table 7.6 Internal Zone-Based Growth Rates (Central Growth)
From PAG Unit 5.3 Growth Rates (2013-2030)

NTM Zone	Light Vehicles AM Period (2013-2030)		Light Vehicles PM Period (2013-2030)		Heavy Vehicles AM Period (2013-2030)		Heavy Vehicles PM Period (2013-2030)	
	Origin	Destin	Origin	Destin	Origin	Destin	Origin	Destin
859	1.0130	1.0127	1.0127	1.0130	1.0238	1.0238	1.0238	1.0238
8292	1.0141	1.0109	1.0109	1.0141	1.0238	1.0238	1.0238	1.0238
862	1.0136	1.0225	1.0225	1.0136	1.0238	1.0238	1.0238	1.0238
8632	1.0098	1.0064	1.0064	1.0098	1.0238	1.0238	1.0238	1.0238
8462	1.0105	1.0116	1.0116	1.0105	1.0238	1.0238	1.0238	1.0238

Table 7.7 Internal Zone-Based Growth Rates (Central Growth)
From PAG Unit 5.3 Growth Rates (2030-2050)

NTM Zone	Light Vehicles AM Period (2030-2050)		Light Vehicles PM Period (2030-2050)		Heavy Vehicles AM Period (2030-2050)		Heavy Vehicles PM Period (2030-2050)	
	Origin	Destin	Origin	Destin	Origin	Destin	Origin	Destin
859	1.0037	1.0028	1.0028	1.0037	1.0148	1.0148	1.0148	1.0148
8292	1.0042	1.0014	1.0014	1.0042	1.0148	1.0148	1.0148	1.0148
862	1.0037	1.0028	1.0028	1.0037	1.0148	1.0148	1.0148	1.0148
8632	1.0027	1.0022	1.0022	1.0027	1.0148	1.0148	1.0148	1.0148
8462	1.0039	1.0027	1.0027	1.0039	1.0148	1.0148	1.0148	1.0148

7.3.4 Model Calibration and Validation

The calibration and validation of the LAM base model followed guidance set out by the 'Project Appraisal Guidelines (PAG) for National Roads Unit 5.1 – The Construction of Transport Models'. The calibration process was carried out on both the network and the base matrix. The following calibration checks were undertaken on the LAM base model:

- Turning proportions at junctions; and
- Flows on individual links.

The following validation checks were undertaken on the LAM base model:

- Journey times along critical routes.

A total of 50 links flows were used in the calibration process. A comparison of modelled and observed flows demonstrated that the AM and PM Peak period models match the flow criteria. PAG specifies the acceptable values for modelled and observed flow comparisons and suggests how calibration should relate to the magnitude of the values being compared. The standard method used to compare modelled values against observations on a link involves the calculation of the Geoff E. Havers (GEH) statistic (Chi-squared statistic), incorporating both relative and absolute errors. The GEH statistic is a measure of comparability that takes account of not only the difference between the observed and modelled flows, but also the significance of this difference with respect to the size of the observed flow. The GEH statistic is calculated as follows:

$$GEH = \sqrt{\frac{(Modelled\ Flow - Observed\ Flow)^2}{0.5(Modelled\ Flow + Observed\ Flow)}}$$

The results therefore confirm that the models have been calibrated to a standard compliant with the PAG criteria in all-time periods.

As part of the validation process, the modelled journey times were compared against the 20 surveyed journey times to ensure the model gave a reasonable representation of existing conditions. All models satisfied the PAG requirement that 85% of all modelled journey times are within 15% of observed data or within 1 minute if higher than 15%. As such, the base year models were considered validated to the requirements of PAG Unit 5.2: Construction of Transport Models in terms of journey times.

In terms of Model convergence, the AM Peak and PM Peak models reached a satisfactory level of convergence as set out by PAG guidance. The criterion that was used to show that the Saturn software reaches a level of convergence was as follows:

- The difference between the costs along the chosen routes and those along the minimum cost routes, summed across the whole network, and expressed as a percentage of the minimum costs, usually known as 'Delta' or the '%GAP' (<0.1%); and
- The percentage (P) of links on which flows, or costs change by less than a fixed percentage (<5%) 2 for four consecutive iterations greater than 98%.

The full calibration and validation of the Local Area Model (LAM) are presented in greater detail in **Section 7** of the Modelling Report prepared by DBFL in **Appendix 7-1**.

7.4 Forecasting and Future Year Traffic Models (2020 & 2035)

7.4.1 Network Development

The future Do-Something network (Figure 7.11) includes the proposed Glenamuck District Roads Scheme (GDRS) in full alongside essential local links proposed in the Kiltiernan-Glenamuck LAP Lands.

An additional future network was developed to include complementary infrastructural measures which are not part of the proposed scheme but planned infrastructure outside the immediate remit of the proposed GDRS. As set out in Section 7.2.5, this future network (Figure 7.12) includes the proposed Glenamuck District Roads Scheme (GDRS) in full alongside proposed future local through link routes within the Kiltiernan-Glenamuck LAP Lands which are outside the proposed GDRS and road infrastructure in the Park Development to connect the GDDR to the Ballyogan Road, the proposed Golf Lane Link and the proposed junction upgrade at the Glenamuck Road / Golf Lane roundabout; again outside the remit of the proposed GDRS but are expected to be implemented between the opening year of 2020 and before 2035.

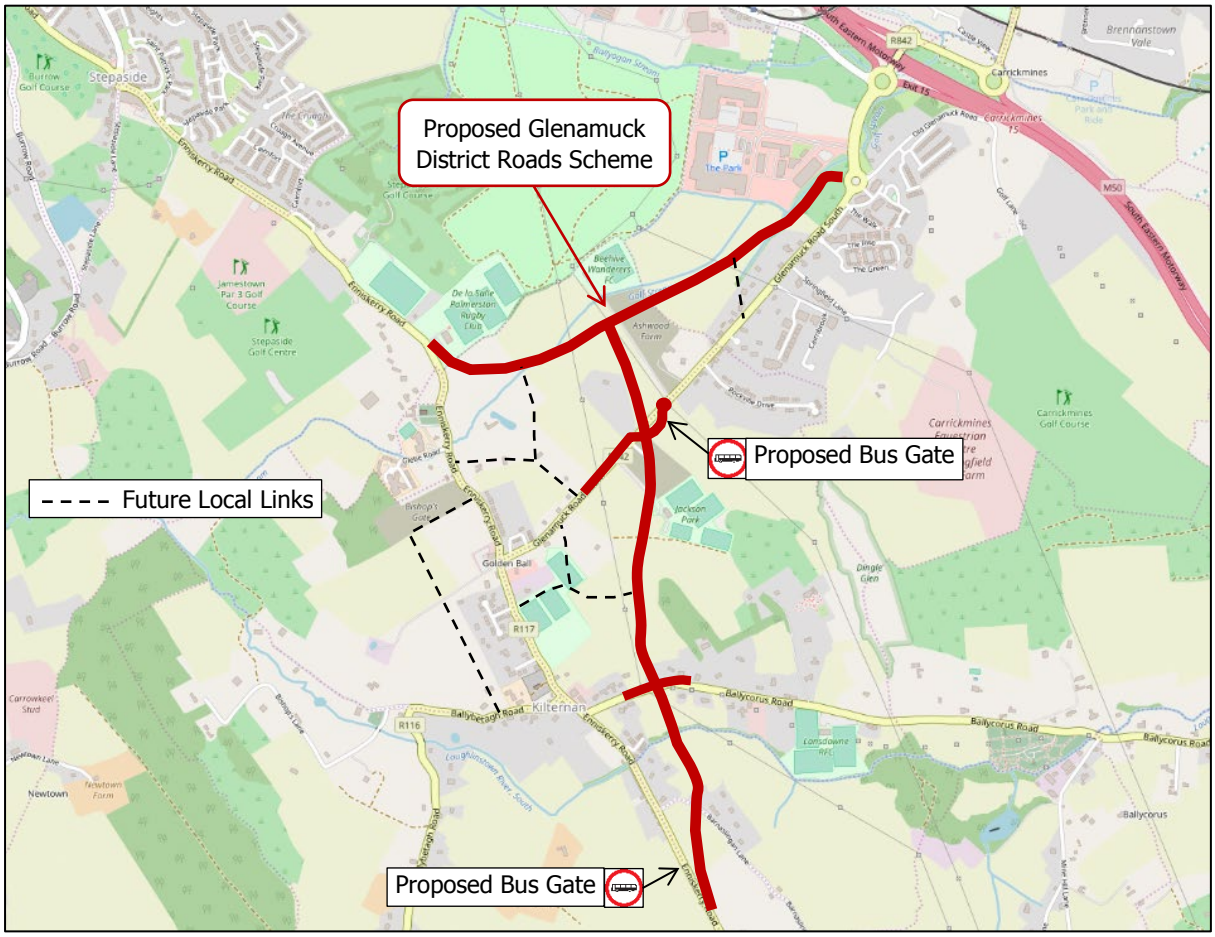

Figure 7.11: Do-Something Road Network

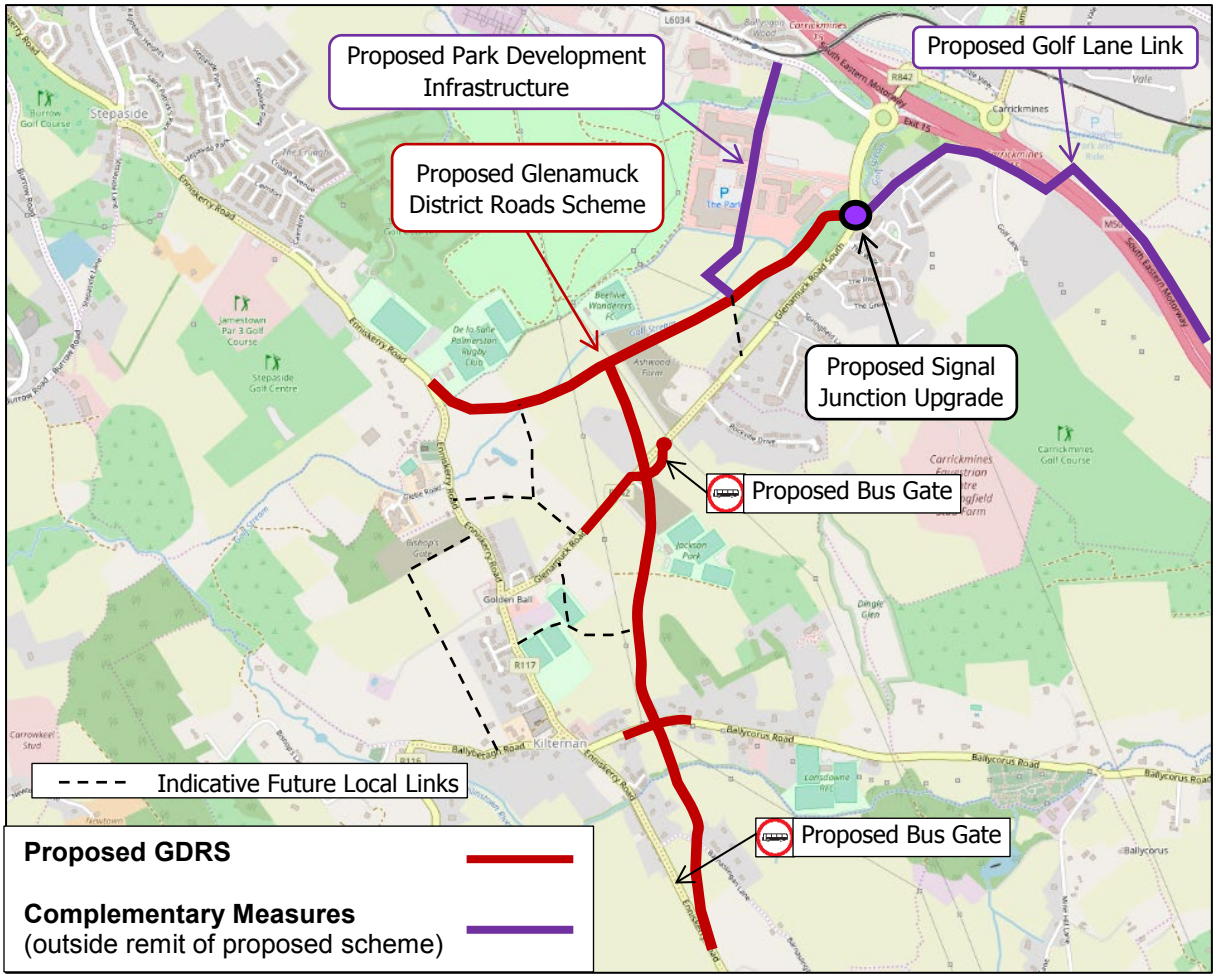

Figure 7.12: Do-Something with Complementary Measures Road Network

7.4.2 Assessment Scenarios

Firstly, the assessment years that were tested as part of this assessment as per TII guidelines:

- Base Year – 2017;
- Opening Year – 2020; and
- Future Horizon Year (15+ years) – 2035

The following is a list of scenarios undertaken as part of this traffic assessment:

Base

- A1 – 2017 Base Traffic Flows (Existing Network)

Do Nothing

- B1 – 2020 Base Traffic Flows (No Glenamuck District Roads Scheme)

- B2 – 2035 Base Traffic Flows & Local Area Plan Lands Traffic Flows & Committed Developments Traffic Flows (No Glenamuck District Roads Scheme)

Do Something

- C1 – 2020 Base Traffic Flows (With Glenamuck District Roads Scheme + Bus Gates)
- C2 – 2035 Base & Local Area Plan Lands Traffic Flows & Committed Developments Traffic Flows (With Glenamuck District Roads Scheme+ Bus Gates)
- C3 – 2035 Base & Local Area Plan Lands Traffic Flows & Committed Developments Traffic Flows (With Glenamuck District Roads Scheme + Bus Gates) + Proposed Complementary Road Infrastructure

An additional scenario was assessed solely in the assessment for a sensitivity test to investigate the efficiency of the Bus Gate. Then the bus gates were removed and compared to modelling results with the Bus Gates still in place.

7.4.3 Traffic Growth Forecasts

Forecasting future demand for the LAM was carried out in a similar approach as the RPS review approach in 2013. The methodology to forecast demand was done by Zone-Based Growth Rates and projections made in the 2013 Glenamuck LAP Transport Study. The methodology for this assessment in calculating growth is based on TII's PAG for 'National Roads Unit 5.3 – Travel Demand Projections'. The process for developing future traffic growth projections is presented in Figure 7.13.

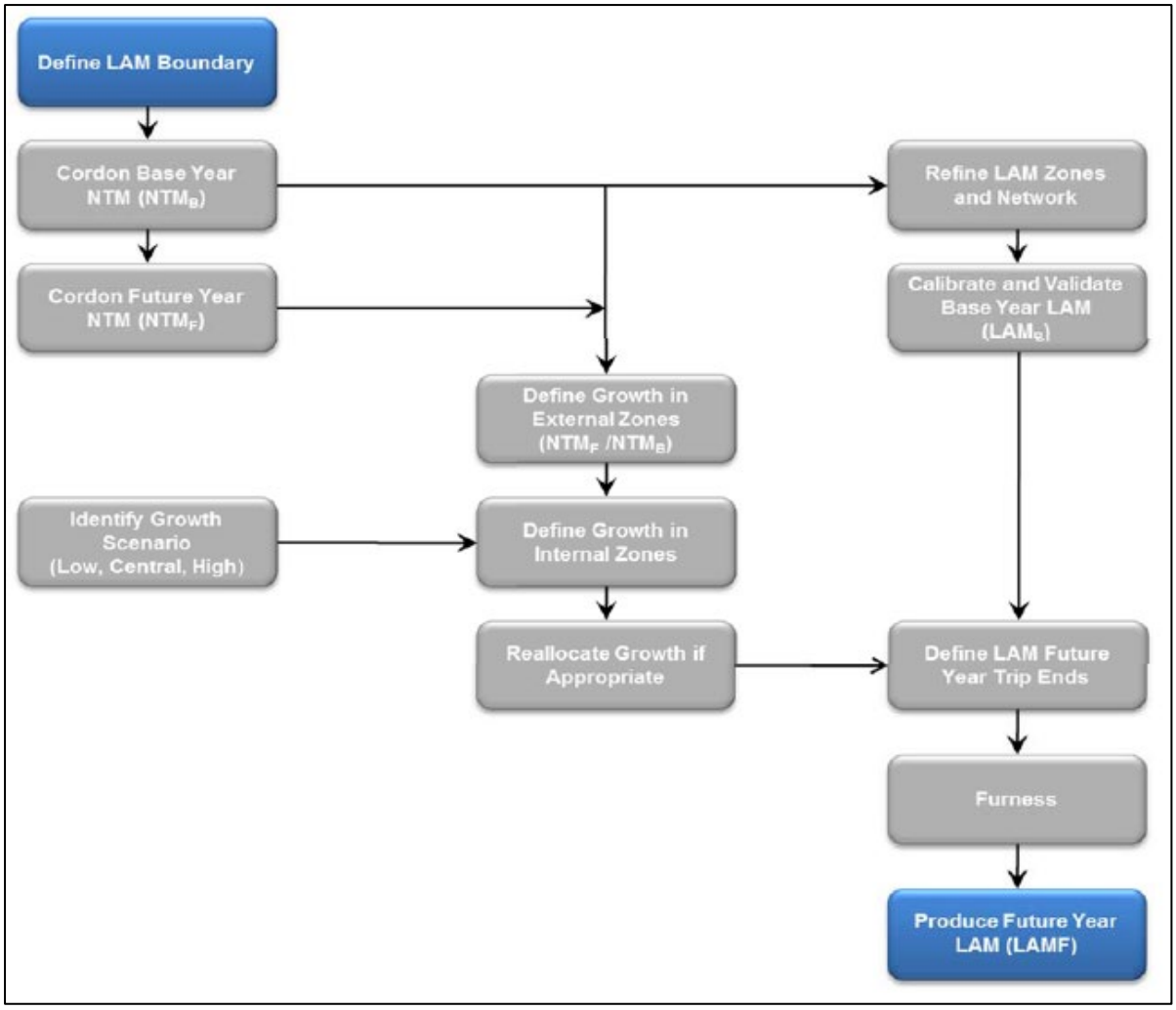

Figure 7.13: Traffic Growth Projection Methodology for Assignment Models

For large schemes such as the GDRS which are supported by assignment models, demand is input in the form of a matrix which allocates demand based on defined trips between geographical zones. In such cases, growth rates should be applied as increases in trip ends at a zonal level. The factoring of origins and destinations at a zonal level leads to the definition of target trip ends. This is then translated into a future year matrix through furnessing, which adjusts the demand matrix such that row and column totals match the target trip ends.

This technique was applied to the background traffic growth on the network. Forecasted traffic flows from the LAP lands were applied in the design year of 2035 and calculations of these traffic flows do not diverge from the trips generated in the previous 2013 RPS transport model, the reason being that the zoning system and the land use has not changed since 2013 LAP transport study.

The future years models developed in this assessment were an opening year 2020 and future horizon year (+15 years) 2035. These years were selected as they complied with guidance provided on forecast assessment years outlined in TII's Traffic and Transport Assessment (TTA) Guidelines 2014.

In this assessment it should be noted that Assignment Models will use zone-based growth rates to produce the initial demand projections for the Do-Something scenarios in the future year model. Assignment Model techniques can then be used to adjust the demand matrices to reflect the demand responses associated with the scheme proposal.

The application of growth to other travel modes requires projections for public transport growth in order to allow a future year Production Attraction (PA) matrix to be developed. This was applied in the previous 2013 LAP traffic growth projections which were again used in this assessment and development of the future demand matrices.

Background Forecasting of Internal Zones

The application of zone-based growth rates requires a different approach for internal and external zones within the Local Area Model (LAM). For internal zones, trip end growth rates for the AM and PM are read from a shapefile that is available from the Downloads page on the TII Publications website. These growth rates are applied to the row and column totals of the base year trip matrix to produce target trip ends for the future year matrix.

The shapefile provides demographic and economic information for each zone in the TII National Transport Model (NTM), in addition to annual growth rates for origin and destination trip ends. The shapefile uses a standard naming convention to identify all variables in the data.

For LAM's where internal zones are smaller than NTM zones, the growth rates for the NTM should initially be applied to all LAM zones within that NTM zone. It is for this reason that it is advisable to ensure that LAM zones are defined as subzones of NTM zones to avoid any overlapping of LAM zones between adjacent NTM zones.

The zoning system in the NTM is based on the aggregation of Electoral Divisions (ED's). ED's are amalgamations of Census Small Areas (CSA's) which the zoning system in the ERM are based. Section 5.4 of the Modelling Report in **Appendix 7-1** outlines further how LAM zones relate closely with the ERM zones and hence correlates with the zones in the NTM.

Background Forecasting of External Zones

To define growth for external zones in the LAM, a cordoning process was necessary within the modelling approach for this assessment. This process involved creating cordon models from strategic donor models as a starting point. Cordon models are generally created from a larger strategic model e.g. the ERM (Strategic, low detail) in this case. The resulting cordon flows at the boundary extents established appropriate extracted Base Year flows and future year growths for external zones for the LAM (in both future years of 2020 and 2035).

Prior to creating the ERM models, the extent of the study area for the (LAM) was established. This study area was based on the previous study area boundary in the RPS 2013 Glenamuck / Kiltiernan LAP transport model. Care was given to ensure the extents of the cordon models were not too tightly drawn and the resultant models were sufficiently large to assess all potential Do Something variants.

Figure 7.14 illustrates the cordon established and the 20 locations along the boundary extent where flows were recorded for the LAM base external zone flows. Table 7.8 lists each of the external zones

in the LAM where the extracted flows will be applied and each of their geographical locations they represent along the boundary extent.

Figure 7.14: Cordon Boundary and Link Extent Extraction Locations

Table 7.8 List of External Zones and Representative Route & Location

External Zone No.	Route (Location)
10202	Wattville Road (By Ballybrack)
11003	Barnslingan Lane (By Kiltiernan)
81233	R117 (Enniskerry Road, by Kiltiernan)
99009	R118 (By Ballybrack)
99010	R119 (Dublin Road, by Shankill)
99011	M11/M50 (By Shankill)
99012	R117 (Enniskerry Road, by Kiltiernan)
99013	R116 (Ballybetagh Road, by Kiltiernan)
99014	R113 (By Ballinteer over the M50)
99015	R826 (By Ballinteer)
99016	M50 (By Ballinteer)
99017	R133 (By Ballinteer)
99101	N11 (By Cherrywood)
99102	Glenamuck Road (North of the M50 Jn 5 Interchange)
99103	N31 (By Sandyford)
99104	Drumartin Link Road (By Sandyford)
99105	R117 (By Wedgewood)
99108	Puck's Castle Lane (By Brides Glen)
99109	Ferndale Road (By Rathmicael)
99110	Carrickmines Woods (Joining the M50 Jn 5 Interchange)

Forecasting Future LAP Development Lands

Forecasting traffic flows from the LAP lands were applied only in the future horizon year of 2035 and calculations of these traffic flows remained mostly unaltered from the trips generated in the previous 2013 RPS transport model, the reason being that the zoning system and the land use has not changed since 2013 LAP transport study.

In the previous work in developing the future demand for the LAP Lands, the LAP area was divided into model zones and each of these zones related to the land parcels defined in the Local Area Plan. The previous 2013 RPS modelling work assumed an all-modes rates of trip generation based on older NTA modelling work (Table 7.9). These trip generation rates were applied for the AM peak period. Developing the PM forecast in the LAP lands the assumption was made that for residential and employment trip rates would exchange between generation and attraction figures from those in the AM period. However, as the PM peak period is between 17:00-18:00, education trips were assumed to be zero to reflect the presence of the two primary schools being closed at this time.

Table 7.10 outlines the all-modes trip generation rates assumed for the PM peak period in this assessment.

Table 7.9 All-mode Trip Generation Rates (AM Peak)

Land Use Data	AM Generation (trips per hour)	AM Attraction (trips per hour)
Residential (rate per unit)	0.733	0
Employment (rate per person)	0	0.772
Education (rate per student)	0	1

Table 7.10 All-mode Trip Generation Rates (PM Peak)

Land Use Data	PM Generation (trips per hour)	PM Attraction (trips per hour)
Residential (rate per unit)	0	0.733
Employment (rate per person)	0.772	0
Education (rate per student)	0	0

A modal split was applied to the generation rates to give the resultant highway trip rates on the network. The approach taken to calculate the modal split in described in Section 5.6 of the Modelling Report in **Appendix 7-1** of this report. Table 7.11 summarises the total number of highway trips to and from the LAP highways following the trip generation process as outlined above.

Table 7.11 Highway Trips Generated by the LAP Lands

Trip Type and Period	Volume of Road Trips (Trips/hr)
AM Road Generated Trips	1,878
AM Road Attracted Trips	2,222
PM Road Generated Trips	2,242
PM Road Attracted Trips	1,795

7.5 Predicted Impacts – Construction Phase

7.5.1 Overview

This section outlines the approach and the likely impact on traffic and transportation to the surrounding network during the construction phase of the subject scheme. All elements of work will be supported by appropriate traffic management measures developed in accordance with the requirements of Chapter 8 of the Traffic Signs Manual and the specific requirements of Dun Laoghaire-Rathdown County Council. Chapter 5 of this EIAR outlines the Construction Strategy in greater detail and measures set to ensure that construction traffic impacts are minimised through the control of site access / egress routes and site access locations and any necessary temporary lane closure requirements.

It would be anticipated that vehicles working on the GDDR & northern portions of the GLDR will exit and enter the site at the existing Glenamuck Road / Golf Lane roundabout junction and travel north to/from Junction 15 of the M50 and to/from their respective destination. For vehicles bound for southern portions of the GLDR it is anticipated that the construction vehicles would utilise the Glenamuck Road to access the site near the proposed second site compound. It is noted that exact compound locations, import/export destinations and detailed traffic management and construction routing will be developed by the appointed contractor for the scheme and will be detailed in a Construction Management Plan and Environmental Operating Plan.

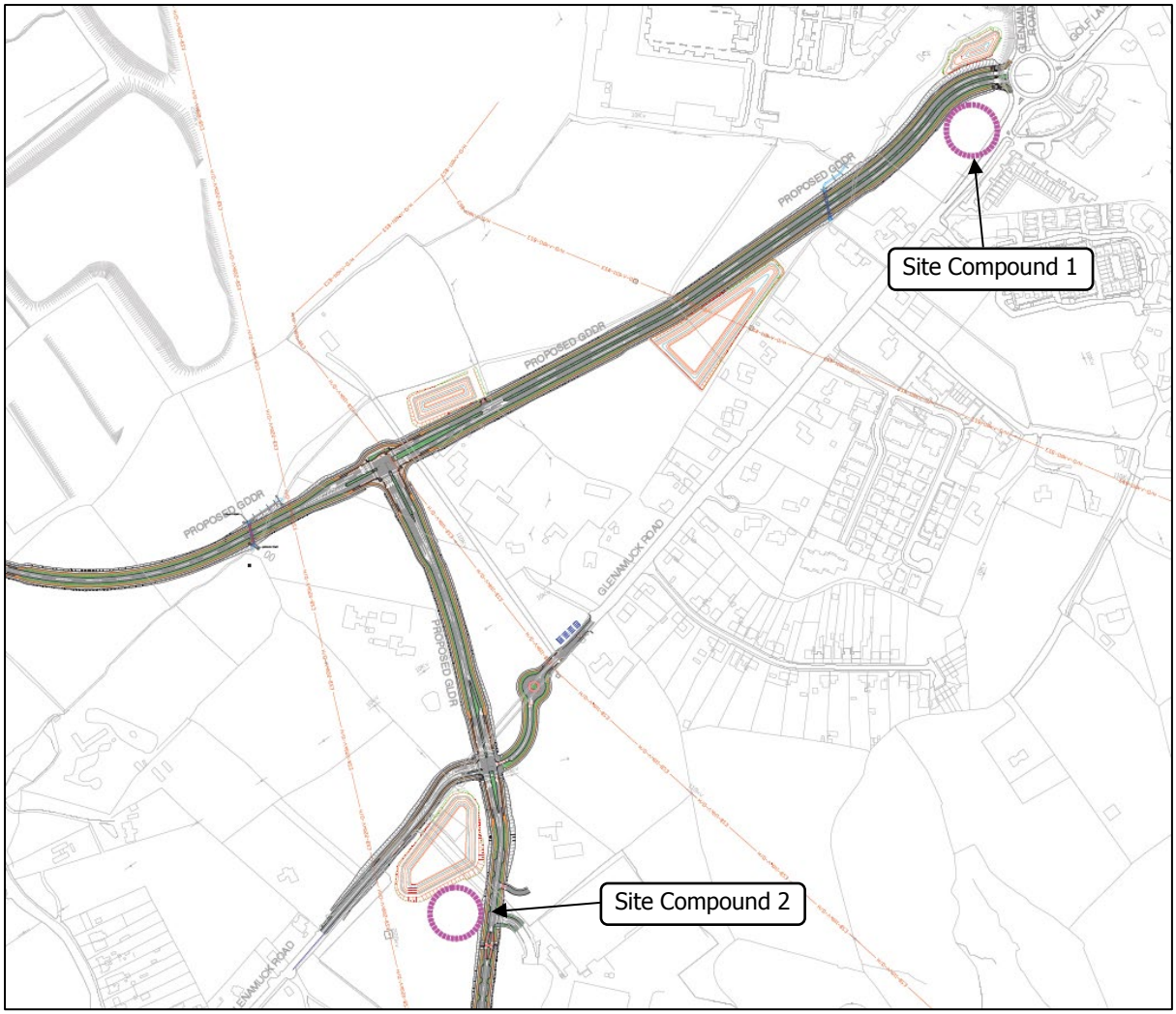

Figure 7.15: Preliminary Site Compound Locations

7.5.2 Existing Conditions

As mentioned in Section 7.2.4, a package of traffic surveys was undertaken in November 2017 to examine the existing traffic conditions on the network. These included 7 ATCs, 9 JTCs and TII permanent ATC counters which provided a baseline AADT flows along the key road corridors as shown in Figure 7.16. All AADT locations were derived from the ATC surveys except six locations 2, 4, 6, 7, 12 and 13. Locations 2, 4, 6 and 7 were deduced from JTC surveys and locations 12 and 13 were from the TII permanent ATC counters. Note that all AADT values are rounded to the nearest 50 vehicles.

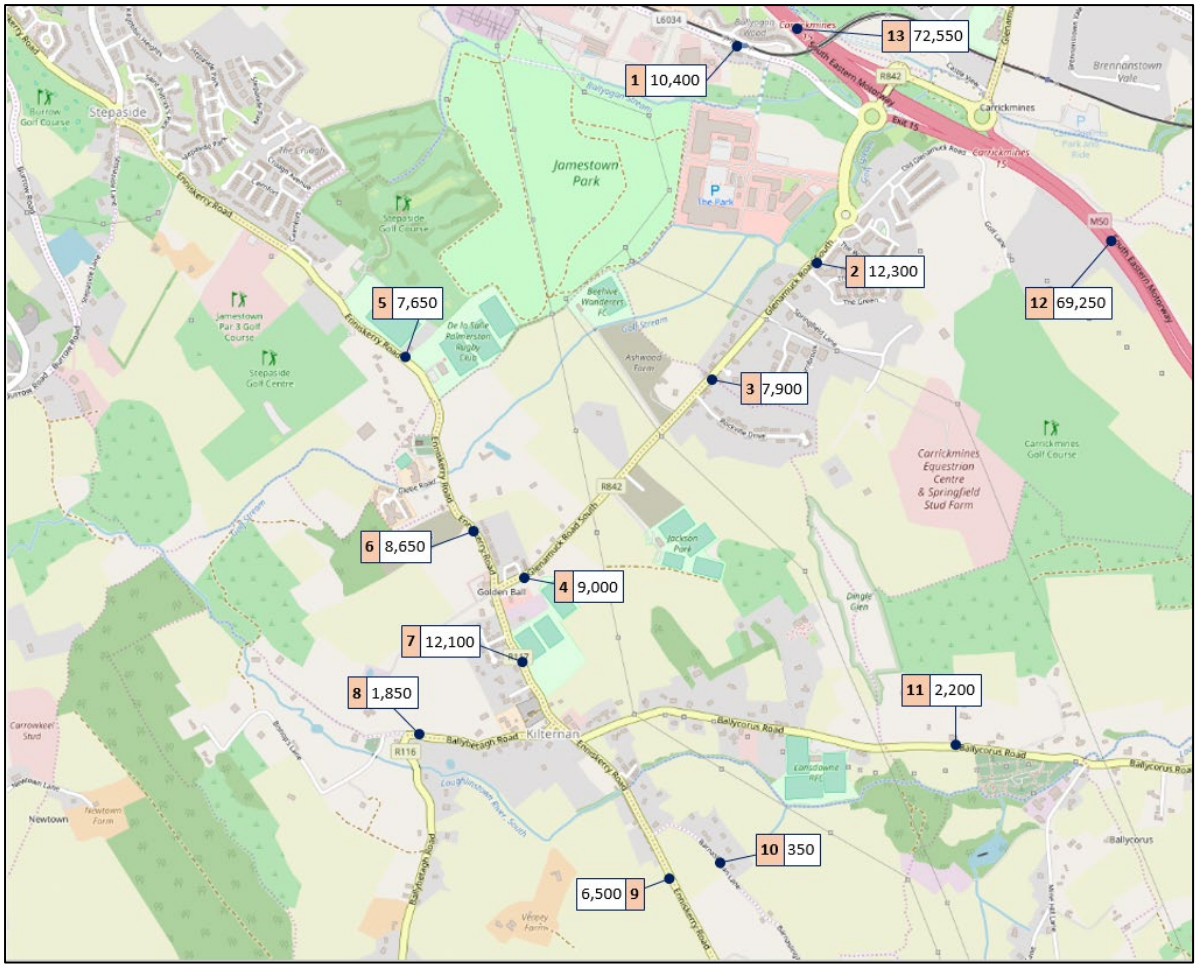

Figure 7.16: 2017 Base AADT Flows

7.5.3 Trip Generation

In relation to trip generation during the construction phase of the scheme the following professional conservative assumptions were made for two-way trip rates (Table 7.12):

Table 7.12 Trip Rates Assumed for the Construction Phase

Trip Generator Type	Trip Rate per Day
Staff (Light Vehicles)	25 – 42 trips
Importation of Materials (Heavy Vehicles)	60 trips (30 arrivals/30 departures)
Exportation of Materials (Heavy Vehicles)	80 trips (40 arrivals/40 departures)

The aforementioned trip rates were based upon professional conservative assumptions utilising experience from similar projects. The rates specified in Table 7.12 would assume the conservative scenario of a peak daily rate for vehicle movements during the construction phase. As parking will be provided on-site construction traffic will consist of the following two principal categories:

- Private vehicles owned and driven by site construction staff and by full time supervisory staff;

- Excavation plant and dumper trucks involved in site development works and material delivery vehicles for the importation and exportation of fill and road materials.

On-site employees will generally arrive before 08:00, thus avoiding the morning peak hour traffic. These employees will generally depart after 16:00. It should be noted that a large proportion of construction workers would arrive in shared transport. Based upon the experience of similar developments, a development of this type and scale would necessitate approximately 30-50 staff on site at any one time, subsequently 25-42 two-way vehicle trips over the day over the period of the construction works.

Deliveries would arrive at a steady rate during the course of the day. An estimated 41,100 m^3 of material will be brought onto the site over the entire duration of the construction stage of the scheme.

The estimated 41,100m^3 of imported material equates to between 4,725 and 5,270 truckloads dependent upon vehicles characteristics. At 3 loads per hour and 10 hours per day this equates to 175 days of importation of fill material as part of the adopted worst-case assessment. Considering the programme for this importation is 18 months, the effect on the local road network is considered negligible.

Similarly, an estimated 69,600 m^3 of material will exported off the site over the entire duration of the construction of the proposed scheme.

The estimated 69,600m^3 of exported material equates to between 8,000 and 8,925 truckloads dependent upon vehicles characteristics. At 4 loads per hour and 10 hours per day this equates to 223 days of importation of fill material as part of the adopted worst-case assessment. Again, considering the programme for this importation is 18 months, the effect on the local road network is considered negligible.

7.5.4 Trip Distribution & Assignment

In relation to the proposed haul routes for materials, it would be anticipated that vehicles working on the GDDR & northern portions of the GLDR will exit and enter the site at the existing Glenamuck Road / Golf Lane roundabout junction and travel north to/from Junction 15 of the M50 and to/from their respective licensed facility. This proposed haul route will bypass local roads around Kiltiernan and surrounding environs. For vehicles bound for southern portions of the GLDR it is anticipated that the construction vehicles would utilise the Glenamuck Road to access the site near the proposed second site compound. It is noted that exact compound locations, import/export locations and detailed traffic management and construction routing will be developed by the appointed contractor for the scheme and will be detailed in a construction management plan and Environmental Operating Plan. All exports/imports of material will be to be a suitably licenced facility.

In terms of trip distribution and assignments, all trips would be assumed to travel to/from the M50 to the site compounds. Assumptions made relating to trip assignment is detailed in Table 7.13 & Table 7.14

7.5.5 Assessment Scope

Two different traffic scenarios have been assessed, namely (a) the 'Base' (Do-Nothing) traffic characteristics and (b) the 'Construction' (Do-Something) traffic characteristics.

The 'Base' traffic scenario takes into account the potential level of traffic that could be generated from the existing flows travelling across the network. The proposed construction traffic is then added to the network's 'Base' traffic flows to establish the 'Construction' traffic flows. In summary, the following scenarios were: -

Do Nothing

- A1 – 2017 Base Traffic Flows

Do Something

- B1 - 2017 Do Nothing (A1) + GDRS Construction Traffic (Northern Portion); and
- B2 - 2017 Do Nothing (A1) + GDRS Construction Traffic (Southern Portion).

7.5.6 Construction Impact

The resulting percentage increase in AADT flows as a result of the construction traffic generated by the scheme were established based on the aforementioned methodology in this Section. At each of the locations specified in **Figure 7.16** the following daily percentage impacts are summarised below in Table 7.13 and Table 7.14:

Table 7.13 2017 Base AADT vs 2017 Base AADT + Construction AADT (Northern Portion)

No.	Location	2017 Base AADT	2017 Base AADT + Construction Traffic (Phase 1)	% Impact
1	Ballyogan Road	10,400	10,440 (+40)	0.39 %
2	Glenamuck Road	12,300	12,322 (-)	0.00 %
3	Glenamuck Road	7,900	7,900 (-)	0.00 %
4	Glenamuck Road	9,000	9,000 (-)	0.00 %
5	R117 Enniskerry Road	7,650	7,650 (-)	0.00 %
6	R117 Enniskerry Road	8,650	8,650 (-)	0.00 %
7	R117 Enniskerry Road	12,100	12,100 (-)	0.00 %
8	R116 Ballybetagh Road	1,850	1,850 (-)	0.00 %
9	R117 Enniskerry Road	6,500	6,500 (-)	0.00 %
10	Barnaslingan Lane	350	350 (-)	0.00 %
11	R116 Ballycorus Road	2,200	2,200 (-)	0.00 %
12	M50 North of Jn 15	72,550	72,628 (+78)	0.11 %
13	M50 South of Jn 15	69,250	69,314 (+64)	0.09 %

Table 7.14 2017 Base AADT vs 2017 Base AADT + Construction AADT (Southern Portion)

No.	Location	2017 Base AADT	2017 Base AADT + Construction Traffic (Phase 2)	% Impact
1	Ballyogan Road	10,400	10,440 (+40)	0.39 %
2	Glenamuck Road	12,300	12,482 (+182)	1.15 %
3	Glenamuck Road	7,900	8,082 (+182)	2.30 %
4	Glenamuck Road	9,000	9,000 (-)	0.00 %
5	R117 Enniskerry Road	7,650	7,650 (-)	0.00 %
6	R117 Enniskerry Road	8,650	8,650 (-)	0.00 %
7	R117 Enniskerry Road	12,100	12,100 (-)	0.00 %
8	R116 Ballybetagh Road	1,850	1,850 (-)	0.00 %
9	R117 Enniskerry Road	6,500	6,500 (-)	0.00 %
10	Barnaslingan Lane	350	350 (-)	0.00 %
11	R116 Ballycorus Road	2,200	2,200 (-)	0.00 %
12	M50 North of Jn 15	72,550	72,628 (+78)	0.11 %
13	M50 South of Jn 15	69,250	69,314 (+64)	0.09 %

7.6 Predicted Impacts – Operational Phase

7.6.1 Scheme Impact – Road Network Assessment

Opening Year AADT (2020)

Forecasted traffic volumes are shown in Table 7.15 for the Do-Nothing and Do-Something Opening Year (2020) scenarios. The traffic flows in each of these scenarios are also illustrated graphically in Figure 7.18 and Figure 7.19 respectively. For comparison purposes the modelled AADT's for 2017 are also shown graphically in Figure 7.17. It should be noted that locations B (for Base and 2020 Do-Nothing) and N are directly supplied from external trip forecasted and provided by the ERM to the LAM. These strategic flows were based on the National Demand Forecasting Model and disaggregated and processed in the ERM as mentioned in Section 7.2.2. These forecasted strategic flows provide planning and industry best statistical probability and numbers in traffic levels and travel distribution prediction and provides a greater level of conservationism in terms of predicting traffic flow and therefore the impact of the proposed scheme.

Table 7.15 AADT Summary for 2020 Opening Year (Vehs) *

ID	Location	2017 Base AADT	2020 Do-Nothing AADT	2020 Do-Something AADT	% Diff 2020 DN vs 2020 DS
A	R117 Enniskerry Road (North of Golden Ball junction)	8650	9050	4700	- 48.1 %
B	R117 Enniskerry Road (South of Kiltiernan Village)	6500	10500	1400	- 86.7 %
C	Barnaslingan Lane	350	500	500	0.0 %
D	Ballycorus Road	2200	4050	4950	+ 22.2 %
E	Glenamuck Road (East of GLDR	12300	13350	2700	- 79.8 %
F	Glenamuck Road (West of GLDR)	9000	10450	1900	- 81.8 %
G	Glenamuck District Distributor Road (West of GDDR/GDLR junction)	-	-	7250	-
H	Glenamuck District Distributor Road (East of GDDR/GDLR junction)	-	-	14000	-
I	Glenamuck District Link Road (South of GDDR/GDLR junction)	-	-	12550	-
J	Glenamuck District Link Road	-	-	10850	-
K	R117 Enniskerry Road / Glenamuck District Link Road	-	-	11900	-
L	Glenamuck District Distributor Road (Adjacent to Park Development)	-	-	13200	-
M	R117 Enniskerry Road (North of GDDR junction)	7650	9000	11950	+ 32.8 %
N	R116 Ballybetagh Road	1850	3550	3550	0.0 %
O	R117 Enniskerry Road (North of Kiltiernan Village)	12100	13000	4950	- 61.9 %
P	Glenamuck District Link Road (South of Ballycorus Road)	-	-	11900	-
Q	M50 South of Junction 15	69250	84350	86050	+ 2.0 %
R	M50 North of Junction 15	72550	88200	87450	- 0.85 %

* All AADT values are rounded up to the nearest 50.

In the 2020 Do-Something scenario the Glenamuck District Roads Scheme is forecast to carry between 7,250 and 14,000 AADT. The flows presented in Table 7.15 highlights a number of impacts as a direct result of the proposed scheme. These include: -

- The proposed scheme diverts road traffic onto its network and away from less suitable and unsafe roads on the network. The proposed scheme acts as an arterial traffic corridor for the local network attracting trips from existing and committed developments;

- There is a reduction in traffic and congestion in Kiltiernan Village (reductions of 86.7% and 61.9% at location B and O respectively which represent a numerical decrease in AADT of 10,500 to 1,400 at location B and 13,000 to 4,950 at location O) and R117 Enniskerry Road (reduces by 48.1% at location A which represent a numerical decrease in AADT of 9,050 to 4,700) where the scheme directs and bypasses traffic from this area;

- Traffic on the existing eastern section of the Glenamuck Road is reduced and congestion is decreased due in part to the proposed scheme and the Bus Gate (this represents a reduction 79.8% or in numeric terms, AADT decreases from 13,350 to 2,700). Similarly, on the southern section of the Glenamuck Road near the Golden Ball junction there is a reduction in traffic and congestion from traffic being redirected to the proposed scheme (which represents a reduction of 81.8% or in numeric terms, AADT decreases from 10,450 to 1,900);

- Traffic on the R116 Ballycorus Road increases before the introduction of the proposed scheme from additional traffic from new development zones such as Cherrywood, Rathmichael and Old Conna from 2017 to the 2020 Do-Nothing scenario (an increase of 84.1% or in numeric terms an increase in AADT of 2,200 to 4,050). With the implementation of the proposed scheme this increases by a further +22.2%. However, the Ballycorus Road has been earmarked in the County Development Plan as a long-term road proposal to be improved to cater for strategic demand;

- With large reductions in traffic volumes in Kiltiernan Village, on Glenamuck Road, the bypassed section of the R117 Enniskerry Road would lead to a safer environment for pedestrians and cyclists along these corridors. Severance is also expected to improve with the decrease in road traffic making a holistic environment for active modes of travel;

- Regarding traffic on the M50, AADT south of Junction 15 of the motorway increases by only 2% in the Do-Something scenario compared to the Do-Nothing scenario. However, north of Junction 15 traffic decreases by 0.85% between the two scenarios; and

- The scheme attracts additional trips from south of the scheme and from Stepaside from time savings for motorists using the scheme.

In summary the Glenamuck District Roads Scheme reduces the level of traffic on the existing road network within the Local Area Plan environ for Kiltiernan-Glenamuck by diverting road traffic onto the proposed scheme's network and enabling traffic to bypass less suitable and unsafe roads on the LAP environ road network. The Kiltiernan Village Centre, Glenamuck Road and the bypassed section of the R117 Enniskerry Road benefit the most from the scheme. The proposed scheme acts as collector road for the local network attracting trips from existing and committed developments. The scheme attracts

additional traffic from further origin points due to the time-saving benefit of the scheme. Finally, it has a marginal to slight impact on the M50 and the nearby Junction 15 in terms of traffic.

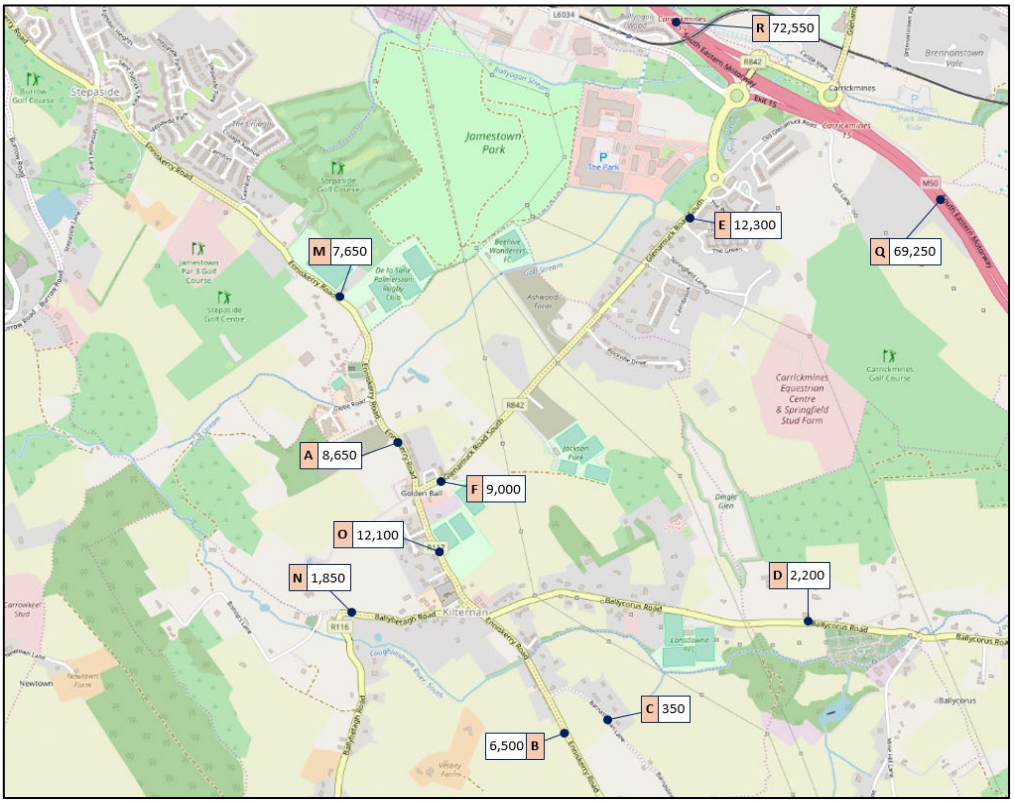

Figure 7.17: 2017 Base AADT

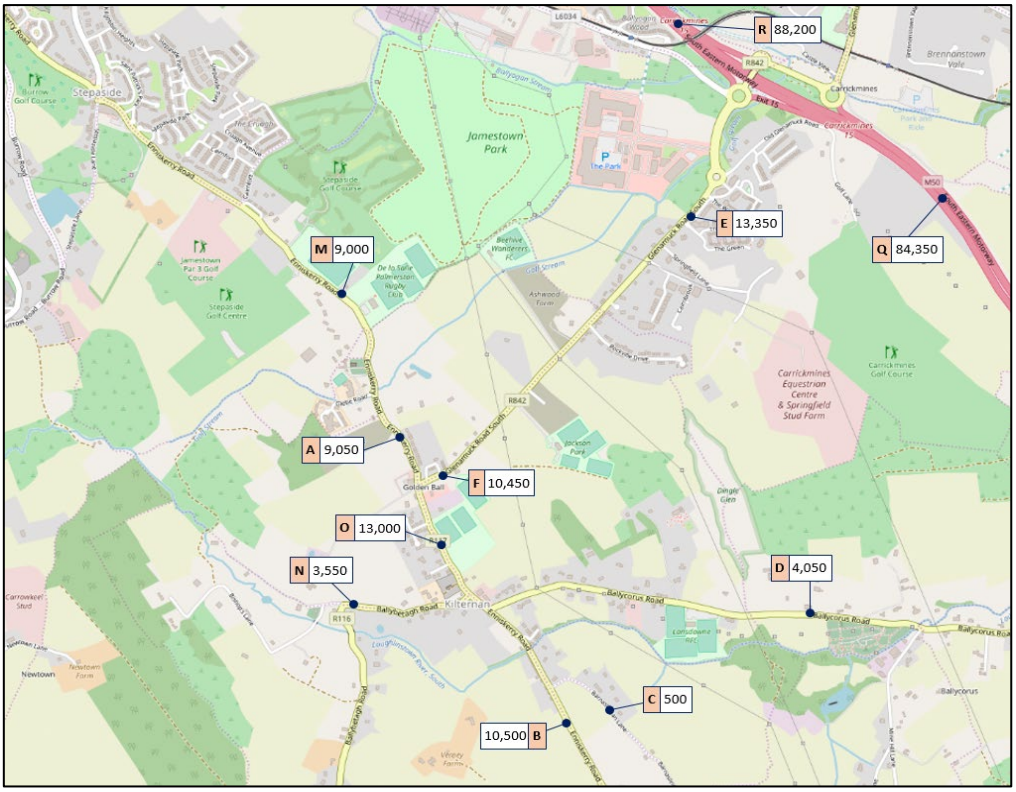

Figure 7.18: 2020 Do-Nothing AADT

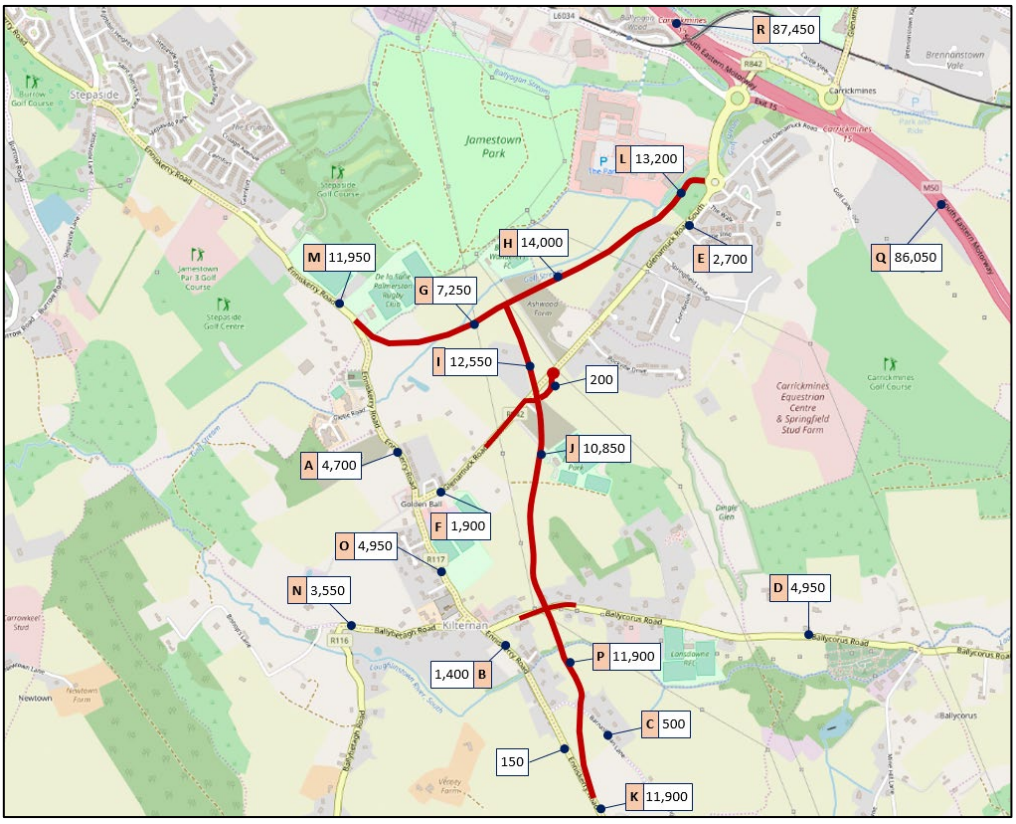

Figure 7.19: 2020 Do-Something AADT

Design Horizon Year AADT (2035)

Forecasted traffic volumes are shown in Table 7.16 for the Do-Nothing and Do-Something Horizon Year (2035) scenarios. The traffic flows in each of these scenarios are also illustrated graphically in Figure 7.20 and Figure 7.21 respectively. Additionally, the modelled forecasted AADT's for 2035 Do-Something with Complementary Measures are also shown graphically in Figure 7.22 and included in Table 7.16.

Table 7.16 AADT Summary for 2035 Design Horizon Year (Vehs) *

ID	Location	2035 Do-Nothing AADT	2035 Do-Something AADT	% Diff 2035 DN vs. 2035 DS	2035 Do-Something + CM AADT	% Diff 2035 DN vs 2035 DS + CM
A	R117 Enniskerry Road (North of Golden Ball junction)	14600	5800	- 60.3 %	5950	- 59.2 %
B	R117 Enniskerry Road (South of Kiltiernan Village)	16900	2050	- 87.9 %	2050	- 87.9 %
C	Barnaslingan Lane	800	800	0.0 %	800	0.0 %
D	Ballycorus Road	7100	11600	+ 63.4 %	11050	+ 55.6 %
E	Glenamuck Road (East of GLDR)	17800	5000	- 71.9 %	5050	- 71.6 %
F	Glenamuck Road (West of GLDR)	13900	5750	- 58.6 %	5650	- 59.4 %
G	Glenamuck District Distributor Road (West of GDDR/GDLR junction)	-	14250	-	14650	-
H	Glenamuck District Distributor Road (East of GDDR/GDLR junction)	-	26450	-	31750	-
I	Glenamuck District Link Road (South of GDDR/GDLR junction)	-	21600	-	20000	-
J	Glenamuck District Link Road	-	20450	-	20450	-
K	R117 Enniskerry Road / Glenamuck District Link Road	-	18450	-	19050	-
L	Glenamuck District Distributor Road (Adjacent to Park Development)	-	26600	-	18400	-
M	R117 Enniskerry Road (North of GDDR junction)	14500	16250	+ 12.1 %	13750	- 5.2 %
N	R116 Ballybetagh Road	6200	6250	+ 0.8 %	6100	- 1.6 %
O	R117 Enniskerry Road (North of Kiltiernan Village)	20800	6200	- 70.2 %	6150	- 70.4 %
P	Glenamuck District Link Road (South of Ballycorus Road)	-	16800	-	17600	-
Q	M50 South of Junction 15	49650	49600	- 0.1 %	46300	- 6.7 %
R	M50 North of Junction 15	39350	39700	+ 0.9 %	39000	- 0.9 %

* All AADT values are rounded up to the nearest 50.

In the 2035 Do-Nothing scenario, the R117 Enniskerry Road is forecast to have an AADT of up to 20,800 vehicles per day. The highest AADT occurs in Kiltiernan's Village Centre. The Glenamuck Road is forecast to have an AADT flow from 13,900 to 17,800 vehicles per day. Similarly, the R116 is expected to have an AADT flow from 6,200 to 7,100 vehicles per day.

In the 2035 Do-Something scenario however, the Glenamuck District Roads Scheme is forecasted to carry between 14,250 and 26,600 AADT (the highest being on the eastern section of the GDDR). Traffic within the LAP lands of Kiltiernan-Glenamuck are forecasted to maintain low levels of AADT compared to the flows on the proposed scheme with increases included from a fully developed LAP lands expected. But, these AADT flows are the same or lower than the 2017 base AADT flows.

The flows presented in Table 7.16 highlights a number of impacts as a direct result of the proposed scheme in the future design year of 2035. These include: -

- The proposed scheme diverts road traffic onto its network and away from less suitable and unsafe roads on the network. The proposed scheme acts as an arterial traffic corridor for the local network attracting trips from existing, committed developments and the fully development LAP lands;

- There is a significant reduction in traffic and congestion in Kiltiernan Village (reductions of 87.9% and 70.2% at location B and O respectively which represent a numerical decrease in AADT of 16,900 to 2,050 at location B and 20,800 to 6,200 at location O) and R117 Enniskerry Road (reduces by 60.3% at location A which represent a numerical decrease in AADT of 14,600 to 5,800) where the scheme directs and bypasses traffic from this area;

- Traffic on the existing eastern section of the Glenamuck Road is reduced and congestion is decreased due in part to the proposed scheme and the Bus Gate (this represents a reduction 71.9% or in numeric terms, AADT decreases from 17,800 to 5,000). Similarly, on the western section of the Glenamuck Road near the Golden Ball junction there is a reduction in traffic and congestion from traffic being redirected to the proposed scheme (which represents a reduction of 58.6% or in numeric terms, AADT decreases from 13,900 to 5,750);

- With large reductions in traffic volumes in Kiltiernan Village, on Glenamuck Road, the bypassed section of the R117 Enniskerry Road would lead to a safer environment for pedestrians and cyclists along these corridors. Severance is also expected to improve with the decrease in road traffic making a holistic environment for active modes of travel;

- Background traffic on the R116 Ballycorus Road is expected to increase from 2020 and again before the introduction of the proposed scheme. Additional traffic from new development zones such as Cherrywood, Rathmichael and Old Conna contribute to this expected growth (in AADT terms 4,050 in 2020 to 7,100 in the 2035 Do-Nothing). With the implementation of the proposed scheme increases further with time saving attraction, AADT increases to 11,050. However, the Ballycorus Road has been earmarked in the County Development Plan as a long-term road proposal to be improved to cater for strategic demand on this corridor after the implementation of the GDRS;

- Regarding traffic on the M50, AADT south of Junction 15 of the motorway decreases slightly by only 0.1% in the Do-Something scenario compared to the 2035 Do-Nothing scenario. However, north of Junction 15 traffic increases by 0.9% between the two scenarios; and

- The scheme attracts additional trips from surrounding environs like Stepaside, Rathmichael, Cherrywood and Enniskerry from time savings for motorists using the scheme.

As a comparison the 2035 Do-Something with the complementary measures that are outside the remit of the GDRS but are assumed as being implemented after the GRDS and before 2035 are forecasted to carry between 14,650 and 31,750 AADT (the highest being on the eastern section of the GDDR to the junction with the proposed Park Development road infrastructure). The 2035 Do-Something with complementary measures shows mostly slight improvements to AADT in the LAP local road network however, reductions in traffic levels occur in the R116 Ballycorus Road (now +55.6% from +63.4%

difference to Do-Nothing with an AADT of 11,050 vehicles per day) and on the M50 with AADT south of Junction 15 of the motorway decreasing by 6.65% (AADT decreases from 49,600 to 46,300 vehicles per day) compared to the other Do-Something scenario and similarly, north of Junction 15 traffic decreases by 1.80% (AADT decreases from 39,700 to 39,000 vehicles per day) between the two Do-Something scenarios.

In summary the Glenamuck District Roads Scheme reduces the level of traffic on the existing road network within the Local Area Plan environ for Kiltiernan-Glenamuck by diverting road traffic onto the proposed scheme's network and enabling traffic to bypass less suitable and unsafe roads on the LAP environ road network. The Kiltiernan Village Centre, Glenamuck Road and the bypassed section of the R117 Enniskerry Road benefit the most from the scheme. AADT traffic figures do increase compared to the 2020 Do Something scenario due to a fully developed LAP lands being assumed. But, these AADT flows are the same or lower than the 2017 base AADT flows. The proposed scheme acts as a link street for the local network attracting trips from existing and committed developments and the fully developed LAP lands. The scheme attracts additional traffic from further origin points due to the time-saving benefit of the scheme. In regard to traffic on the M50 there is a marginal to slight impact on the M50 and the nearby Junction 15. Comparing the two Do-Something scenarios (one being with the complementary measures that are outside the remit of the GDRS but are assumed as being implemented after the GRDS and before 2035) shows mostly slight improvements to AADT in the LAP local road network however, reductions in traffic levels occurring on the R116 Ballycorus Road and the M50.

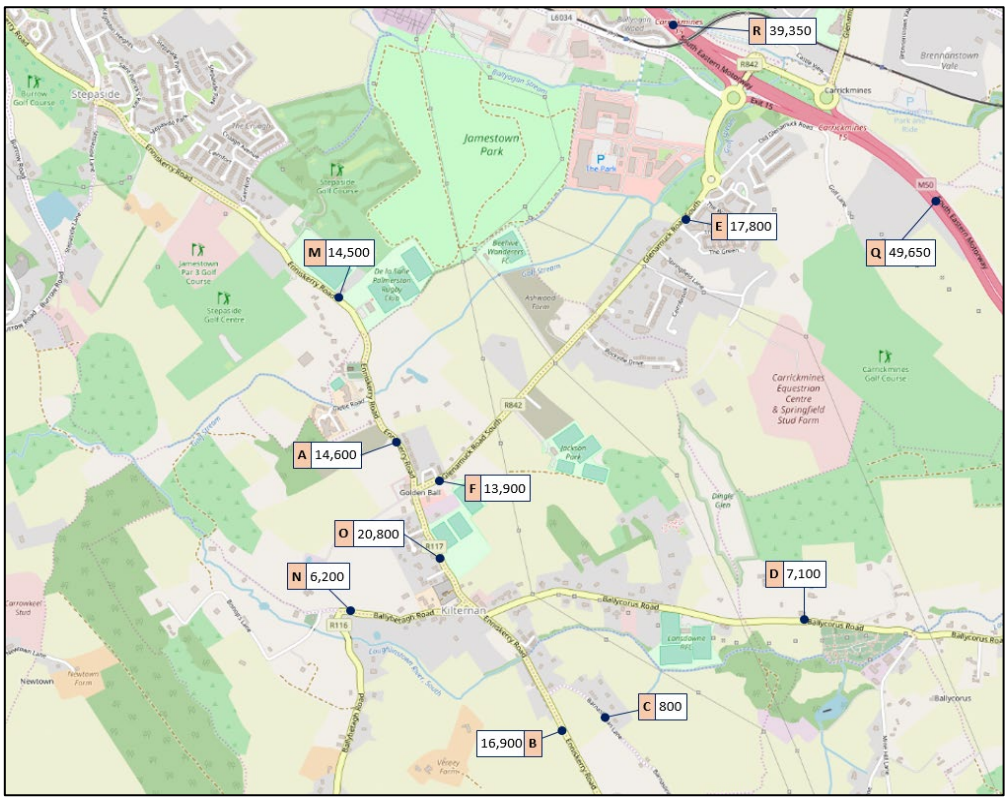

Figure 7.20: 2035 Do-Nothing AADT

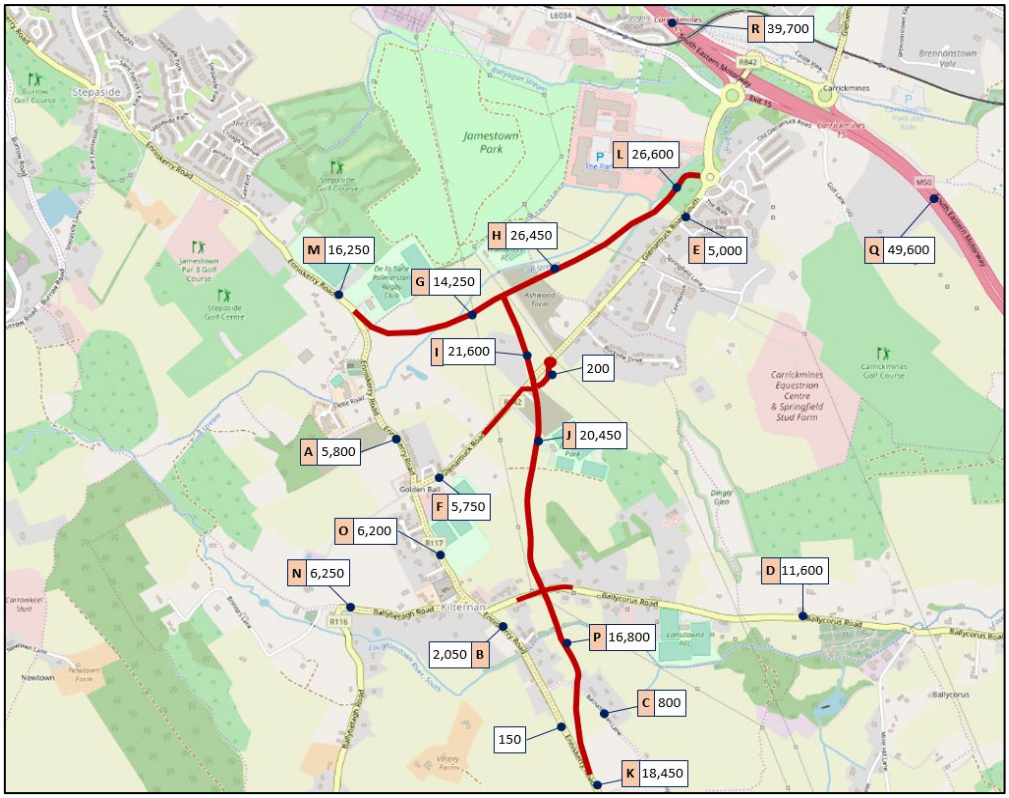

Figure 7.21: 2035 Do-Something AADT

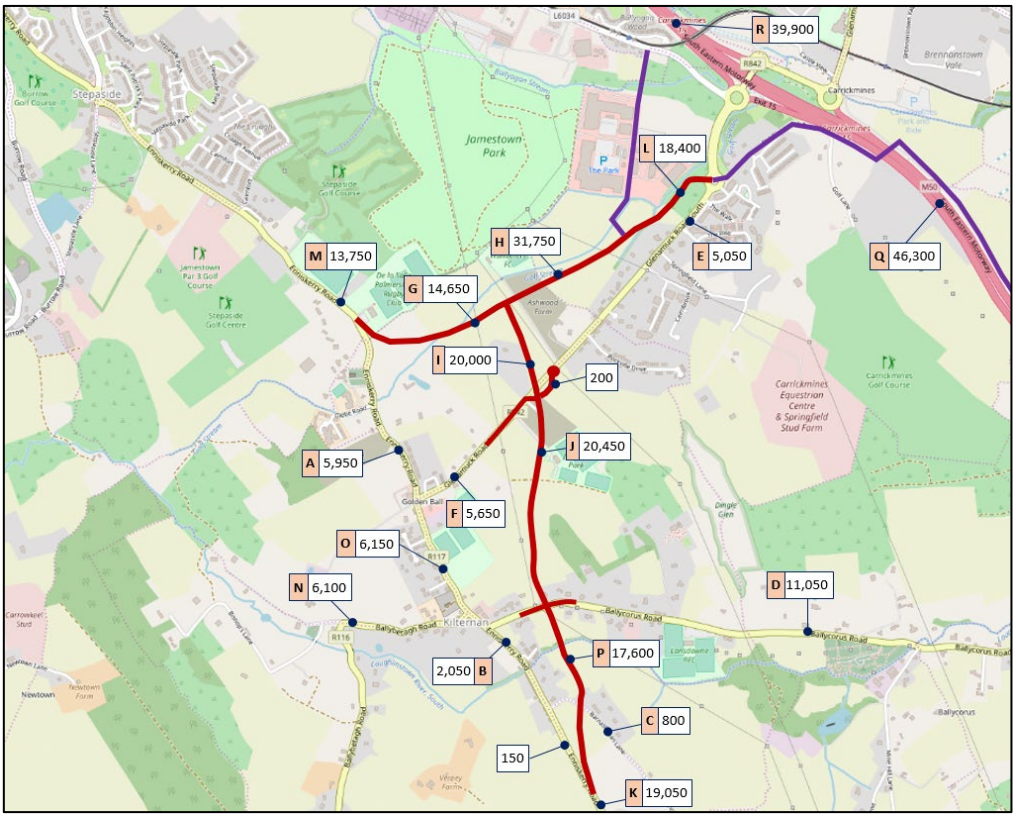

Figure 7.22: 2035 Do-Something with Complementary Measures AADT

7.6.2 Scheme Impact – Delays and Queuing

The section compares the network results for each of the scenarios tested in the LAM. This LAM analysis was developed based on the impacts on the network performance parameters:

- Total Network Travel Time (hrs) for all vehicles;
- Total Network Vehicle Kilometres (hrs) for all vehicles; and
- Total Delays (hrs).

Total delay in this assessment was measured by two SATURN key statistics, Transient Queues and Over Capacity Queues. These types of queuing are defined as follows:

- Transient queues are under capacity queues that form during the red phases of signals; and
- Over-capacity queues are the queues that form due to capacity shortage at a junction where a permanent queue develops and is unable to clear in a single cycle.

These two combined statistics of Transient Queues and Over Capacity Queues to give total delay gives an overview measure of how vehicles perform travelling through the LAM network. Table 7.17 and Table 7.18 summarises the key network statistics for each of the scenarios tested in the AM and PM peak periods, while Figure 7.23 and Figure 7.24 compares delays in each of the scenarios.

Table 7.17 Key LAM Network Statistics for AM Peak Period

Key Statistic (AM Peak Hour)	2017 Base	2020 DN	2020 DS	2035 DN	2035 DS	2035 DS + CM
Includes LAP Flows	**NO**	**NO**	**NO**	**YES**	**YES**	**YES**
Transient Queues (Hours)	303.7	316.9	475.8	367.8	507.3	551.6
Over Capacity Queues (Hours)	2306.3	2571.2	1572.8	3656.3	2267.2	1754.3
Total Delay (Hours)	2610	2888.1	2048.6	4024.1	2774.5	2305.9
Total Travel Times (Hours)	4096.2	4407.1	3838.7	5576.6	4478	3712.6
Travel Distance (km)	107926.5	110008.2	123131.3	97627.4	104495.9	106503.7

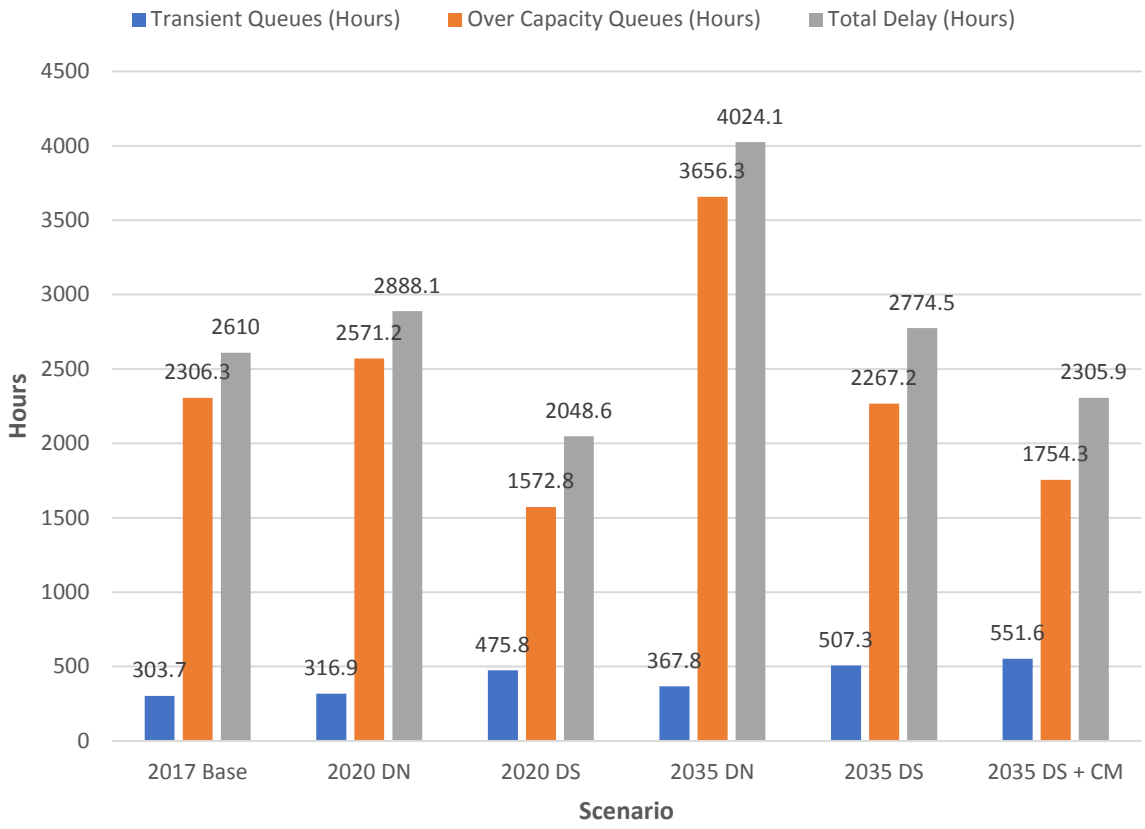

Figure 7.23: LAM Modelled Queues and Total Delay for AM Peak Period

Comparing the AM peak periods in each of the scenarios the trend generally describes that the GDRS improves traffic conditions as there is a reduction in delay in the 2020 and 2035 opening and horizon years and with the complementary measures there is further benefits with greater demand following the development of the LAP lands (with up to 3,000 residential units) and committed developments. Contrasting the 2035 Do-Nothing scenario results with the Do-Something scenarios in 2035, there is a significant reduction in delay across the network, highlighting the benefits of the proposed GDRS and that the existing road network as it stands is unsustainable for catering traffic in the future horizon year of 2035.

Table 7.18 Key LAM Network Statistics for PM Peak Period

Key Statistic (PM Peak Hour)	2017 Base	2020 DN	2020 DS	2035 DN	2035 DS	2035 DS + CM
Includes LAP Flows	**NO**	**NO**	**NO**	**YES**	**YES**	**YES**
Transient Queues (Hours)	319.8	318.8	409.1	442.5	467.5	544.3
Over Capacity Queues (Hours)	2030	2040.6	1557.3	3306.8	2229.2	1571.1
Total Delay (Hours)	2349.8	2359.4	1966.4	3749.3	2696.7	2115.4
Total Travel Times (Hours)	3891	3890.9	4685.5	5385.2	4784	4311.3

Travel Distance (km)	107567.8	106848.4	114833	100523.2	97062.3	99193.9

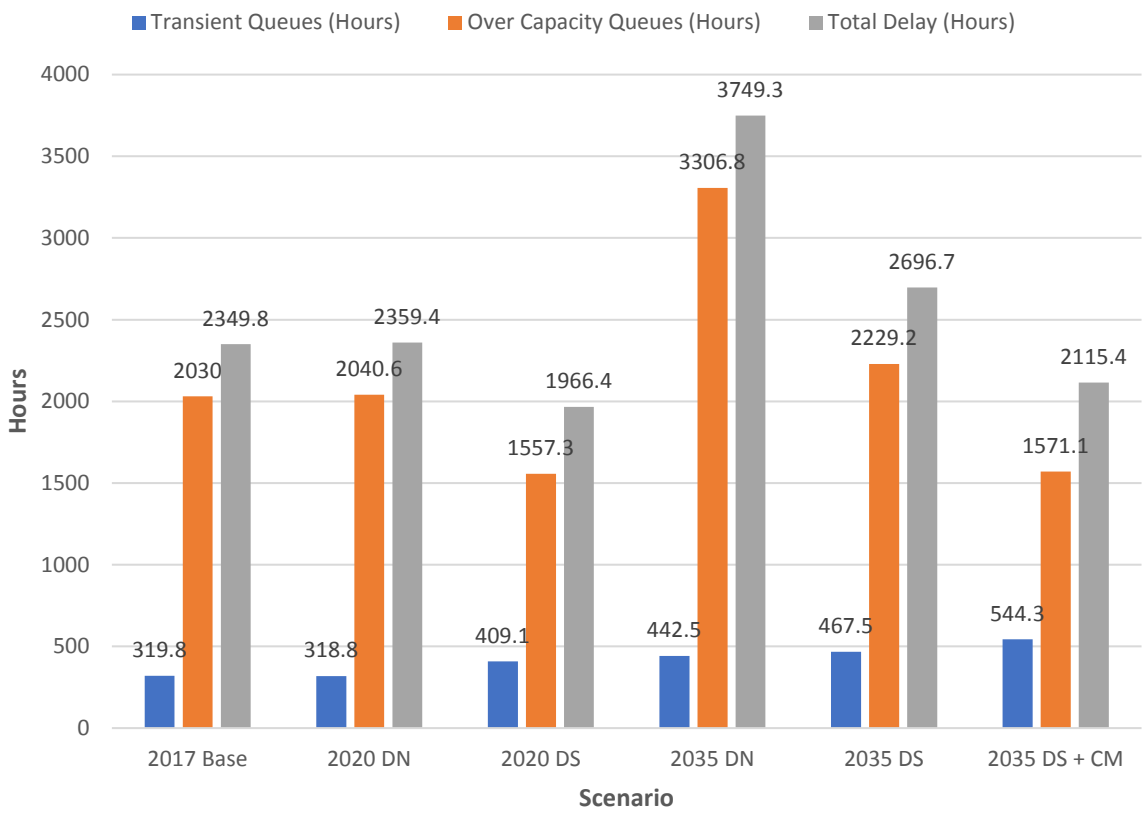

Figure 7.24: LAM Modelled Queues and Total Delay for PM Peak Period

Comparing the PM peak periods in each of the scenarios the trend generally describes that the GDRS improves traffic conditions as there is a reduction in delay in the 2020 and 2035 opening and horizon years comparing the Do-Nothing and Do-Something scenarios. The complementary measures show further improvements with greater demand following the development of the LAP lands (with up to 3,000 residential units) and committed developments compared to the Do-Something scenarios. Contrasting the 2035 Do-Nothing scenario results with the Do-Something scenarios in 2035, there is a significant reduction in delay across the network, highlighting the benefits of the proposed GDRS and that the existing road network as it stands is unsustainable for catering traffic in the future horizon year of 2035.

7.6.3 Scheme Impact – Vehicle Speeds

Investigating the efficiency of the network in each scenario assessed, the average speeds on the network for general traffic and buses are presented in Table 7.19 and Table 7.20 while Figure 7.25 and Figure 7.26 compares average speeds in each of the scenarios.

Table 7.19 LAM General Traffic Average Speed (kph)

Average Speed for Cars (kph)	2017 Base	2020 DN	2020 DS	2035 DN	2035 DS	2035 DS + CM
Includes LAP Flows	NO	NO	NO	YES	YES	YES
AM Peak Period	26.3	24.7	32.3	17.5	27.6	28.7
PM Peak Period	27.6	27.5	28.8	18.7	20.5	24.8

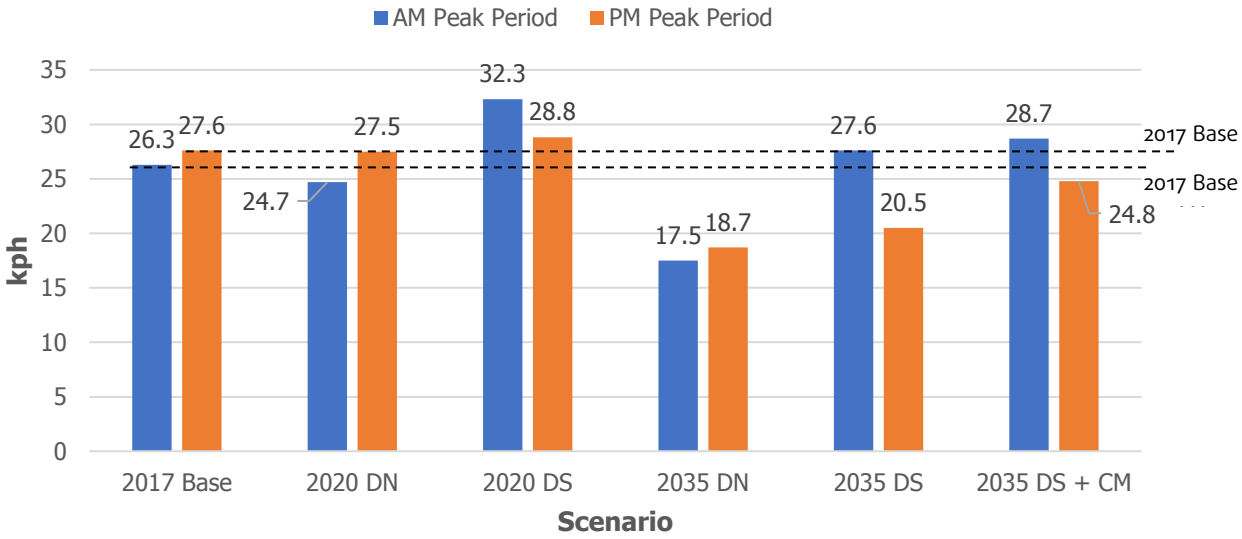

Figure 7.25: Average Speed for General Traffic (kph)

Comparing the average speeds for general traffic, the overall trend is that average speed increases in the AM peak period in the Do-Something scenarios as opposed to a downward trend in the Do-Nothing scenarios. There is a slight decrease between the 2017 base and 2020 Do Nothing, this is correlating to a slight increase in background traffic. Comparing the 2020 and 2035 Do Something there is a noticeable decrease in average speed, this is correlating to an increase in background traffic over a 15-year period, however with the introduction of the complementary measures, average speed is improved. Contrasting the 2035 Do-Nothing scenario results with the Do-Something scenarios in 2035 and the 2017 Base, there is a significant reduction in average speed across the network, however with the introduction of the proposed GDRS average speed improves. This shows that the existing network as it stands is not efficiently catering traffic in the future horizon year of 2035.The PM peak period reflects a similar trend as in the AM peak period.

Comparing the average speeds for bus traffic only, the overall trend is that average speed increases in the AM peak period in all Do-Something scenarios as opposed to a downward trend in the Do-Nothing scenarios. There is a slight decrease between the 2017 base and 2020 Do Nothing, this is correlating to a slight increase in background traffic and the delay paralleled with this increase in traffic. This continues to the 2035 Do-Nothing scenario. High average bus speeds are maintained in the 2035 Do-Something scenarios. This shows that the Do-Something network has a significant benefit for average bus speeds. The PM peak period reflects a similar trend as in the AM peak period.

Table 7.20 LAM Bus Average Speed (kph)

Average Speed for Buses (kph)	2017 Base	2020 DN	2020 DS	2035 DN	2035 DS	2035 DS + CM
Includes LAP Flows	NO	NO	NO	YES	YES	YES
AM Peak Period	27.7	27	46.9	25.9	46.4	42.8
PM Peak Period	33	32	46.2	28.6	33.9	41.4

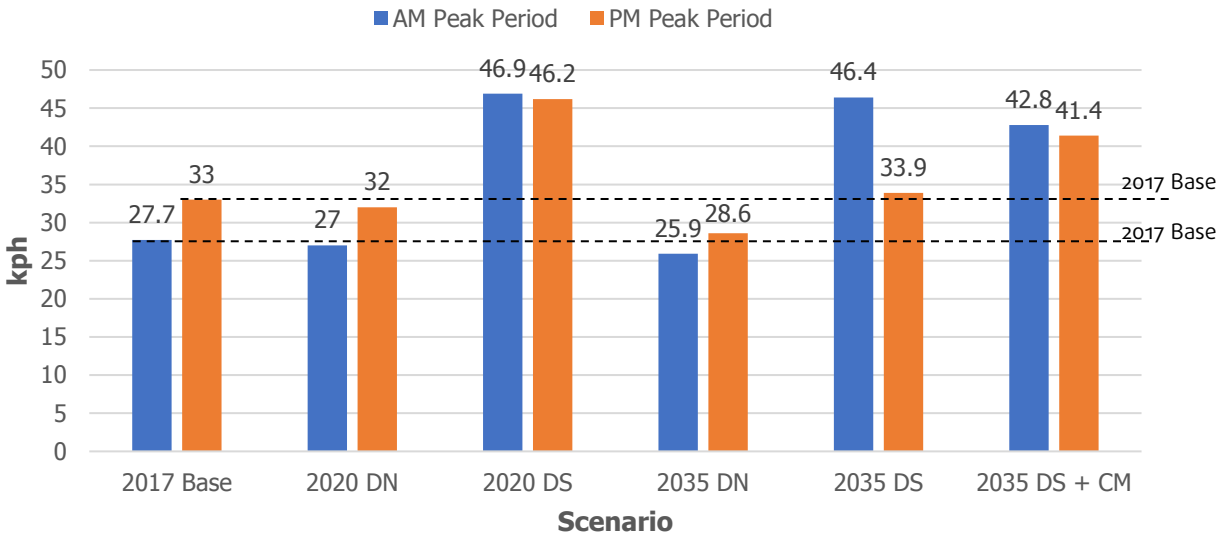

Figure 7.26: Average Speed for Buses (kph)

While comparing the average speeds for Buses, this assessment shows the significant benefit from the introduction to the GDRS and its provision for the Bus Gates. The general trend is that average speed increases with each progressive scenario in the AM peak period especially for with the introduction of the GDRS. The exception being the 2035 Do Something scenario where average speeds decrease. But this changes with the implementation of the Complementary measures. For the PM peak period this is a similar case as in the AM peak period.

7.6.4 Scheme Impact – Strategic Impacts on the M50

A strategic impact assessment was undertaken on the following junctions on the M50: -

- Junction 13 (Sandyford, Dundrum Interchange);
- Junction 14 (Stillorgan, Dun Laoghaire Interchange);
- Junction 15 (Kiltiernan, Leopardstown Interchange); and
- Junction 16 (Loughlinstown, Cherrywood Interchange).

Strategic level flows using the National Transport Authority's (NTA) Eastern Regional Model (ERM) were compared for each scenario and analysed at key locations based on the TII permanent ATC traffic counter locations as specified in Figure 7.8. It should be noted that between the 2020 and 2035 Do-Nothing scenarios there is a marked decrease in AADT. The reason for this is that the NTA ERM model

for 2035 includes a full suite of transport measures (mentioned in Section 7.2.2) included in it to reflect the GDA Transport Strategy which includes large public transport infrastructural projects (like the Metrolink, Core Bus corridors and new Luas lines), a fully realised cycle network and TII's Demand Management Measures on the M50 to reduce traffic on the motorway and address future capacity. The combination of all of these reduces demand on the M50 corridor. Changes between the Do-Nothing (DN) and Do-Something (DS) scenarios at each model year reflects the impact on the M50 by the proposed GDRS.

This assessment found that there were marginal differences in AADT flow on the M50 at key locations from the proposed scheme as outlined in Table 7.21. Comparing the 2020 Do-Nothing and 2020 Do-Something, AADT flows in the locations between Junctions 12-13 and 16-17 presented have a small increase in flows and a decrease in flow between Junctions 14 and 15. There was 2% increase in AADT for the opening year 2020 between junctions 15 and 16.

For the model year 2035 the impact at the locations between M50 Junctions 12-13, 14-15 and 15-16 were slight or marginal. However, AADT between junction 16 and 17 showed a 9.15% decrease in flow as trips to and from zones south of the proposed GDRS were diverted onto the scheme. The major difference with the inclusion of the complementary measures was a 6.75% decrease in AADT flow to the Do-Nothing scenario between junctions 15 and 16, mostly due to traffic using the proposed Golf Lane Link as an alternative to travel on the M50. The Modelling Report in **Appendix 7-1** outlines in further detail on the strategic impacts on these junctions on the M50.

Table 7.21 Base and Forecasted Strategic Flows at M50 Traffic Counter Locations

Counter ID	Location Between M50 Junctions	2017 Base	2020 DN	2020 DS	2020 % Diff DN vs DS	2035 DN	2035 DS	2035 % Diff DN vs DS	2035 DS + CM	2035 % Diff DN vs DS+CM
TMU M50 035.0 S	12	74500	85550	86000	+0.53%	30650	29950	-0.22%	30750	+0.00%
	13									
TMU M50 040.0 S	14	72550	88200	87450	-0.85%	39350	39700	+0.89%	39000	-0.89%
	15									
TMU M50 035.0 N	15	69250	84350	86050	+2.02%	49650	49600	-0.10%	46300	-6.75%
	16									
TMU M50 040.0 N	16	49500	60850	60900	+0.08%	36600	33250	-9.15%	33450	-8.60%
	17									

7.6.5 Scheme Impact – Public Transport

The impacts of the proposed scheme on public transport are considered to be positive in both the short and longer term. The proposed scheme will have a positive impact in terms of reducing traffic volumes on the local network particularly on the existing Glenamuck Road, and Kiltiernan Village with the implementation of the bus gates, thereby improving bus journey times and their reliability for existing and potential additional future bus services. The proposed scheme will also facilitate increased accessibility and connectivity with the Carrickmines Luas Stop on the Greenline.

7.6.6 Scheme Impact – Benefits of the Bus Gates

A sensitivity assessment was undertaken to investigate the overall benefits of the Bus gates as part of the GDRS. The primary finding from this sensitivity test was that overall bus speeds decrease significantly in scenarios where the bus gates are not included compared to scenarios which have implemented the two bus gates. Table 7.22 summarises the results from the sensitivity test and Figure 7.27 illustrates this graphically.

Table 7.22 LAM Bus Average Speed (kph) with No Bus Gates Sensitivity Test

Average Speed for Buses (kph)	2017 Base	2020 DN	2020 DS	2035 DN	2035 DS	2035 DS + CM	2020 DS	2035 DS	2035 DS + CM
Includes LAP Flows	**NO**	**NO**	**NO**	**YES**	**YES**	**YES**	**NO**	**YES**	**YES**
AM Peak Period (With Bus Gate)	27.7	27	46.9	25.9	46.4	42.8	-	-	-
PM Peak Period (With Bus Gate)	33	32	46.2	28.6	33.9	41.4	-	-	-
AM Peak Period (Without Bus Gate)	-	-	-	-	-	-	38.9	38.6	38.9
PM Peak Period (Without Bus Gate)	-	-	-	-	-	-	23.1	20.5	35.7

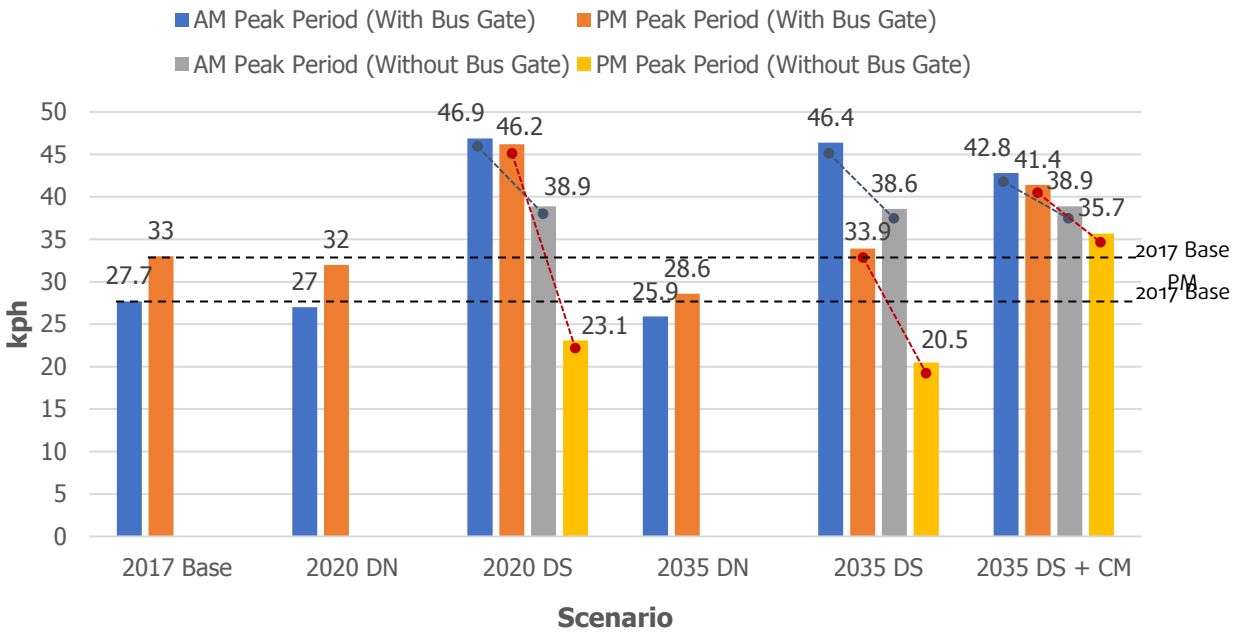

Figure 7.27: Average Speed for Buses (kph) with No Bus Gates Sensitivity Test

In terms of AADT, the eastern section of Glenamuck Road without the bus gate, AADT figures are forecasted to be in the range of 10,900-12,950 vehicles per day in the 2035 Do-Something. The highest

being on the end section connecting with the roundabout which compares to an AADT figure of 5,000 vehicles per day with scenarios with the bus gate in the same model year. These AADT figures for the scenario without the bus gate are unsuitable and unsustainable for this type of road.

7.6.7 Scheme Impact – Pedestrians and Cyclists

Careful consideration has been given as part of the scheme design to the provision of new cyclist and pedestrian facilities and their integration into the wider existing and future proposed networks. Segregated cycle tracks and footways are to be provided along the entire scheme on the GDDR and GDLR, on both sides of the carriageway. Further, provisions are made for cycle and pedestrian facilities to be provided at all key junctions on the scheme.

The proposed scheme has been designed to provide alternative cycle and pedestrian connectivity for the Glenamuck-Kiltiernan lands and support the transportation needs of future demand from the implementation of the Local Area Plan proposals. For cyclists, connection to the existing 11C secondary cycle route (south from Goatstown Cross on Drummartin Link Road / Kilgobbin Road / Ballyogan Road to Carrickmines) can be achieved. Future cycle connections would be achieved with the following routes as illustrated with Figure 7.28: -

- Proposed 11E secondary route (from Dundrum along Sandyford Road / Enniskerry Road to Stepaside (and rural route onward to Enniskerry and the Wicklow Mountains), with spur north into Dundrum Village)
- Proposed D1 rural cycle route (Dublin - Kiltiernan - The Scalp - Enniskerry - Djouce: the main access route from Dublin to the Wicklow Mountains for recreational cyclists); and
- Proposed D4 rural cycle route (cycle route along the R116, Shankill to Rockbrook)

In general, the proposed scheme will have a positive impact in terms of enhancing the existing pedestrian and cyclist environment and adding new amenity walking and cycling routes to the area. Along the local road network particularly on the existing Glenamuck Road, and in Kiltiernan Village, the pedestrian and cyclist environment will benefit from the resulting reduction in traffic levels from traffic diverted from the proposed scheme. The reduction in traffic along the existing Glenamuck Road and Kiltiernan Village along the Enniskerry Road in particular will provide considerable relief from severance and will enhance existing facilities and afford opportunities to provide new pedestrian and cycle facilities, such as a feeder cycle route along the Glenamuck Road (**Figure 7.28**).

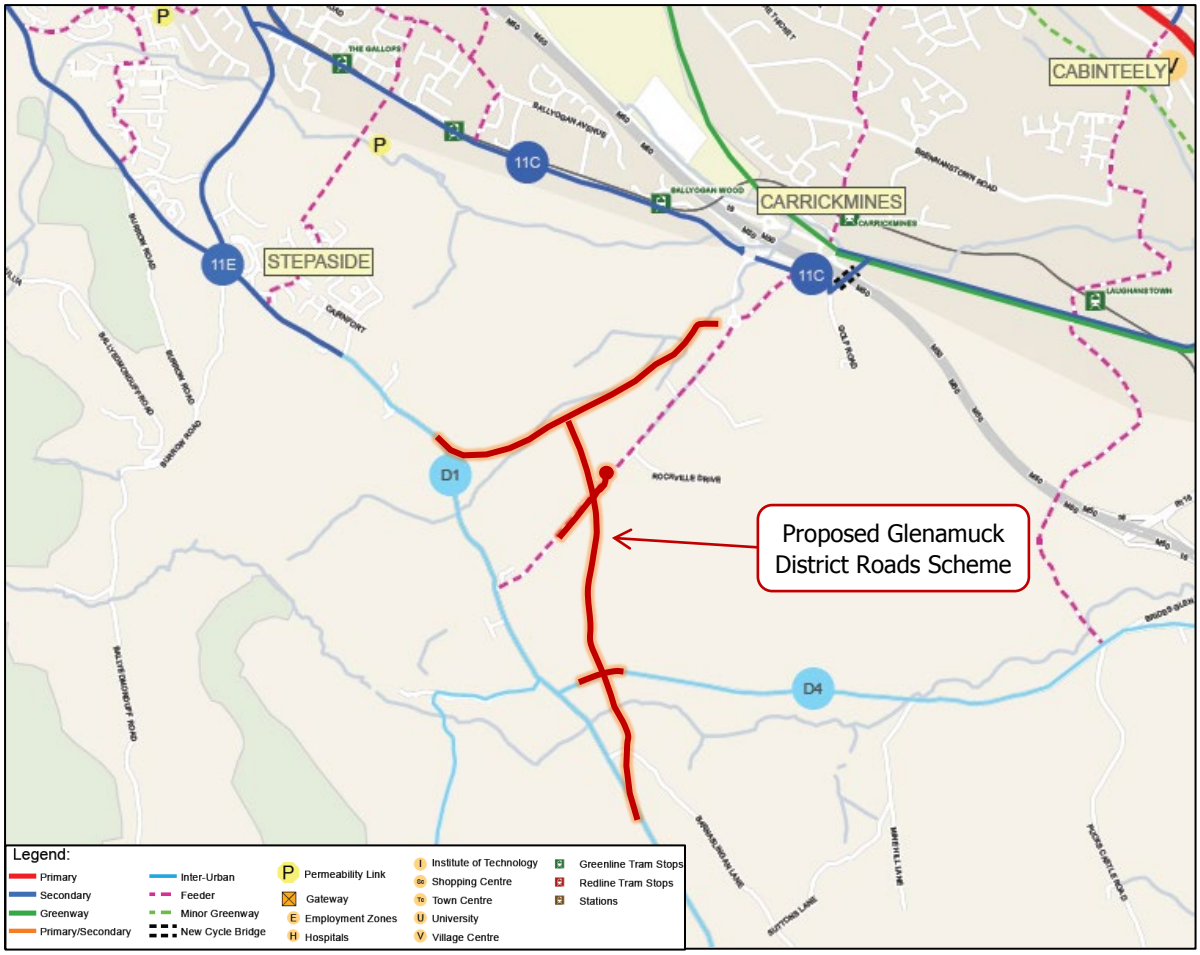

Figure 7.28: Proposed Scheme within the Proposed Cycle Network
(Source: 2013 NTA Cycle Network Plan)

7.7 Mitigation Measures

7.7.1 During Construction Phase

As indicated in Chapter 5, construction of the proposed scheme will cause temporary short-term traffic impacts on the local road network. Enforcement of a Construction Management Plan will ensure that construction traffic impacts are minimised through the control of site access / egress routes and site access locations and any necessary temporary lane closure requirements.

7.7.2 During Operational Phase

A number of specific mitigation measures have been incorporated into the scheme designs to ensure that the proposed scheme provides adequate traffic capacity to avoid any traffic congestion issues arising. Additional, provisions for cyclist and pedestrian safety and enhanced connectivity with the local network were also integrated into the scheme designs. Traffic forecasted to be diverted away from the Village core of Kiltiernan, the bypassed section of the R117 Enniskerry Road and Glenamuck Road following completion of the scheme, are expected to provide considerable relief representing a significant opportunity for environmental improvements in these areas.

Further provisions for public transport (bus) were included in the designs of the proposed scheme with the inclusion of the bus gates which should provide priority and increased service quality and reliability for bus services within the Kiltiernan-Glenamuck LAP area.

During the traffic analysis, increased AADT flows were forecasted on the R116 Ballycorus Road and the R117 Enniskerry Road onto the proposed scheme. As a mitigation measure these flows would meet signalised junction on the proposed scheme (these being where the GDDR meets the R117 Enniskerry Road and where the R116 Ballycorus Road meets the GDLR). Additional green time within the traffic signal staging can be reallocated at these locations to meet the demand on affected arms at the junctions.

7.8 Residual Impacts

7.8.1 Traffic and Transportation

The opening of the proposed Glenamuck District Roads Scheme will see changes to the local and regional roads and traffic flows. The modelling work undertaken to assess the traffic impacts of the proposed scheme indicates that there will be an overall traffic benefit associated with the proposed scheme. Further, the proposed scheme will provide benefits to existing and new public transport services and walking and cycling routes on the adjoining local and regional road network. The proposed scheme is expected to have the following residual impacts on: -

Traffic Impacts

The Glenamuck District Roads Scheme reduces the level of traffic on the existing road network within the Local Area Plan environ for Kiltiernan-Glenamuck by diverting road traffic onto the proposed scheme's network and enabling traffic to bypass less suitable and unsafe roads on the LAP environ road network. The Kiltiernan Village Centre, Glenamuck Road and the bypassed section of the R117 Enniskerry Road benefit the most from the scheme. 2035 AADT traffic figures do increase compared to the 2020 Do Something scenario due to a fully developed LAP lands being assumed. However, these AADT flows are the same or lower than the 2017 base AADT flows. The proposed scheme will act as a link street for the local network attracting trips from existing and committed developments and the fully developed LAP lands. The scheme will attract additional traffic from further origin points due to the time-saving benefit of the scheme. In regard to 2035 traffic levels on the M50, there is a marginal to slight impact on the M50 and the nearby Junction 15 with the proposed scheme. Comparing the 2035 Do-Something and the 2035 Do-Something with Complementary Measures scenarios (complementary measures are outside the remit of the GDRS but are assumed as being implemented after the GRDS and before 2035) shows mostly slight improvements in AADT in the LAP local road network and reductions in traffic levels occurring on the R116 Ballycorus Road and the M50.

Public Transport Impacts

The impacts of the proposed scheme on public transport are considered to be positive in both the short and longer term. The proposed scheme will have a positive impact in terms of reducing traffic volumes on the local network particularly on the existing Glenamuck Road, and Kiltiernan Village with the implementation of the bus gates, thereby improving bus journey times and their reliability for existing and potential additional future bus services. The proposed scheme will also facilitate increased accessibility and connectivity with the Carrickmines Luas Stop on the Greenline.

Pedestrian and Cyclist Impacts

The proposed scheme will have a positive impact in terms of enhancing the existing pedestrian and cyclist environment and adding new amenity walking and cycling routes to the area. Along the local road network particularly on the existing Glenamuck Road, and Kiltiernan Village, the pedestrian and cyclist environment will benefit from the resulting reduction in traffic levels from traffic diverted onto the proposed scheme. The reduction in traffic along the existing Glenamuck Road and Kiltiernan Village along the Enniskerry Road in particular will provide considerable relief from severance and afford opportunities to existing and provide new pedestrian and cycle facilities

7.8.2 Air Quality

Dust from the construction phase of the scheme would contribute to a reduction of air quality. Chapter 8 outlines the impacts on air quality within the study area based on traffic figures undertaken as part of this traffic modelling framework.

7.8.3 Noise and Vibration

The proposed Glenamuck District Roads Scheme will result in a short term increase of construction traffic related noise and vibration. Chapter 9 outlines the impacts on noise and vibration to the study area based on traffic figures undertaken as part of this traffic modelling framework.

7.9 Difficulties Encountered

Difficulties encountered in this overall assessment was primarily calculating the future number of units in different zones within the Kiltiernan-Glenamuck Local Area Plan in the absence of detailed proposals for these lands. Preliminary number of units, densities per zone, etc. may differ from what would be permitted in the future. However, DBFL approached this with consultation with DLRCC to give realistic estimates of densities and the number of units in each zone.

7.10 References

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8 Air Quality and Climatic Factors

8.1 Introduction

This chapter assesses the likely air quality and climate impacts, if any, associated with the proposed Glenamuck District Roads Scheme. A full description of the development can be found in Chapter 5.

This chapter was completed by Ciara Nolan, an Environmental Consultant at AWN Consulting. She holds an MSc. (First Class) in Environmental Science from University College Dublin and has also completed a BSc. in Energy Systems Engineering. She is an Associate Member of both the Institute of Air Quality Management and the Institution of Environmental Science. She has been active in the field of air quality for 2 years, with a primary focus on consultancy.

8.1.1 Ambient Air Quality Standards

In order to reduce the risk to health from poor air quality, national and European statutory bodies have set limit values in ambient air for a range of air pollutants. These limit values or "*Air Quality Standards*" are health or environmental-based levels for which additional factors may be considered. For example, natural background levels, environmental conditions and socio-economic factors may all play a part in the limit value which is set (see Table 1).

Air quality significance criteria are assessed on the basis of compliance with the appropriate standards or limit values. The applicable standards in Ireland include the Air Quality Standards Regulations 2011, which incorporate EU Directive 2008/50/EC, which has set limit values for NO_2, PM_{10}, $PM_{2.5}$, benzene and CO (see Table 8- 1: Air Quality Standards Regulations). Although the EU Air Quality Limit Values are the basis of legislation, other thresholds outlined by the EU Directives are used which are triggers for particular actions (see Appendix 8-1).

Table 8- 1: Air Quality Standards Regulations

Pollutant	Regulation [Note 1]	Limit Type	Value
Nitrogen Dioxide (NO_2)	2008/50/EC	Hourly limit for protection of human health - not to be exceeded more than 18 times/year	200 µg/m³
		Annual limit for protection of human health	40 µg/m³
		Critical level for protection of vegetation	30 µg/m³ NO + NO_2
Particulate Matter (PM_{10})	2008/50/EC	24-hour limit for protection of human health - not to be exceeded more than 35 times/year	50 µg/m³
		Annual limit for protection of human health	40 µg/m³
Particulate Matter ($PM_{2.5}$)	2008/50/EC	Annual limit for protection of human health	25 µg/m³
Benzene	2008/50/EC	Annual limit for protection of human health	5 µg/m³
Carbon Monoxide (CO)	2008/50/EC	8-hour limit (on a rolling basis) for protection of human health	10 mg/m³ (8.6 ppm)

[Note 1] EU 2008/50/EC – Clean Air For Europe (CAFÉ) Directive replaces the previous Air Framework Directive (1996/30/EC) and daughter directives 1999/30/EC and 2000/69/EC

8.1.2 Climate Agreements

Ireland ratified the United Nations Framework Convention on Climate Change (UNFCCC) in April 1994 and the Kyoto Protocol in principle in 1997 and formally in May 2002 (UNFCCC, 1997; 1999). For the

purposes of the EU burden sharing agreement under Article 4 of the Kyoto Protocol, in June 1998, Ireland agreed to limit the net growth of the six GHGs under the Kyoto Protocol to 13% above the 1990 level over the period 2008 to 2012 (ERM, 1998; European Commission, 2014). The UNFCCC is continuing detailed negotiations in relation to GHGs reductions and in relation to technical issues such as Emission Trading and burden sharing. The most recent Conference of the Parties to the Convention (COP23) took place in Bonn, Germany from the 6th to the 17th of November 2017 and focused on advancing the implementation of the Paris Agreement. The "Paris Agreement", agreed by over 200 nations, has a stated aim of limiting global temperature increases to no more than 2°C above pre-industrial levels with efforts to limit this rise to 1.5°C. The aim is to limit global GHG emissions to 40 gigatonnes as soon as possible whilst acknowledging that peaking of GHG emissions will take longer for developing countries. Contributions to greenhouse gas emissions will be based on Intended Nationally Determined Contributions (INDCs) which will form the foundation for climate action post 2020. Significant progress was also made on elevating adaption onto the same level as action to cut and curb emissions.

The EU, on the 23rd/24th of October 2014, agreed the "2030 Climate and Energy Policy Framework" (EU 2014). The European Council endorsed a binding EU target of at least a 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990. The target will be delivered collectively by the EU in the most cost-effective manner possible, with the reductions in the ETS and non-ETS sectors amounting to 43% and 30% by 2030 compared to 2005, respectively. Secondly, it was agreed that all Member States will participate in this effort, balancing considerations of fairness and solidarity. The policy also outlines, under "Renewables and Energy Efficiency", an EU binding target of at least 27% for the share of renewable energy consumed in the EU in 2030.

8.1.3 Gothenburg Protocol

In 1999, Ireland signed the Gothenburg Protocol to the 1979 UN Convention on Long Range Transboundary Air Pollution. The initial objective of the Protocol was to control and reduce emissions of Sulphur Dioxide (SO_2), Nitrogen Oxides (NO_X), Volatile Organic Compounds (VOCs) and Ammonia (NH_3). To achieve the initial targets Ireland was obliged, by 2010, to meet national emission ceilings of 42 kt for SO_2 (67% below 2001 levels), 65 kt for NO_X (52% reduction), 55 kt for VOCs (37% reduction) and 116 kt for NH_3 (6% reduction). In 2012, the Gothenburg Protocol was revised to include national emission reduction commitments for the main air pollutants to be achieved in 2020 and beyond and to include emission reduction commitments for $PM_{2.5}$. In relation to Ireland, 2020 emission targets are 25 kt for SO_2 (65% on 2005 levels), 65 kt for NO_X (49% reduction on 2005 levels), 43 kt for VOCs (25% reduction on 2005 levels), 108 kt for NH_3 (1% reduction on 2005 levels) and 10 kt for $PM_{2.5}$ (18% reduction on 2005 levels).

European Commission Directive 2001/81/EC, the National Emissions Ceiling Directive (NECD), prescribes the same emission limits as the 1999 Gothenburg Protocol. A National Programme for the progressive reduction of emissions of these four transboundary pollutants has been in place since April 2005 (DEHLG, 2004; 2007). Data available from the EU in 2010 indicated that Ireland complied with the emissions ceilings for SO_2, VOCs and NH_3 but failed to comply with the ceiling for NO_X (EEA, 2012). Directive (EU) 2016/2284 "*On the Reduction of National Emissions of Certain Atmospheric Pollutants and Amending Directive 2003/35/EC and Repealing Directive 2001/81/EC*" was published in December 2016. The Directive will apply the 2010 NECD limits until 2020 and establish new national emission reduction commitments which will be applicable from 2020 and 2030 for SO_2, NO_X, NMVOC, NH_3, $PM_{2.5}$ and CH_4. In relation to Ireland, 2020 - 2029 emission targets are for SO_2 (65% below 2005 levels), for

NO_x (49% reduction), for VOCs (25% reduction), for NH_3 (1% reduction) and for $PM_{2.5}$ (18% reduction). In relation to 2030, Ireland's emission targets are for SO_2 (85% below 2005 levels), for NO_x (69% reduction), for VOCs (32% reduction), for NH_3 (5% reduction) and for $PM_{2.5}$ (41% reduction).

8.2 Methodology

8.2.1 Local Air Quality

The air quality assessment has been carried out following procedures described in the publications by the EPA (2002, 2003, 2015, 2017a) and using the methodology outlined in the guidance documents published by the UK DEFRA (2016a; 2016b). The assessment of air quality was carried out using a phased approach as recommended by the UK DEFRA (2016b). The phased approach recommends that the complexity of an air quality assessment be consistent with the risk of failing to achieve the air quality standards. In the current assessment, an initial scoping of possible key pollutants was carried out and the likely location of air pollution "*hot-spots*" identified. An examination of recent EPA data in Ireland (EPA, 2018) has indicated that SO_2, smoke and CO are unlikely to be exceeded at locations such as the current one and thus these pollutants do not require detailed monitoring or assessment to be carried out. However, the analysis did indicate potential issues in regards to nitrogen dioxide (NO_2), PM_{10} and $PM_{2.5}$ at busy junctions in urban centres (EPA, 2018). Benzene, although previously reported at quite high levels in urban centres, has recently been measured at several city centre locations to be well below the EU limit value (EPA, 2018). Historically, CO levels in urban areas were a cause for concern. However, CO concentrations have decreased significantly over the past number of years and are now measured to be well below the limits even in urban centres (EPA 2017a; 2018). The key pollutants reviewed in the assessments are NO_2, PM_{10}, $PM_{2.5}$, benzene and CO, with particular focus on NO_2 and PM_{10}.

Key pollutant concentrations will be predicted for nearby sensitive receptors for the following five scenarios:

- The baseline scenario (2017), for model verification;
- Opening Year Do-Nothing scenario (DN), which assumes the retention of present site usage with no development in place (2020);
- Opening Year Do-Something scenario (DS), which assumes the proposed scheme in place (2020);
- Design Year Do-Nothing scenario (DN), which assumes the retention of present site usage with no development in place (2035); and
- Design Year of the Do-Something scenario (DS), which assumes the proposed scheme in place (2035).

The assessment methodology involved air dispersion modelling using the UK DMRB Screening Model (Version 1.03c, July 2007), the NO_x to NO_2 Conversion Spreadsheet (Version 5.1, June 2016) (UK DEFRA, 2016), and following guidance issued by the TII (2011), UK Highways Agency (2007), UK DEFRA (2016a; 2016b), UK DETR (1998) and the EPA (2002; 2003; 2015; 2017a).

The TII guidance (2011) states that the assessment must progress to detailed modelling if:

- Concentrations exceed 90% of the air quality limit values when assessed by the screening method; or
- Sensitive receptors exist within 50m of a complex road layout (e.g. grade separated junctions, hills etc).

The UK DMRB guidance (UK Highways Agency, 2007), on which the TII guidance was based, states that road links meeting one or more of the following criteria can be defined as being 'affected' by a proposed development and should be included in the local air quality assessment:

- Road alignment change of 5 metres or more;
- Daily traffic flow changes by 1,000 AADT or more;
- HDV flows change by 200 vehicles per day or more;
- Daily average speed changes by 10 km/h or more; or
- Peak hour speed changes by 20 km/h or more.

Concentrations of key pollutants are calculated at sensitive receptors that have the potential to be affected by the proposed scheme. For road links which are deemed to be affected by the proposed scheme and within 200 m of the chosen sensitive receptors inputs to the air dispersion model consist of road layouts, receptor locations, annual average daily traffic movements (AADT), percentage heavy goods vehicles, annual average traffic speeds and background concentrations.

The UK DMRB guidance states that road links at a distance of greater than 200 m from a sensitive receptor will not influence pollutant concentrations at the receptor. Using this input data the model predicts the road traffic contribution to ambient ground level concentrations at the worst-case sensitive receptors using generic meteorological data. The DMRB model uses conservative emission factors, the formulae for which are outlined in the DMRB Volume 11 Section 3 Part 1 – HA 207/07 Annexes B3 and B4. These worst-case road contributions are then added to the existing background concentrations to give the worst-case predicted ambient concentrations. The worst-case ambient concentrations are then compared with the relevant ambient air quality standards to assess the compliance of the proposed scheme with these ambient air quality standards. The TII *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (2011) detail a methodology for determining air quality impact significance criteria for road schemes. The degree of impact is determined based on both the absolute and relative impact of the proposed development. The TII significance criteria have been adopted for the proposed development and are detailed in Appendix 8.2, Table A.8.2.1 to Table A.8.2.3. The significance criteria are based on PM_{10} and NO_2 as these pollutants are most likely to exceed the annual mean limit values (40 µg/m^3). However, the criteria have also been applied to the predicted 8-hour CO, annual benzene and annual $PM_{2.5}$ concentrations for the purposes of this assessment.

8.2.2 Regional Air Quality & Climate Assessment

The impact of the proposed scheme on climate at a national / international level is determined using the procedures given by Transport Infrastructure Ireland (2011) and the methodology provided in Annex 2 of the UK Design Manual for Roads and Bridges (UK Highways Agency, 2007). The assessment

focuses on determining the resulting change in emissions of volatile organic compounds (VOCs), nitrogen oxides (NO_x) and carbon dioxide (CO_2). The Annex provides a method for the prediction of the regional impact of emissions of these pollutants from road schemes. The inputs to the air dispersion model consist of information on road link lengths, AADT movements and annual average traffic speeds.

8.2.3 Conversion of NO_x to NO_2

NO_x (NO + NO_2) is emitted by vehicles exhausts. The majority of emissions are in the form of NO, however, with greater diesel vehicles and some regenerative particle traps on HGV's the proportion of NOx emitted as NO_2, rather than NO is increasing. With the correct conditions (presence of sunlight and O_3) emissions in the form of NO, have the potential to be converted to NO_2.

Transport Infrastructure Ireland states the recommended method for the conversion of NO_x to NO_2 in "*Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes*"(2011). The TII guidelines recommend the use of DEFRAs NO_x to NO_2 calculator (2017) which was originally published in 2009 and is currently on version 6.1. This calculator (which can be downloaded in the form of an excel spreadsheet) accounts for the predicted availability of O_3 and proportion of NO_x emitted as NO for each local authority across the UK. O_3 is a regional pollutant and therefore concentrations do not vary in the same way as concentrations of NO_2 or PM_{10}.

The calculator includes Local Authorities in Northern Ireland and the TII guidance recommends the use of 'Armagh, Banbridge and Craigavon' as the choice for local authority when using the calculator. The choice of Craigavon provides the most suitable relationship between NO_2 and NO_x for Ireland. The "All other Non-Urban UK Traffic "traffic mix option was used.

8.3 Baseline Environment

8.3.1 Meteorological Data

A key factor in assessing temporal and spatial variations in air quality is the prevailing meteorological conditions. Depending on wind speed and direction, individual receptors may experience very significant variations in pollutant levels under the same source strength (i.e. traffic levels). Wind is of key importance in dispersing air pollutants and for ground level sources, such as traffic emissions, pollutant concentrations are generally inversely related to wind speed. Thus, concentrations of pollutants derived from traffic sources will generally be greatest under very calm conditions and low wind speeds when the movement of air is restricted. In relation to PM_{10}, the situation is more complex due to the range of sources of this pollutant. Smaller particles (less than $PM_{2.5}$) from traffic sources will be dispersed more rapidly at higher wind speeds. However, fugitive emissions of coarse particles ($PM_{2.5}$ - PM_{10}) will actually increase at higher wind speeds. Thus, measured levels of PM_{10} will be a non-linear function of wind speed.

The nearest representative weather station collating detailed weather records is Dublin Airport, which is located approximately 23 km north of the proposed scheme at its furthest point. Dublin Airport met data has been examined to identify the prevailing wind direction and average wind speeds over a five-year period (see Figure 8- 1: **Dublin Airport Windrose 2012 – 2016**). For data collated during five representative years (2012 - 2016), the predominant wind direction is westerly to south-westerly, with generally moderate wind speeds.

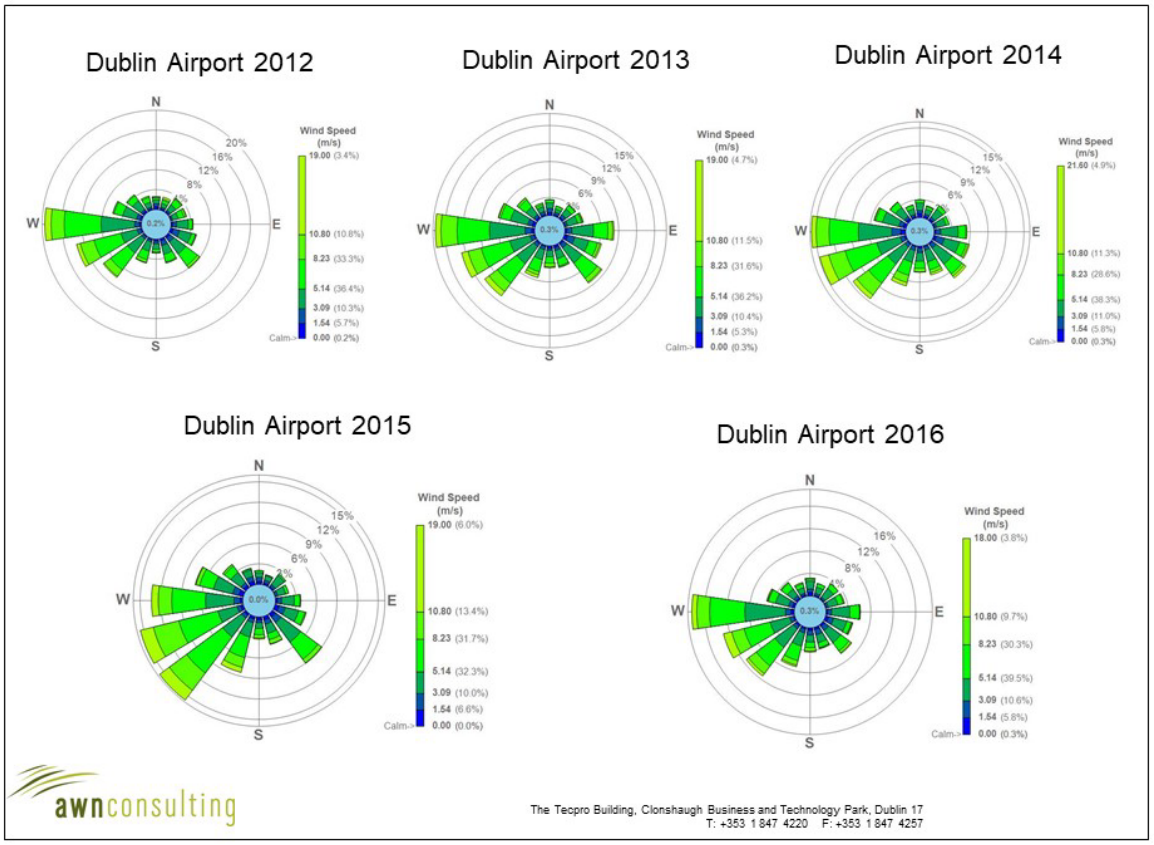

Figure 8- 1: Dublin Airport Windrose 2012 – 2016

8.3.2 Trends in Air Quality

Air quality is variable and subject to both significant spatial and temporal variation. In relation to spatial variations in air quality, concentrations generally fall significantly with distance from major road sources (WHO, 2006). Thus, residential exposure is determined by the location of sensitive receptors relative to major roads sources in the area. Temporally, air quality can vary significantly by orders of magnitude due to changes in traffic volumes, meteorological conditions and wind direction. In 2011 the UK DEFRA published research (2011) on the long term trends in NO_2 and NO_x for roadside monitoring sites in the UK. This study found a marked decrease in NO_2 concentrations between 1996 and 2002, after which the concentrations stabilised with little reduction between 2004 and 2010. The result of this study is that there now exists a gap between projected NO_2 concentrations which UK DEFRA previously published and monitored concentrations. The impact of this 'gap' is that the DMRB screening model can under-predict NO_2 concentrations for predicted for future years. Subsequently, the UK Highways Agency (HA) published an Interim advice note (IAN 170/12) in order to correct the DMRB results for future years.

8.3.3 Review of Available Background Air Quality Data

Air quality monitoring programs have been undertaken in recent years by the EPA and Local Authorities. The most recent annual report on air quality in Ireland is "*Air Quality In Ireland 2016 – Indicators of Air Quality*" (EPA, 2017a). The EPA website details the range and scope of monitoring undertaken throughout Ireland and provides both monitoring data and the results of previous air quality assessments (EPA, 2018).

As part of the implementation of the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2018). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D. In terms of air monitoring and assessment, the proposed scheme is within Zone A (EPA, 2017b). The long-term monitoring data has been used to determine background concentrations for the key pollutants in the region of the proposed scheme. The background concentration account for all non-traffic derived emissions (e.g. natural sources, industry, home heating etc.).

With regard to NO_2, continuous monitoring data from the EPA (EPA, 2017a, 2018) at the Zone A locations of Winetavern Street, Rathmines, Dún Laoghaire and Swords show that levels of NO_2 are below both the annual and 1-hour limit values. Average long-term concentrations range from 13 - 37 µg/m^3 for the period 2012 – 2016; city centre roadside locations experience higher concentrations and are not representative of the area of the proposed scheme (see Table 8- 2: Trends In Zone A Air Quality - Nitrogen Dioxide (NO_2)). There were four exceedances of the maximum 1 hour limit of 200 µg/m^3 in Swords in 2014 (18 exceedances are allowed per year). The most representative monitoring station is Dún Laoghaire which is located approximately 5km north-east of the proposed scheme and suggests an upper average annual mean concentration of no more than 17 µg/m^3. Based on these results a conservative estimate of the current background NO_2 concentration in the region of proposed scheme is 19 µg/m^3.

Table 8- 2: Trends In Zone A Air Quality - Nitrogen Dioxide (NO_2)

Year	Winetavern Street	Rathmines	Dún Laoghaire	Swords
2012	29	21	18	15
2013	31	19	16	15
2014	31	17	15	14
2015	31	18	16	13
2016	37	20	19	16
Average	**31.7**	**19.0**	**16.7**	**14.5**

Continuous PM_{10} monitoring carried out at the locations of Winetavern Street, Rathmines, Dún Laoghaire and Tallaght showed annual mean concentrations for the 2012 – 2016 period ranging from 12 – 17 µg/m³ (Table 8- 3: Trends In Trends In Zone A Air Quality - PM_{10}), with at most 8 exceedances (in Rathmines) of the 24-hour limit value of 50 µg/m³ (35 exceedances are permitted per year) (EPA, 2017). This long-term data suggests an upper average concentration of no more than 15 µg/m³. Dún Laoghaire is the most representative monitoring station with an upper average limit of no more than 14 µg/m³. Based on the EPA data (Table 8- 3: Trends In Trends In Zone A Air Quality - PM_{10}) a conservative estimate of the current background PM_{10} concentration in the region of the proposed scheme is 15 µg/m³.

Table 8- 3: Trends In Trends In Zone A Air Quality - PM_{10}

Year	Winetavern Street	Rathmines	Dún Laoghaire	Tallaght
2012	13	14	12	-
2013	14	17	17	17
2014	14	14	14	15
2015	14	15	13	14
2016	14	15	13	14
Average	**13.8**	**15.0**	**13.8**	**15.1**

Continuous $PM_{2.5}$ monitoring carried out at the Zone A location of Rathmines showed average levels of 9 – 11 µg/m³ over the 2012 - 2016 period, with a $PM_{2.5}/PM_{10}$ ratio ranging from 0.64 – 0.79. In the absence of $PM_{2.5}$ data from the most representative station in Dún Laoghaire, a conservative ratio of 0.8 based on data from Rathmines was used to generate a current background $PM_{2.5}$ concentration in the region of the proposed scheme of 12 µg/m³.

In terms of benzene, the annual mean concentration in the Zone A monitoring location of Rathmines for 2016 was 1.01 µg/m³. This is well below the limit value of 5 µg/m³. Between 2012 - 2016 annual mean concentrations at Zone A sites ranged from 0.92 – 1.2 µg/m³. Based on this EPA data a conservative estimate of the current background benzene concentration in the region of the proposed scheme is 1.0 µg/m³.

With regard to CO, annual averages at the Zone A locations of Winetavern Street and Coleraine Street over the 2012 – 2016 period are low, peaking at 5% of the limit value (10 mg/m³) (EPA, 2017a). Based on this EPA data, a conservative estimate of the current background CO concentration in the region of the proposed scheme is 0.5 mg/m³.

Background concentrations for the Opening (2020) and Design (2035) years are calculated using estimated current background concentrations and the year on year reduction factors provided by Transport Infrastructure Ireland in the *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (2011) and the UK Department for Environment, Food and Rural Affairs LAQM.TG(16) (2016a).

8.4 Predicted Impacts

The scheme has an opening year of 2020. When considering a development of this nature, the potential air quality and climate impact on the surroundings must be considered for each of two distinct stages:

A. construction phase, and;

B. operational phase.

During the construction stage the main source of air quality impacts will be as a result of fugitive dust emissions from site activities. Emissions from construction vehicles and machinery have the potential to impact climate. The primary sources of air and climatic emissions in the operational context are deemed long term and will involve the change in traffic flows or congestion in the local areas which are associated with the development.

The following describes the primary sources of potential air quality and climate impacts which have been assessed as part of this EIAR.

8.4.1 Do Nothing Scenario

The Do Nothing scenario includes retention of the current sites without the proposed scheme. In this scenario, ambient air quality in the area will remain as per the baseline and will change in accordance with trends within the wider area (including influences from potential new developments in the surrounding area, changes in road traffic, etc).

The Do Nothing scenario for the operational phase of the proposed scheme is assessed under the operation phase local air quality impact assessment.

8.4.2 Construction Phase

8.4.2.1 Air Quality

The greatest potential impact on air quality during the construction phase of the proposed scheme is from construction dust emissions and the potential for nuisance dust and PM_{10}/$PM_{2.5}$ emissions. While construction dust tends to be deposited within 200m of a construction site, the majority of the deposition occurs within the first 50m. As this is a moderate scale development there is the potential for soiling impacts up to 50m from the source (Table 8- 4: Assessment Criteria for the Impact of Dust from Construction, with Standard Mitigation in Place (TII, 2011) (TII, 2011).

There are a number of sensitive receptors, predominantly residential properties along the length of the proposed scheme in close proximity to potential works areas. Due to the nature of the scheme, potential impacts as a result of construction dust emissions will be short-term and temporary in nature. In order to minimise dust emissions during construction, a series of mitigation measures have been prepared in the form of a dust minimisation plan. Provided the dust minimisation measures outlined in the plan (see Appendix 8.3) are adhered to, the air quality impacts during the construction phase will not be significant. These measures are summarised in the mitigation section of this chapter.

Table 8- 4: Assessment Criteria for the Impact of Dust from Construction, with Standard Mitigation in Place (TII, 2011)

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 roads	100m	25m	25m
Moderate	Moderate sized construction sites, with moderate use of haul roads	50m	15m	15m
Minor	Minor construction sites, with limited use of haul roads	25m	10m	10m

8.4.2.2 Climate

There is the potential for a number of greenhouse gas emissions to atmosphere during the construction of the proposed scheme. Construction vehicles, generators etc., may give rise to CO_2 and N_2O emissions. However, the impact on climate is considered to be **imperceptible** in the **long and short term**.

8.4.2.3 Human Health

Best practice mitigation measures are proposed for the construction phase of the proposed scheme which will focus on the pro-active control of dust and other air pollutants to minimise generation of emissions at source. The mitigation measures that will be put in place during construction of the proposed scheme will ensure that the impact of the scheme complies with all EU ambient air quality legislative limit values which are based on the protection of human health. Therefore, the impact of construction of the proposed scheme is likely to be **short-term** and **imperceptible** with respect to human health.

8.4.3 Operational Phase

8.4.3.1 Local Air Quality

There is the potential for a number of emissions to the atmosphere during the operational phase of the scheme. In particular, the traffic-related air emissions may generate quantities of air pollutants such as NO_2, CO, benzene and PM_{10}.

Traffic flow information was obtained from traffic engineers for this project and has been used to model pollutant levels under various traffic scenarios and under sufficient spatial resolution to assess whether any significant air quality impact on sensitive receptors may occur.

Cumulative effects have been assessed, as recommended in the EU Directive on EIA (Council Directive 2014/52/EU) and using the methodology of the UK DEFRA (2016a; 2016b). Firstly, background concentrations have been included in the modelling study. These background concentrations are year-specific and account for non-localised sources of the pollutants of concern. Appropriate background levels were selected based on the available monitoring data provided by the EPA (EPA, 2017a; 2018).

The impact of the proposed scheme has been assessed by modelling emissions from the traffic generated as a result of the scheme. The impact of CO, benzene, NO_2, PM_{10} and $PM_{2.5}$ for the opening and design years was predicted at the nearest sensitive receptors to the development. This assessment allows the significance of the development, with respect to both relative and absolute impact, to be determined.

The receptors modelled represent the worst-case locations close to the proposed scheme and were chosen due to their close proximity (within 200m) to the road links impacted by proposed scheme. The worst-case traffic data used in this assessment is shown in Table 8- 5: Traffic Data used in Modelling Assessment, with the percentage of HGV's shown in parenthesis below the AADT. Nine sensitive receptors in the vicinity of the proposed scheme have been assessed. Sensitive receptors have been chosen as they have the potential to be adversely impacted by the development, these receptors are detailed in Table 8- 6: Description of Sensitive Receptors.

Table 8- 5: Traffic Data used in Modelling Assessment

Link Number	Road Name	Base Year	Do-Nothing		Do-Something		Speed (kph)
		2017	2020	2035	2020	2035	
1	Glenamuck Rd South (E)	12300 (4.4%)	13350 (5.3%)	17800 (7.6%)	2700 (1.7%)	5000 (1.8%)	50
2	R117 Enniskerry Rd (N)	7650 (3.7%)	9000 (4%)	14500 (5.1%)	11950 (3%)	16250 (4.4%)	50
3	Glenamuck Rd South (W)	9000 (2.7%)	10450 (3.1%)	13900 (4.8%)	1900 (2.2%)	5750 (3.2%)	50
4	R117 Enniskerry Rd (S)	8350 (4.6%)	10500 (5%)	16900 (6.2%)	1400 (1.1%)	2050 (1.5%)	50
5	Barnaslingan Lane	350 (1.6%)	500 (1.4%)	800 (1.1%)	500 (1.4%)	800 (1.5%)	50
6	R116 Ballycorus Rd	2200 (2.7%)	4050 (2.7%)	7100 (3.3%)	4950 (2.4%)	11600 (2.9%)	50
7	Glenamuck District Distributor Rd (E)	0 (0%)	0 (0%)	0 (0%)	13200 (6.3%)	26600 (8.6%)	50
8	Glenamuck District Distributor Rd (E) Junct GLDR	0 (0%)	0 (0%)	0 (0%)	1400 (5.6%)	26450 (8.7%)	50
9	Glenamuck District Distributor Rd (W)	0 (0%)	0 (0%)	0 (0%)	7250 (3.2%)	14250 (6%)	50
10	Glenamuck Link Distributor Rd (N)	0 (0%)	0 (0%)	0 (0%)	12550 (4.3%)	21600 (5.4%)	50
11	R117 Enniskerry Rd Junct Glenamuck Rd South	0 (0%)	9050 (4%)	14600 (4%)	4700 (2.7%)	5800 (3.2%)	50
12	Glenamuck Link Distributor Rd (S)	0 (0%)	0 (0%)	0 (0%)	10850 (5%)	20450 (4.7%)	50
13	Glenamuck Link Distributor Rd south of Ballycorus Rd	0 (0%)	0 (0%)	0 (0%)	11900 (4.4%)	16800 (4.8%)	50

Table 8- 6: Description of Sensitive Receptors

Receptor	Type	Irish Grid Coordinates	
		Easting	Northing
1	Residential	321566	223653
2	Residential	320772	223051
3	Residential	320286	223186
4	School	320212	222871
5	Residential	320647	222667
6	Sports Club	320944	222750
7	Residential	320961	222146
8	Residential	320937	221940
9	Residential	320996	221758

Modelling Assessment

Transport Infrastructure Ireland '*Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes*' (2011) detail a methodology for determining air quality impact significance criteria for road schemes. The degree of impact is determined based on both the absolute and relative impact of the proposed scheme. Results are compared against the 'Do-Nothing' scenario, which assumes that the proposed scheme is not in place in future years, in order to determine the degree of impact.

"Do Nothing" (DN) Scenario

NO_2

The results of the "do nothing" assessment of annual average NO_2 concentrations in the opening and design years are shown in Table 8- 7: Annual Mean NO_2 Concentrations (µg/m^3) (using Interim advice note 170/12 V3 Long Term NO_2 Trend Projections) for the Highways Agency IAN 170/12 and Table 8- 8: Annual Mean NO_2 Concentrations (µg/m^3) (using UK Department for Environment, Food and Rural Affairs Technical Guidance) using the UK Department for Environment, Food and Rural Affairs technique respectively. The purpose of IAN 170/12 was to account for the conclusions of UK's Department for Environment, Food and Rural Affairs advice on long term trends that there is now a gap between current projected vehicle emission reductions and projections on the annual rate of improvements in ambient air quality as previously published in UK Department for Environment, Food and Rural Affairs technical guidance and observed trends. Hence, the projections calculated via the IAN 170/12 technique show a slower than previously predicted reduction between the base year and future year predictions. Concentrations are below the limit value at all locations, with levels ranging from 56% of the limit in the opening year (2020) and 58% in the design year (2035) using the more conservative IAN 170/12 V3 method.

The hourly limit value for NO_2 is 200 µg/m^3 is expressed as a 99.8th percentile (i.e. it must not be exceeded more than 18 times per year). The maximum 1-hour NO_2 concentrations for the "do nothing" scenario is not predicted to be exceeded in 2020 or 2035 (see Table 8- 9: 99.8th percentile of daily maximum 1-hour for NO_2 concentrations (µg/m^3)).

PM_{10}

The results of the "do nothing" modelling assessment for PM_{10} in the opening and design years are shown in Table 8- 10: Annual Mean PM_{10} Concentrations ($\mu g/m^3$). Concentrations are well within the annual limit value at all worst-case receptors. In addition, the 24-hour PM_{10} concentration of 50 $\mu g/m^3$ is not exceeded at the receptors modelled (Table 8- 11: Number of days with PM_{10} concentration > 50 $\mu g/m^3$). Annual average PM_{10} concentrations are 38.9% of the limit value in 2020 and 39.6% in 2035.

$PM_{2.5}$

The results of the "do nothing" modelling assessment for $PM_{2.5}$ in the opening and design years are shown in Table 8- 12: $PM_{2.5}$ Annual Mean $PM_{2.5}$ Concentrations ($\mu g/m^3$). The predicted concentrations at all worst-case receptors are well below the $PM_{2.5}$ limit value of 25 $\mu g/m^3$. The annual average $PM_{2.5}$ concentration peaks at 41% of the limit value in 2020 and 2035.

CO and Benzene

The results of the modelled impact for CO and benzene in the opening and design years are shown in Table 8- 13: Maximum 8-hour CO Concentrations (mg/m^3) and Table 8- 14: Annual Mean Benzene Concentrations ($\mu g/m^3$) respectively. The results for the "do nothing" assessment are below the ambient standards at all locations. Levels of CO are 28% of the limit value in 2020; with levels of benzene reaching 21% of the limit value. Future trends indicate similarly low levels of CO and benzene. Levels of both pollutants are below their respective limit values, with CO reaching 25% of the limit and benzene reaching 22% in 2030.

There are some increases in traffic volumes between 2020 and 2035 therefore, any decrease in concentrations is as a result of decreasing background concentrations and better engine efficiency and technology.

"Do Something" (DS) Scenario

NO_2

The results of the assessment of the impact of the proposed scheme on NO_2 in the opening and design years are shown Table 8- 7: Annual Mean NO_2 Concentrations ($\mu g/m^3$) (using Interim advice note 170/12 V3 Long Term NO_2 Trend Projections) for the Highways Agency IAN 170/12 and Table 8- 8: Annual Mean NO_2 Concentrations ($\mu g/m^3$) (using UK Department for Environment, Food and Rural Affairs Technical Guidance) using the UK Department for Environment, Food and Rural Affairs technique respectively. The annual average concentration is within the limit value at all worst-case receptors using both techniques. Levels of NO_2 are 57.9% and 67.9% of the annual limit value in 2020 and 2035 using the more conservative IAN technique, while concentrations are 47.7% and 47.6% of the annual limit value in 2020 and 2035 using the UK Department for Environment, Food and Rural Affairs technique. The hourly limit value for NO_2 is 200 $\mu g/m^3$ and is expressed as a 99.8th percentile (i.e. it must not be exceeded more than 18 times per year). The maximum 1-hour NO_2 concentration is not predicted to be exceeded in 2020 or 2035 using either technique (Table 8- 9: 99.8th percentile of daily maximum 1-hour for NO_2 concentrations ($\mu g/m^3$)).

The impact of the proposed scheme on annual mean NO_2 levels can be assessed relative to "Do Nothing (DN)" levels in 2020 and 2035. Relative to baseline levels, some large increases in pollutant levels are predicted as a result of the proposed scheme. With regard to impacts at individual receptors, the

greatest impact on NO_2 concentrations will be an increase of 23% of the annual limit value at Receptor 7. Thus, using the assessment criteria outlined in Appendix 8.2 Tables A.8.2.1 – A.8.2.2, the impact of the proposed development in terms of NO_2 is slight adverse. However, there are a number of receptors that will receive a beneficial impact with the development of the proposed scheme; there will be a decrease of at least 6% of the limit value at Receptors 1 and 5 along the R842 once the proposed scheme is developed which according to the criteria in Appendix 8.2, Tables A.8.2.1 – A.8.2.2 results in a slight beneficial rating.

Therefore, the overall impact of NO_2 concentrations as a result of the proposed scheme is **long-term** and **slight negative** at the majority of receptors along the proposed route, but with a **slight beneficial** impact at receptors located in bypassed areas such as along the R117.

PM_{10}

The results of the modelled impact of the proposed scheme for PM_{10} in the opening and design years are shown in Table 8- 10: Annual Mean PM_{10} Concentrations (µg/m³). Predicted annual average concentrations at the worst-case receptor in the region of the scheme are at most 39% of the limit value in 2020. Future trends with the proposed scheme in place indicate similarly low levels of PM_{10}. Annual average PM_{10} concentrations are 41% of the limit in 2035. Furthermore, it is not predicted that the worst-case receptors will have any exceedances of the 50 µg/m³ 24-hour mean value in 2020 or 2035 (Table 8- 11: Number of days with PM_{10} concentration > 50 µg/m³).

The impact of the proposed development can be assessed relative to "Do Nothing" levels in 2020 and 2035 (see Table 8- 10: Annual Mean PM_{10} Concentrations (µg/m³)). Relative to baseline levels, some small increases in PM_{10} levels at the worst-case receptors are predicted as a result of the proposed scheme. The greatest impact on PM_{10} concentrations in the region of the proposed scheme in either 2020 or 2035 will be an increase of 3.4% of the annual limit value at Receptor 7, which results in a negligible rating according to Appendix 8.2 Tables A.8.2.1 – A.8.2.3. However, there are some receptors for which the proposed scheme will result in a beneficial impact. There will be a decrease of at least 1% of the limit value at Receptors 1 and 5 on the R842, this equates to a negligible rating when assessed against the significance criteria in Appendix 8.2 Tables A.8.2.1 – A.8.2.2

Thus, the magnitude of the changes in air quality are negligible at all receptors based on the criteria outlined in Appendix 8.2 Tables A.8.2.1 – A.8.2.3. Therefore, the overall impact of PM_{10} concentrations as a result of the proposed scheme is **long-term** and **imperceptible**.

$PM_{2.5}$

The results of the modelled impact of the proposed scheme for $PM_{2.5}$ in the opening and design years are shown in Table 8- 12: $PM_{2.5}$ Annual Mean $PM_{2.5}$ Concentrations (µg/m³). Predicted annual average concentrations in the region of the proposed scheme are 41% of the limit value in 2020 at all worst-case receptors. Future trends with the development in place indicate similarly low levels of $PM_{2.5}$; annual average $PM_{2.5}$ concentrations are 42% of the limit in 2035.

The impact of the development can be assessed relative to "Do Nothing" levels in 2020 and 2035. Relative to baseline levels, small increases in $PM_{2.5}$ levels at the worst-case receptors are predicted as a result of the proposed scheme. The greatest impact on $PM_{2.5}$ concentrations in the region of the proposed scheme in either 2020 or 2035 will be an increase of 3.5% of the annual limit value at Receptor

7, which results in a negligible rating according to Appendix 8.2 Tables A8.2.1 – A.8.2.2. However, there are some receptors for which the proposed scheme will result in a beneficial impact. There will be a decrease of at least 1% of the limit value at Receptors 1 and 5, this equates to a negligible rating when assessed against the significance criteria in Appendix 8.2 Tables A.8.2.1 – A.8.2.2.

Therefore, using the assessment criteria outlined in Appendix 8.2 Tables A.8.2.1 – A.8.2.2, the impact of the proposed scheme with regard to $PM_{2.5}$ is negligible at all of the receptors assessed. Overall, the impact of increased $PM_{2.5}$ concentrations as a result of the proposed scheme is **long-term** and **imperceptible**.

CO and Benzene

The results of the modelled impact of the CO and benzene in the opening and design years are shown in Table 8- 13: Maximum 8-hour CO Concentrations (mg/m^3) and Table 8- 14: Annual Mean Benzene Concentrations (µg/m^3) respectively. Predicted pollutant concentrations with the proposed scheme in place are below the ambient standards at all locations. Levels of CO are 28% of the limit value in 2020; with levels of benzene reaching 21% of the limit value. Future trends indicate similarly low levels of CO and benzene. Levels of both pollutants are below their respective limit values, with CO reaching 25% of the limit and benzene reaching 22% in 2035. There are some increases in traffic flows between 2020 and 2035, therefore any reduction in concentrations is due to reduced background concentrations and greater efficiencies predicted in engines.

The impact of the proposed development can be assessed relative to "Do Nothing" levels in 2020 and 2035. Relative to baseline levels, some imperceptible increases in pollutant levels at the worst-case receptors are predicted as a result of the proposed scheme. The greatest impact on CO and benzene concentrations in either 2020 or 2035 will be an increase of 3.8% of the limit value for CO at Receptor 7 and an increase of 2.0% of the limit value for benzene at Receptor 7. Any beneficial impacts as a result of the proposed scheme with regard to CO and benzene are also considered imperceptible.

Thus, using the assessment criteria for NO_2 and PM_{10} outlined in Appendix 8.2 and applying these criteria to CO and benzene, the impact of the proposed scheme in terms of CO and benzene is **negligible**, **long-term** and **imperceptible**.

Summary of Local Air Quality Modelling Assessment

Levels of traffic-derived air pollutants for the development will not exceed the ambient air quality standards either with or without the proposed scheme in place. Using the assessment criteria outlined in Appendix 8.2 Tables A.8.2.1 – A.8.2.3, the impact of the development in terms of NO_2, is **slight negative** at the majority of receptors along the proposed route but is there is a **slight positive** impact in bypassed areas such as the R842. In terms of all other pollutants: PM_{10}, $PM_{2.5}$, CO and benzene the impact is considered imperceptible and long-term.

Impact on Regional Air Quality

The regional impact of the proposed development on emissions of NO_x and VOCs has been assessed using the procedures of Transport Infrastructure Ireland (2011) and the UK Department for Environment, Food and Rural Affairs (2016a). The results (see Table 8- 15: Regional Air Quality & Climate Assessment) show that the likely impact of the proposed scheme on Ireland's obligations under the Targets set out

by Directive EU 2016/2284 "*On the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC*" are imperceptible and long-term. For the assessment year of 2020, the predicted impact of the changes in AADT is to increase NO_X levels by 0.0022% of the NO_X emissions ceiling and increase VOC levels by 0.00088% of the VOC emissions ceiling to be complied with in 2020. For the assessment year of 2035, the predicted impact of the changes in AADT is to increase NO_X levels by 0.012% of the NO_X emissions ceiling and increase VOC levels by 0.0035% of the VOC emissions ceiling to be complied with in 2035.

8.4.3.2 Climate

The impact of the proposed scheme on emissions of CO_2 were also assessed using the Design Manual for Roads and Bridges screening model (see Table 8- 15: Regional Air Quality & Climate Assessment). The results show that the impact of the proposed scheme in 2020 will be to increase CO_2 emissions by 0.0017% of Ireland's EU 2020 Target. In the design year of 2035, the proposed scheme will increase CO_2 emissions by 0.006% of the EU 2020 Target. Thus, the impact of the proposed scheme on national greenhouse gas emissions will be insignificant in terms of Ireland's obligations under the EU 2020 Target (EU, 2017).

Therefore, the likely overall magnitude of the changes on climate in the operational stage are **imperceptible**, **long-term** and **not significant**.

Table 8- 7: Annual Mean NO_2 Concentrations (µg/m³) (using Interim advice note 170/12 V3 Long Term NO_2 Trend Projections)

Receptor	Impact Opening Year (2020)					Impact Design Year (2035)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	22.4	18.4	-3.96	Medium	Medium Decrease	23.3	17.9	-5.34	Large	Large Decrease
2	17.6	18.9	1.28	Small	Small Increase	16.4	18.7	2.33	Medium	Medium Increase
3	18.8	20.1	1.26	Small	Small Increase	18.8	21.3	2.51	Medium	Medium Increase
4	18.0	17.7	-0.38	Imperceptible	Negligible Decrease	17.2	16.4	-0.81	Small	Small Decrease
5	20.1	17.5	-2.55	Medium	Medium Decrease	20.5	17.2	-3.28	Medium	Medium Decrease
6	17.5	18.6	1.11	Small	Small Increase	16.2	18.1	1.95	Small	Small Increase
7	18.3	23.2	4.83	Large	Large Increase	18.0	27.2	9.14	Large	Large Increase
8	19.4	18.4	-1.02	Small	Small Decrease	19.6	17.4	-2.18	Medium	Medium Decrease
9	20.3	19.1	-1.17	Small	Small Decrease	21.1	18.5	-2.62	Medium	Medium Decrease

Table 8- 8: Annual Mean NO_2 Concentrations (µg/m³) (using UK Department for Environment, Food and Rural Affairs Technical Guidance)

Receptor	Impact Opening Year (2020)					Impact Design Year (2035)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	19.2	15.8	-3.39	Medium	Medium Decrease	17.7	13.7	-4.07	Large	Large Decrease
2	14.5	15.5	1.05	Small	Small Increase	11.4	13.0	1.62	Small	Small Increase
3	15.6	16.7	1.05	Small	Small Increase	13.4	15.2	1.79	Small	Small Increase
4	14.9	14.6	-0.31	Imperceptible	Negligible Decrease	12.1	11.5	-0.57	Small	Small Decrease
5	16.9	14.7	-2.14	Medium	Medium Decrease	15.0	12.6	-2.40	Medium	Medium Decrease
6	14.3	15.2	0.91	Small	Small Increase	11.2	12.5	1.35	Small	Small Increase
7	15.1	19.1	3.98	Medium	Medium Increase	12.6	19.0	6.40	Large	Large Increase
8	16.2	15.3	-0.85	Small	Small Decrease	14.1	12.5	-1.57	Small	Small Decrease
9	17.0	16.0	-0.98	Small	Small Decrease	15.4	13.5	-1.91	Small	Small Decrease

Table 8- 9: 99.8th percentile of daily maximum 1-hour for NO_2 concentrations (µg/m³)

Receptor	IAN 170/12 V3 Long Term NO_2 Trend Projections Technique				Defra's Technical Guidance Technique			
	Impact Opening Year (2020)		Impact Design Year (2035)		Impact Opening Year (2020)		Impact Design Year (2035)	
	DN	DS	DN	DS	DN	DS	DN	DS
1	78.3	64.5	81.5	62.8	78.3	64.5	81.5	62.8
2	61.6	66.1	57.4	65.6	61.6	66.1	57.4	65.6
3	65.8	70.2	65.9	74.7	65.8	70.2	65.9	74.7
4	63.2	61.8	60.3	57.5	63.2	61.8	60.3	57.5
5	70.3	61.4	71.6	60.1	70.3	61.4	71.6	60.1
6	61.1	65	56.6	63.4	61.1	65	56.6	63.4
7	64.2	81.1	63.1	95	64.2	81.1	63.1	95
8	67.9	64.3	68.7	61	67.9	64.3	68.7	61
9	70.9	66.8	73.9	64.8	70.9	66.8	73.9	64.8

Table 8- 10: Annual Mean PM_{10} Concentrations (µg/m³)

Receptor	Impact Opening Year (2020)					Impact Design Year (2035)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	15.6	15.0	-0.62	Small	Small Decrease	15.9	15.2	-0.68	Small	Small Decrease
2	14.7	14.9	0.21	Imperceptible	Negligible Increase	14.7	15.0	0.32	Imperceptible	Negligible Increase
3	14.9	15.2	0.23	Imperceptible	Negligible Increase	15.1	15.5	0.36	Imperceptible	Negligible Increase
4	14.8	14.7	-0.06	Imperceptible	Negligible Decrease	14.8	14.7	-0.12	Imperceptible	Negligible Decrease
5	15.2	14.8	-0.44	Small	Small Decrease	15.4	15.0	-0.46	Small	Small Decrease
6	14.7	14.8	0.17	Imperceptible	Negligible Increase	14.7	14.9	0.27	Imperceptible	Negligible Increase
7	14.8	15.6	0.77	Small	Small Increase	15.0	16.3	1.35	Small	Small Increase
8	15.0	14.9	-0.15	Imperceptible	Negligible Decrease	15.2	14.9	-0.27	Imperceptible	Negligible Decrease
9	15.2	15.0	-0.17	Imperceptible	Negligible Decrease	15.5	15.1	-0.33	Imperceptible	Negligible Decrease

Table 8- 11: Number of days with PM_{10} concentration > 50 µg/m³

Receptor	Impact Opening Year (2020)		Impact Design Year (2035)	
	DN	DS	DN	DS
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0

Table 8- 12: $PM_{2.5}$ Annual Mean $PM_{2.5}$ Concentrations (µg/m³)

Receptor	Impact Opening Year (2020)					Impact Design Year (2035)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	10.1	9.7	-0.40	Small	Small Decrease	10.3	9.9	-0.44	Small	Small Decrease
2	9.5	9.7	0.13	Imperceptible	Negligible Increase	9.6	9.8	0.21	Imperceptible	Negligible Increase
3	9.7	9.8	0.15	Imperceptible	Negligible Increase	9.8	10.1	0.24	Imperceptible	Negligible Increase
4	9.6	9.6	-0.04	Imperceptible	Negligible Decrease	9.6	9.6	-0.07	Imperceptible	Negligible Decrease
5	9.9	9.6	-0.29	Imperceptible	Negligible Decrease	10.0	9.7	-0.30	Imperceptible	Negligible Decrease
6	9.5	9.6	0.11	Imperceptible	Negligible Increase	9.5	9.7	0.18	Imperceptible	Negligible Increase
7	9.6	10.1	0.50	Small	Small Increase	9.7	10.6	0.88	Small	Small Increase
8	9.8	9.7	-0.10	Imperceptible	Negligible Decrease	9.9	9.7	-0.18	Imperceptible	Negligible Decrease
9	9.9	9.8	-0.11	Imperceptible	Negligible Decrease	10.1	9.8	-0.21	Imperceptible	Negligible Decrease

Table 8- 13: Maximum 8-hour CO Concentrations (mg/m³)

Receptor	Impact Opening Year (2020)					Impact Design Year (2035)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	2.75	2.59	-0.169	Imperceptible	Negligible Decrease	2.81	2.64	-0.163	Imperceptible	Negligible Decrease
2	2.51	2.57	0.060	Imperceptible	Negligible Increase	2.51	2.60	0.087	Imperceptible	Negligible Increase
3	2.58	2.65	0.071	Imperceptible	Negligible Increase	2.62	2.72	0.099	Imperceptible	Negligible Increase
4	2.53	2.52	-0.016	Imperceptible	Negligible Decrease	2.55	2.52	-0.032	Imperceptible	Negligible Decrease
5	2.66	2.53	-0.130	Imperceptible	Negligible Decrease	2.71	2.59	-0.124	Imperceptible	Negligible Decrease
6	2.50	2.55	0.048	Imperceptible	Negligible Increase	2.50	2.57	0.075	Imperceptible	Negligible Increase
7	2.55	2.77	0.217	Imperceptible	Negligible Increase	2.59	2.97	0.376	Imperceptible	Negligible Increase
8	2.60	2.56	-0.040	Imperceptible	Negligible Decrease	2.65	2.58	-0.068	Imperceptible	Negligible Decrease
9	2.65	2.60	-0.044	Imperceptible	Negligible Decrease	2.72	2.64	-0.081	Imperceptible	Negligible Decrease

Table 8- 14: Annual Mean Benzene Concentrations (µg/m³)

Receptor	Impact Opening Year (2020)					Impact Design Year (2035)				
	DN	DS	DS-DN	Magnitude	Description	DN	DS	DS-DN	Magnitude	Description
1	1.06	1.02	-0.037	Imperceptible	Negligible Decrease	1.07	1.04	-0.037	Imperceptible	Negligible Decrease
2	1.00	1.02	0.014	Imperceptible	Negligible Increase	1.00	1.03	0.024	Imperceptible	Negligible Increase
3	1.02	1.03	0.016	Imperceptible	Negligible Increase	1.03	1.05	0.024	Imperceptible	Negligible Increase
4	1.01	1.00	-0.004	Imperceptible	Negligible Decrease	1.01	1.00	-0.007	Imperceptible	Negligible Decrease
5	1.04	1.01	-0.030	Imperceptible	Negligible Decrease	1.05	1.02	-0.027	Imperceptible	Negligible Decrease
6	1.00	1.01	0.011	Imperceptible	Negligible Increase	1.00	1.02	0.020	Imperceptible	Negligible Increase
7	1.01	1.06	0.049	Imperceptible	Negligible Increase	1.02	1.12	0.100	Imperceptible	Negligible Increase
8	1.02	1.01	-0.009	Imperceptible	Negligible Decrease	1.03	1.02	-0.016	Imperceptible	Negligible Decrease
9	1.03	1.02	-0.010	Imperceptible	Negligible Decrease	1.05	1.03	-0.019	Imperceptible	Negligible Decrease

Table 8- 15: Regional Air Quality & Climate Assessment

Year	Scenario	VOC (kg/annum)	NOx (kg/annum)	CO_2 (tonnes/annum)
2020	Do Nothing	2428	7795	4154
	Do Something	2839	9017	4855
2035	Do Nothing	3876	13032	6680
	Do Something	5362	17950	9239
Increment in 2020		411.2 kg	1222.5 kg	701.4 Tonnes
Increment in 2035		1486 kg	4918.3 kg	2559.7 Tonnes
Emission Ceiling (kilo Tonnes) 2020 Note 1		46.5	46.5	56.1
Emission Ceiling (kilo Tonnes) 2035 Note 2		42.2	42.2	27.5
Impact in 2020 (%)		0.00088 %	0.002 %	0.0017%
Impact in 2035 (%)		0.0035 %	0.018 %	0.0060 %

Note 1 Targets under Directive EU 2016/2284 "On the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC"

Note 2 20-20-20 Climate and Energy Package

8.5 Mitigation Measures

In order to sufficiently ameliorate the likely air quality impact, a schedule of air control measures has been formulated for both construction and operational phases associated with the proposed development.

8.5.1 Construction Phase

8.5.1.1 Air Quality

The pro-active control of fugitive dust will ensure the prevention of significant emissions, rather than an inefficient attempt to control them once they have been released. The main contractor will be responsible for the coordination, implementation and ongoing monitoring of the dust management plan. The key aspects of controlling dust are listed below. Full details of the dust management plan can be found in Appendix 8.3.

- The specification and circulation of a dust management plan for the site and the identification of persons responsible for managing dust control and any potential issues;
- The development of a documented system for managing site practices with regard to dust control;
- The development of a means by which the performance of the dust management plan can be monitored and assessed;
- The specification of effective measures to deal with any complaints received.

At all times, the procedures within the plan will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust would be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

8.5.1.2 Climate

Construction traffic and embodied energy of construction materials are expected to be the dominant source of greenhouse gas emissions as a result of the construction phase of the development. Construction vehicles, generators etc., may give rise to some CO_2 and N_2O emissions. However, due to short-term and temporary nature of these works, the impact on climate will not be significant.

Nevertheless, some site-specific mitigation measures can be implemented during the construction phase of the proposed development to ensure emissions are reduced further. In particular the prevention of on-site or delivery vehicles from leaving engines idling, even over short periods. Minimising waste of materials due to poor timing or over ordering on site will aid to minimise the embodied carbon footprint of the site.

8.5.2 Operational Phase

8.5.2.1 Air Quality

Mitigation measures in relation to traffic-derived pollutants have focused generally on improvements in both engine technology and fuel quality. EU legislation, based on the EU sponsored Auto-Oil

programmes, has imposed stringent emission standards for key pollutants (REGULATION (EC) No 715/2007) for passenger cars which was complied with in 2009 (Euro V) and 2014 (Euro VI).

As outlined in the TII guidance (2011), the guidance states that "for the purpose of the EIS, it should be assumed that pollutant concentrations will decline in future years, as a result of various initiatives to reduce vehicle emissions both in Europe and in Ireland" (Page 52). A range of legislation in Europe over the period 1992 – 2013 has significantly reduced the allowable steady cycle emissions of both NO_x and PM from road vehicles with NO_x emission reductions for HDV (Heavy Duty Vehicles) reduced by a factor of 20 and PM by a factor of 36 over this period (Euro I to Euro VI). In relation to LDV (Light Duty Vehicles) the reduction of NO_x and PM from road vehicles has also been significant with NO_x emission reductions from HDV reducing by a factor of 12 and PM by a factor of 40 over this period (Euro I to Euro VI). Although actual on-road emission reductions will be less dramatic, significant reductions in vehicle-related NO_x and PM emissions are to be expected over the next 5-10 years as the fleet turns over.

Emissions of pollutants from road traffic can be controlled most effectively by either diverting traffic away from heavily congested areas or ensuring free flowing traffic through good traffic management plans and the use of automatic traffic control systems (UK DEFRA, 2016a, 2016b).

8.5.2.2 Climate

Improvements in air quality are likely over the next few years as a result of the on-going comprehensive vehicle inspection and maintenance program, fiscal measures to encourage the use of alternatively fueled vehicles and the introduction of cleaner fuels.

CO_2 emissions for the average new car fleet were reduced to 120 g/km by 2012 through EU legislation on improvements in vehicle motor technology and by an increased use of biofuels. This measure has reduced CO_2 emissions from new cars by an average of 25% in the period from 1995 to 2008/2009 whilst 15% of the necessary effort towards the overall climate change target of the EU has been met by this measure alone (DEHLG, 2007).

Additional measures included in the National Climate Change Strategy (DEHLG, 2000, 2006, 2007) include: (1) VRT and Motor Tax rebalancing to favour the purchase of more fuel-efficient vehicles with lower CO_2 emissions; (2) continuing the Mineral Oils Tax Relief II Scheme and introduction of a biofuels obligation scheme; (3) implementation of a national efficient driving awareness campaign, to promote smooth and safe driving at lower engine revolutions; and (4) enhancing the existing mandatory vehicle labelling system to provide more information on CO_2 emission levels and on fuel economy.

8.5.3 Monitoring

There is no monitoring required for the proposed scheme.

8.6 Residual Impacts

8.6.1 Construction Phase

8.6.1.1 Air Quality

When the dust minimisation measures detailed in the mitigation section and Appendix 8.3 of this Section are implemented, fugitive emissions of dust from the site will be insignificant and pose no nuisance at nearby receptors.

8.6.1.2 Climate

Due to the size and nature of the construction activities with appropriate mitigation measures, CO_2 and N_2O emissions during construction will have an imperceptible impact on climate.

8.6.2 Operational Phase

The results of the air dispersion modelling study indicate that the residual impacts of the proposed development on air quality and climate is predicted to be slight adverse with respect to the operational phase for the long and short term.

8.7 Difficulties Encountered

There were no difficulties encountered as part of this assessment.

8.8 References

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- UK Highways Agency (2007) Design Manual for Roads and Bridges Vol 11 Chapter 3, HA 207/07 (Document & Calculation Spreadsheet);
- UK Highways Agency (2012) Interim Advice Note 170/12 Updated air quality advice on the assessment of future NO_x and NO_2 projections for users of DMRB Volume 11, Section 3, Part 1 - Air Quality;
- UK Office of Deputy Prime Minister (2002) Controlling the Environmental Effects of Recycled and Secondary Aggregates Production Good Practice Guidance;
- UN Framework Convention on Climate Change (1997) Kyoto Protocol To The United Nations Framework Convention On Climate Change;
- UN Framework Convention on Climate Change (1999) Ireland - Report on the in-depth review of the second national communication of Ireland;
- USEPA (1997) Fugitive Dust Technical Information Document for the Best Available Control Measures;
- USEPA (1986) Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition (periodically updated); and

- World Health Organisation (2006) Air Quality Guidelines - Global Update 2005 (and previous Air Quality Guideline Reports 1999 & 2000).

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9 Noise and Vibration

9.1 Introduction

This chapter of the EIAR assesses the impacts of noise and vibration associated with the proposed Glenamuck District Roads Scheme. A full description of the development can be found in Section 5 of this EIAR.

The noise and vibration assessment has been prepared by Dr. Aoife Kelly (Acoustic Consultant) who holds a BSc (Hons) in Environmental Health, a Diploma in Acoustics and Noise Control and a PhD in Occupational Noise. Aoife has specialised in acoustics since 2014 and has extensive knowledge in the field of occupational noise risk assessments, environmental noise and vibration impact assessment and inward impact assessments. She has extensive experience in environmental and occupational noise surveying and environmental acoustics.

The assessment takes the worst-case scenario, assuming high traffic growth for future opening and design years.

The assessment of direct, indirect and cumulative noise and vibration impacts on the surrounding environment have been considered as part of the assessment. The assessment of potential impacts presented in this chapter considers the relevant aspects of the *Environmental Protection Agency's Guidelines on the Information to be contained in Environmental Impact Assessment Reports Draft, August 2017* and *Advice Notes for preparing Environmental Impact Statements Draft September 2015.*

Note that Appendix 9.1 presents an overview of the basic fundamentals of acoustics to assist in understanding of this part of the EIAR.

9.2 Methodology

In order to assess the noise impact of any proposed road scheme, the following methodology is normally adopted:

- The first stage is to assess and quantify the existing noise environment in the vicinity of sensitive receptors that may be affected by the proposed development. In the case of a road scheme, the selected noise-sensitive locations are likely to be those in closest proximity to the proposed road.
- The noise levels resulting from both the construction and operational phases are then calculated using established prediction techniques.
- The noise levels associated with the operational phase of the proposed development are predicted in accordance with guidance set out in UK's Calculation of Road Traffic Noise (CRTN), giving results in the form of $L_{A10(18hour)}$ values. These are then converted to L_{den} values in accordance with the procedures detailed in the NRA guidance. The derived values for L_{den} should be rounded to the nearest whole number, with 0.5 being rounded up.
- The results of the predicted assessment are compared against the most appropriate criteria for both construction and operational phases. Where predicted noise levels are in excess of the adopted criteria, mitigation measures are proposed.

Further details of each phase of the assessment are set out in the individual sections of the chapter.

9.2.1 Assessment Criteria

Operational Phase

There are no statutory guidelines or standards for noise mitigation in Ireland applicable for Street or Road Schemes. The Department for Transport, Tourism and Sports *Design Manual for Urban Roads and Streets* (DMRUS) (2013) offers approaches for the design of urban streets, including the acoustic benefits to designing boulevards to separate vehicular traffic from pedestrians. Nevertheless, the DMURS document does not detail noise assessment criteria for residential receivers.

For new national roads in Ireland, it is standard practice to adopt the traffic noise design goal contained within the TII document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes 2004* and Guidance contained within the TII's *Good Practice Guide for the Treatment of Noise during the Planning on National Road Schemes* (2014). Both documents note the use of a traffic noise design goal of 60dB L_{den} (free field residential façade criterion) for new national roads.

The following three conditions must be satisfied under the TII guidelines in order for noise mitigation to be provided:

- 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 of 60dB L_{den};
- the relevant noise level is at least 1dB more than the expected traffic noise level without the proposed road scheme in place, and;
- the contribution to the increase in the relevant noise level from the proposed road scheme is at least 1dB.

It should be noted that the Design Goal is applicable to new national road schemes. In the case of this scheme the proposed distributor road does not fall under the strict requirements for noise design goals set within the TII's guidance document. It is therefore acknowledged that it may not always be sustainable or possible to achieve the 60dB L_{den} design goal at existing or future developments in the area.

This design goal is to be applied to existing receptors in respect of both the year of opening and the design year, typically 15 years after projected year of opening. In this case, an opening year of 2020 and a design year of 2035 have been assessed.

The 2014 Good Practice Guide recognises that "in some cases the attainment of the design goal may not be possible by sustainable means". The guidance also notes that the benefit gained by the insertion of a barrier is limited and notes that for caution should be exercised specifying substantial screening where small benefits (<3dB) are only achieved, given a change of 3dB(A) is the smallest change that would give a reliable difference in public response.

Due to very low levels of vibration generated by road traffic on well-maintained and smooth road surfaces, ground borne vibration from this development is unlikely to cause perceptible levels of

vibration to building occupants. Similarly, the operational phase is not expected to generate any form of cosmetic damage to buildings located in proximity to the alignment. As such, the impacts of operational vibration have not been addressed further in this chapter.

Construction Phase

The TII guidance document specifies noise levels that it typically deems acceptable in terms of construction noise. These limits are set out in Table 9-1.

Table 9-1: Maximum Permissible Noise Levels at the Façade of Nearby Dwellings at Construction

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

It should be noted that the noise criteria quoted in the table are specific to construction activities only (i.e. these levels are not cumulative with the existing noise environment from road traffic and other surrounding sources).

9.3 Baseline Environment

An environmental noise survey was conducted in the vicinity of the proposed road realignment in the Glenamuck area. These locations have been chosen in order to quantify the existing noise environment in the vicinity of the noise-sensitive locations that may be affected by the proposed works.

A survey of vibration along the proposed route corridor was not undertaken, as levels associated with existing roads would not be expected to be of a magnitude sufficient to cause disturbance to people or structural damage to property. Furthermore, vibration was not perceptible at any of the noise survey locations.

9.3.1 Survey Periods

Unattended noise surveys were conducted at two locations:

- UN 1, between 09:00hrs on 19 April to 09:00hrs on 20 April 2018, and;
- UN 2, between 10:00hrs on 19 April to 10:00hrs on 20 April 2018.

Attended monitoring was conducted at 5 locations, AN1 to AN5, on 19 April between 10:00 and 17:00 hours.

9.3.2 Measurement Locations

The first stage is to assess and quantify the existing noise environment in the vicinity of sensitive receptors that may be affected by the proposed development. In the case of a road development, the selected noise-sensitive locations are those in closest proximity to the proposed road. Both the

construction and operational phases of the proposed road development should be reviewed when selecting appropriate measurement locations.

The measurement location descriptions are presented below and illustrated in Figure 9-1.

Table 9-2: Baseline Noise Monitoring Locations

Survey Location	Description	Grid Reference (ITM)	
		E	N
AN1	Outside residential property along Glenamuck Road, near Enniskerry Road junction	720,436	722,582
AN2	Proxy location in line with residential property 140m from Glenamuck Road, positioned on roadside near Wayside Celtic FC.	720,830	722,780
AN3	Grass verge along roadside on Enniskerry Road.	720,209	723,105
AN4	Outside residential property along Ballycorus Road.	720,835	722,131
AN5	Outside residential property along Barnaslingan Lane.	720,973	721,801
UN1	Outside residential property along Glenamuck Road. Chosen due to proximity to existing road.	721,107	723,307
UN2	Outside residential property along Glenamuck Road. Chosen due to proximity to proposed road.	720,735	723,050

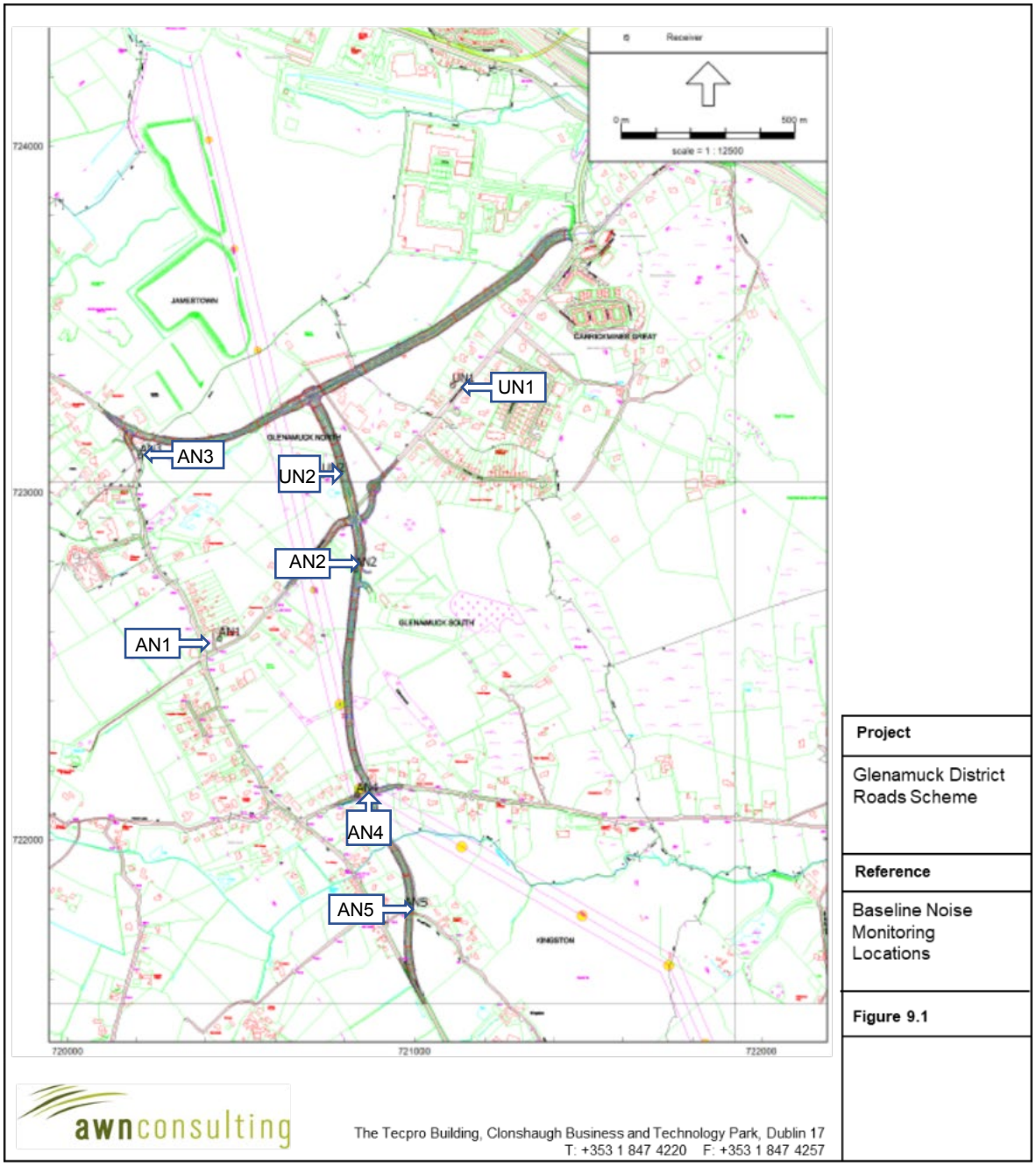

Figure 9-1 Baseline Noise Monitoring Locations

9.3.3 Instrumentation

The attended measurements were performed using a Brüel & Kjær Type 2250 Sound Level Meter. The unattended measurements were performed using Brüel & Kjær Type 3592 Environmental Kits with Brüel & Kjær Type 2238 Sound Level Meter. Before and after the survey the measurement apparatus was check calibrated using a Brüel & Kjær Type 4231 Sound Level Calibrator.

9.3.4 Procedure

Unattended Noise Measurements

Unattended continuous measurements were performed over a 24-hour period at two locations. Sample periods were 1-hour long and the results were saved to the instrument memory for later analysis. L_{den} values are derived directly from the measured data.

At UN1 a 4m tripod was used to obtain representative noise levels at first floor level of the receptor. At UN2 a 1.5m tripod was used to obtain representative noise levels at ground floor level of the receptor.

Attended Noise Measurements (Derived Value)

Attended measurements were conducted at 5 survey locations. Surveys were conducted on a cyclical basis with sample periods of 15 minutes. The results were noted onto a Survey Record Sheet immediately following each sample, and were also saved to the instrument memory for later analysis where appropriate. Survey personnel noted all primary noise sources contributing to noise build-up. The survey work was conducted in accordance with the shortened measurement procedure as laid down in the TII guidance document.

In all cases, measurements were performed free-field at least 3m from any reflecting wall or structure.

When surveying traffic noise, the acoustical parameters of interest are $L_{A10\ (1hour)}$ and $L_{A10\ (18hour)}$, expressed in terms of decibels (dB) relative to 2×10^{-5}Pa. The value of $L_{A10\ (1hour)}$ is the noise level exceeded for just 10% of the time over the period of one hour. $L_{A10\ (18hour)}$ is the arithmetic average of the values of $L_{A10\ (1hour)}$ for each of the one-hour periods between 06:00 and 24:00hrs.

The shortened measurement procedure involves a method whereby $L_{A10\ (18hour)}$ values are obtained through a combination of measurement and calculation as follows:

- noise level measurements are undertaken at the chosen location over three consecutive hours between 10:00 and 17:00hrs;
- the duration of the sample period during each hour is selected to encompass sufficient traffic flows to ensure reliable results;
- the $L_{A10\ (18hour)}$ for the location is derived by subtracting 1dB from the arithmetic average of the three hourly sample values,

  i.e. $L_{A10(18hour)} = ((\Sigma L_{A10(1hour)}) / 3) - 1dB$.

- The L_{den} for the location is then derived from the calculated $L_{A10(18hour)}$ value,

  i.e. $L_{den} = 0.86\ L_{A10(18hour)} + 9.86dB$.

9.3.5 Results of Noise Surveys

Table 9-3 presents the results of the attended measured noise levels for each of the five survey locations. Tables A1 and A2 in Appendix 9-2 presents the results of the unattended survey results at UN1 and UN2.

The results of the survey have indicated that baseline noise levels at all locations assessed are dominated by existing traffic flows along the roads within the Glenamuck area.

Measured noise levels were above 60dB L_{den} at the majority of monitoring locations in close proximity to the existing road edges. Marginally lower noise levels were recorded at properties set back from road traffic.

Table 9-3: Baseline Noise Monitoring Results

Survey Location	Start time	Measured Noise Levels (dB re.2x10^{-5}Pa)			dB L_{den}		Notes
		L_{Aeq}	L_{A10}	L_{A90}	Derived (Short term)	Measured (long term)	
AN1	10:00	52	55	44	57	n/a	Road traffic dominant source
	11:00	56	57	44			
	12:00	54	56	47			
AN2	10:19	54	51	42	53	n/a	Road traffic dominant source
	11:19	47	50	41			
	12:19	49	52	42			
AN3	10:42	68	73	45	72	n/a	Road traffic dominant source. Positioned 5m from Enniskerry Road.
	11:39	69	73	50			
	12:39	68	73	49			
AN4	13:24	67	69	36	69	n/a	Road traffic dominant source with additional noise from overhead cables.
	14:10	68	71	40			
	15:00	68	70	40			
AN5	13:45	58	53	36	53	n/a	Passing road traffic along Enniskerry Road dominates
	14:32	48	47	37			
	15:23	51	53	37			
UN1	09:00	L_{day}	$L_{evening}$	L_{night}	n/a	60	Road traffic dominant source.
		58	57	52			
UN2	10:00	L_{day}	$L_{evening}$	L_{night}	n/a	51	Road traffic dominant source with local car movements around property.
		50	47	43			

The baseline environment in the vicinity of the proposed road development has been characterised through a noise survey. The noise climate was observed to vary considerably across the proposed road development although for the most part, the baseline environment can be regarded as typical of quasi urban/rural locations in close proximity to local or regional roads.

The primary land use across the extent of the proposed road development is agricultural and includes greenfield areas of land.

The majority of noise sensitive receptors in the vicinity of the proposed road are comprised of residential dwellings although a small number of a number of recreational receptors are also located along the proposed route.

For all attended locations the measured ambient noise levels ranged from 47 to 69 dB L_{Aeq} whilst the calculated L_{den} ranged from 53 to 72 dB.

For the unattended locations the measured ambient noise levels ranged from 50 to 58dB $L_{day,}$, 47 to 57dB $L_{evening}$ and 43 to 52dB L_{night}. The calculated L_{den} value for the unattended survey locations ranged from 51 to 60dB.

The higher attended values were measured at locations along the existing road edge on the Enniskerry Road and Ballychorus Road. The higher unattended value at UN1 (60dB L_{den}) was measured along the existing Glenamuck Road East, which had a direct line of sight to the road. The lower unattended value at UN2 (51dB L_{den}) was measured at a property that was at a greater distance to the existing Glenamuck Road (no direct line of sight) but was chosen due to its proximity to the proposed road.

In the majority of cases, for both the attended and unattended survey locations, the ambient noise levels were influenced primarily by road traffic noise although other sources of noise such as birdsong, wind generated noise and barking dogs were also contributory sources.

9.4 Predicted Impacts

9.4.1 Assessment of Operational Noise

Noise Model

A computer-based prediction model has been prepared in order to quantify the traffic noise level associated with the operational phase of the proposed scheme. This section discusses the methodology behind the noise modelling process and presents the results of the modelling exercise.

Bruel and Kjaer Type 7810 Predictor

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, Brüel & Kjær Type 7810 *Predictor*, calculates traffic noise levels in accordance with CRTN and NRA guidance. The calculation module of Predictor allows the calculation of L_{den} by converting predicted L_{A10} values using the "end corrections" derived by the UK Transport Research Laboratory (TRL) and subsequently verified and adopted by TII.

Brüel & Kjær Type 7810 *Predictor* is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. *Predictor* predicts noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of sound power or traffic flow and average velocity;
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces, and;
- the hardness of the ground between the source and receiver.

Prediction of Traffic Noise

Noise emissions during the operational phase of the project have been modelled using *Predictor* in accordance with CRTN and with the application of the relevant TRL conversion factors as detailed in the TII Guidance. The CRTN method of predicting noise from a road scheme consists of the following five elements:

- divide the road scheme into segments so that the variation of noise within this segment is small;
- calculate the basic noise level at a reference distance of 10 metres from the nearside carriageway edge for each segment;
- assess for each segment the noise level at the reception point taking into account distance attenuation and screening of the source line;
- correct the noise level at the reception point to take account of site layout features including reflections from buildings and facades, and the size of source segment, and;

- combine the contributions from all segments to give the predicted noise level at the receiver location for the whole road scheme.

Note that all calculations are performed to one decimal place. For the purposes of comparison with the design goal of 60dB L_{den}, the relevant noise level is to be rounded to the nearest whole number.

Input to the Noise Model

The noise model was prepared using the following data:

- Up to date Ordnance Survey mapping, and alignment data of the new road supplied by DBFL Consulting Engineers,
- Review of the Dun Laoghaire-Rathdown planning website carried out to include closest receivers for all developments granted planning permission before October 10th 2018 and disregard receivers outlined in the OS mapping, which have been/will be demolished; and,
- Traffic flows and speeds data as supplied by DBFL Consulting Engineers for all existing and proposed roads within the proposed road development for the opening year 2020 and design year 2035. Data was provided for the Do Nothing and Do Something scenarios.

Hourly noise predictions were conducted based on these traffic figures in accordance with Method A of the TII guidelines. The hourly predictions were carried out using the diurnal traffic profiles provided in Appendix 1 of the TII guidelines.

Table 9-4 summarises the traffic flow volumes used for the design year impact assessment.

Table 9-4: Traffic Volumes used for Noise Impact Assessment

Ref.	Link	Do Nothing 2035		Do Something 2035	
		AADT	%HGV	AADT	%HGV
A	R117 Enniskerry Road (N) Junct. Glebe Rd	14,600	4.0%	5,800	3.2%
B	R117 Enniskerry Road (S)	16,900	6.2%	2,050	1.5%
C	Barnaslingan Lane	800	1.1%	800	1.5%
D	R116 Ballycorus Road	7,100	3.3%	11,600	2.9%
E	Glenamuck Road (E)	17,800	7.6%	5,000	1.8%
F	Glenamuck Road (W)	13,900	4.8%	5,750	3.2%
G	GDDR (W)	--	--	14,250	6.0%
H	GDDR Junct. GLDR	--	--	26,450	8.7%
I	GLDR (N)	--	--	21,600	5.4%
J	GLDR Junct. Glenamuck Road	--	--	20,450	4.7%
K	GLDR Junct. R117 (S)	--	--	18,450	4.3%
L	GDDR (E)	--	--	26,600	8.6%
M	R117 Enniskerry Road (N) Junct. GDDR	14,500	5.1%	16,250	4.4%
O	R117 Enniskerry Road (S) Junct. Ballybetagh Road	20,800	6.0%	6,200	3.3%
P	GLDR Junct. Barnaslingan Lane	--	--	16,800	4.8%

Key: GDDR – Glenamuck District Distributor Road; GLDR – Glenamuck Link Distributor Road

Traffic flows provided by DBFL Consulting Engineers indicate that traffic volumes are expected to reduce substantially between the Do Minimum or Do Something scenarios on the existing R117 (N and

S) and Glenamuck Road (E and W). The addition of the GDDR and GLDR will redirect the difference in traffic along these new link roads. The speed limit along the length of scheme is 50km/hr. Junctions will be signalised and minor arm approaches are likely to be on red lights the majority of the time, reducing the speed limit to 30km/hr along the Ballycorus Road and Barnaslingan Lane in particular.

A standard road surface type, such as hot rolled asphalt (HRA) has been assumed for all existing roads. A PSMA road surface type has been assumed for all new roads, with a 1dB reduction applied compared to the standard HRA road surface.

Output of the Noise Model

Predictor calculates noise levels for a set of receiver locations specified by the user. The results include an overall level in dB L_{den}.

Calibration

The purpose of noise model validation is to ensure that the software is correctly interpreting the input data and providing results that are valid for the scenario under consideration. It should be noted that the purpose of the model validation is not to validate the prediction methodology in use as the CRTN prediction methodology has itself been previously validated.

The most appropriate mechanism for calibration is to compare the output of a Predictor model scenario, using the AADT traffic flows for the existing road network in 2017, with the measured L_{den} value at unattended survey location UN01, which was in the vicinity of the existing road network (Glenamuck Road). The reason for choosing this survey location for the purposes of calibration is to ensure that the noise environment was dominated by road traffic noise during the survey period.

Traffic data for the year 2017 was provided by DBFL Consulting Engineers. The AADT value used for the existing roads is outlined in Table 9-5 below.

Table 9-5: Traffic Volumes used for Calibration of Noise Model

Ref.	Link	Baseline Traffic 2017	
		AADT	%HGV
M	R117 Enniskerry Road (N)	7,650	3.7%
B	R117 Enniskerry Road (S)	8,350	4.6%
C	Barnaslingan Lane	350	1.6%
D	R116 Ballycorus Road	2,200	2.7%
E	Glenamuck Road (E)	12,300	4.4%
F	Glenamuck Road (W)	9,000	2.7%

The results of the calibration are presented in Table 9-6. The difference between the measured and predicted results is 0 dB(A), which demonstrates a strong correlation and confirms that the model is correctly interpreting the input data.

Table 9-6: Noise Model Calibration

Location Reference	Measured L_{den} (dB)	Predicted L_{den} (dB)	Variation (dB)
UN01	60	60	0

Choice of Receiver Locations

Free-field traffic noise levels have been predicted at 64 existing properties and 2 properties granted planning permission but have yet to be built, in the vicinity of proposed and existing roads[1]. The locations of all receptors are shown in Figure 9-2 to Figure 9-5. The predicted relevant noise levels have been presented in Table 9-8.

For certain properties, receiver locations have been positioned at two or more locations around the building to assess noise levels associated with existing road traffic from existing roads and from the proposed future GDDR and GLDR road alignments (114 modelled locations). The properties were selected on the basis of proximity to the existing and proposed roads. All properties with the nearest proximity to the realigned road have been considered as per best practice.

[1] All receivers have been modelled at heights of 1.5 and 4.0m above ground which corresponds approximately to ground and first floor windows respectively. The relevant result for the worst case highest window has been presented in each case.

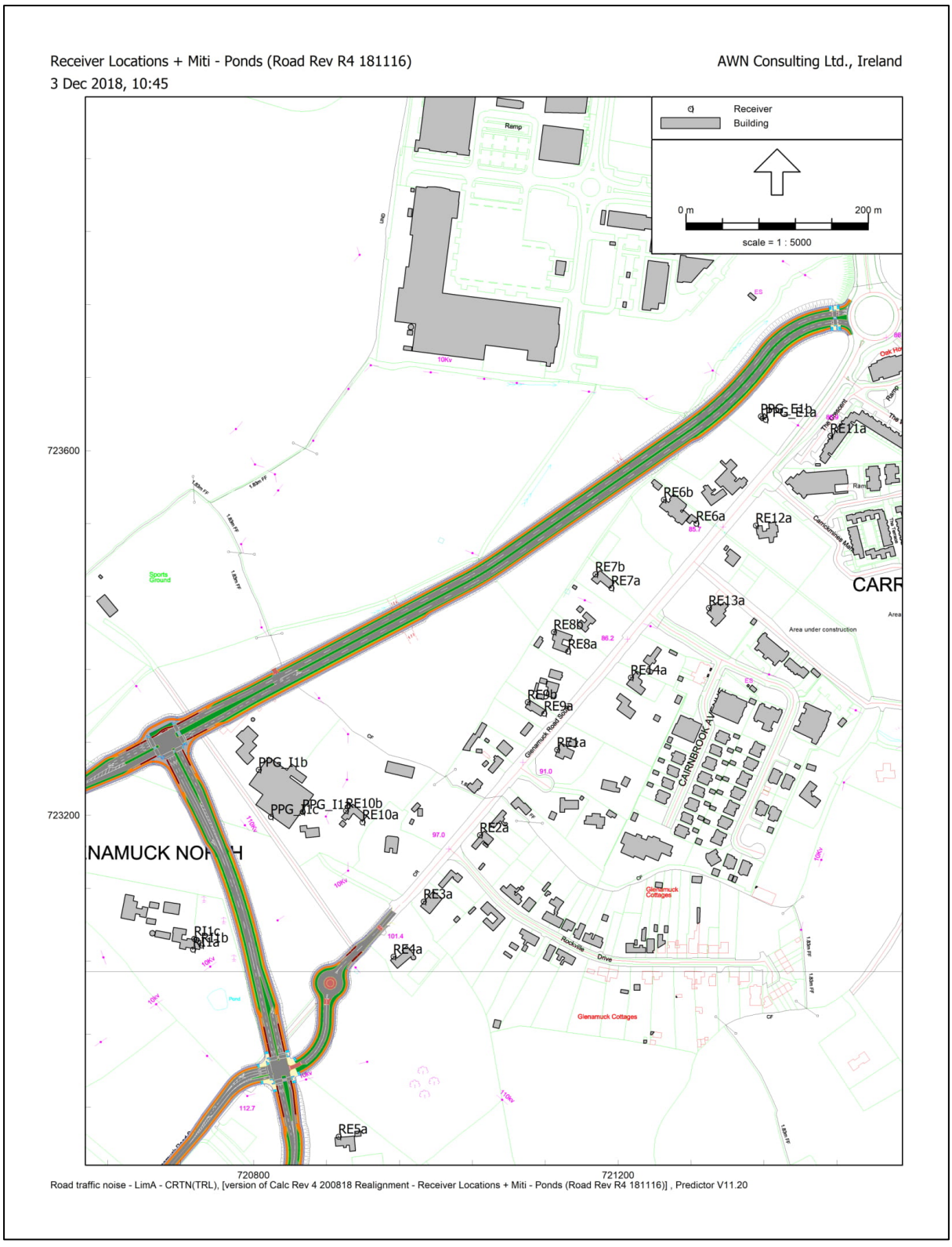

Figure 9-2: Receiver Locations to the North East.

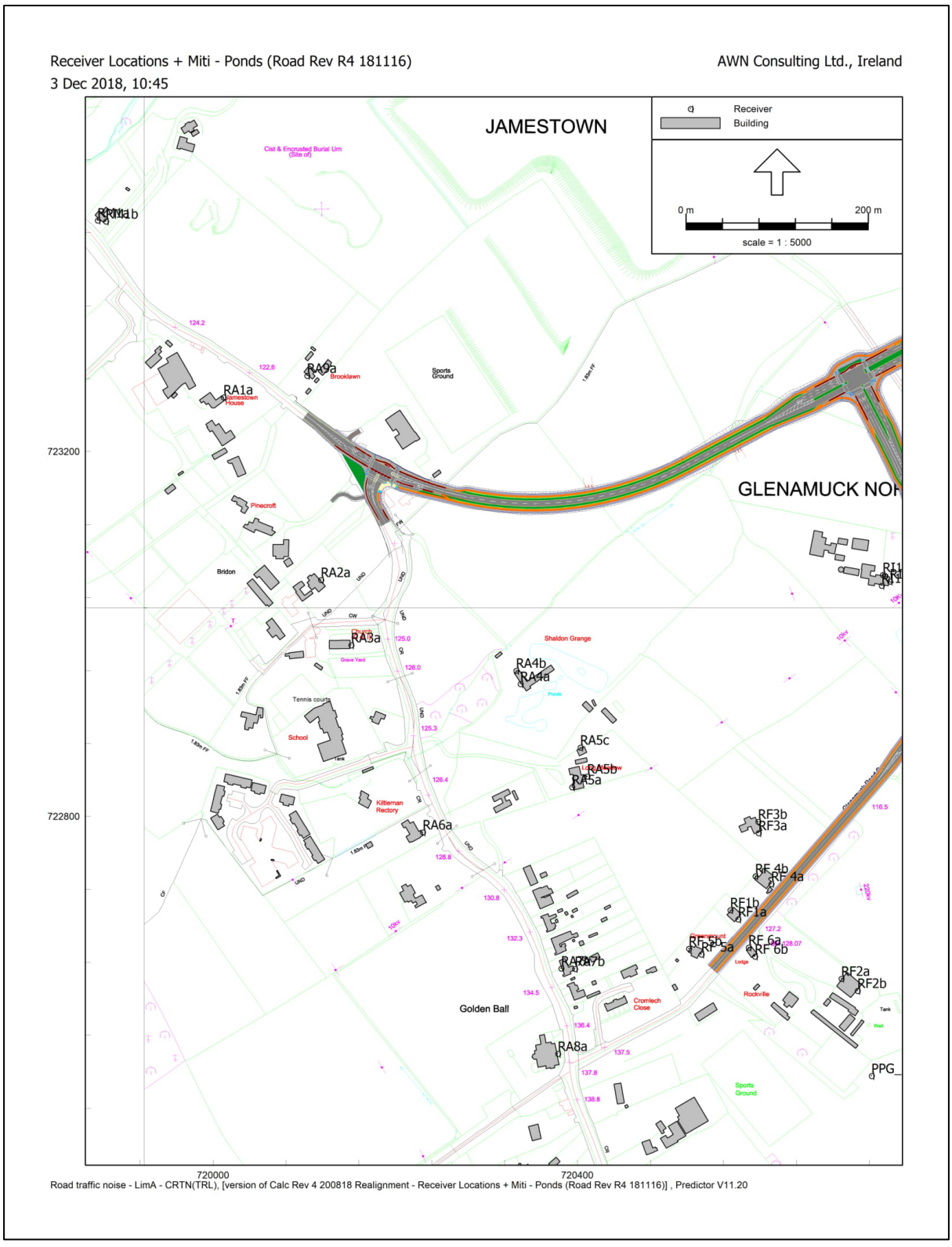

Figure 9-3: Receiver Location to the North West.

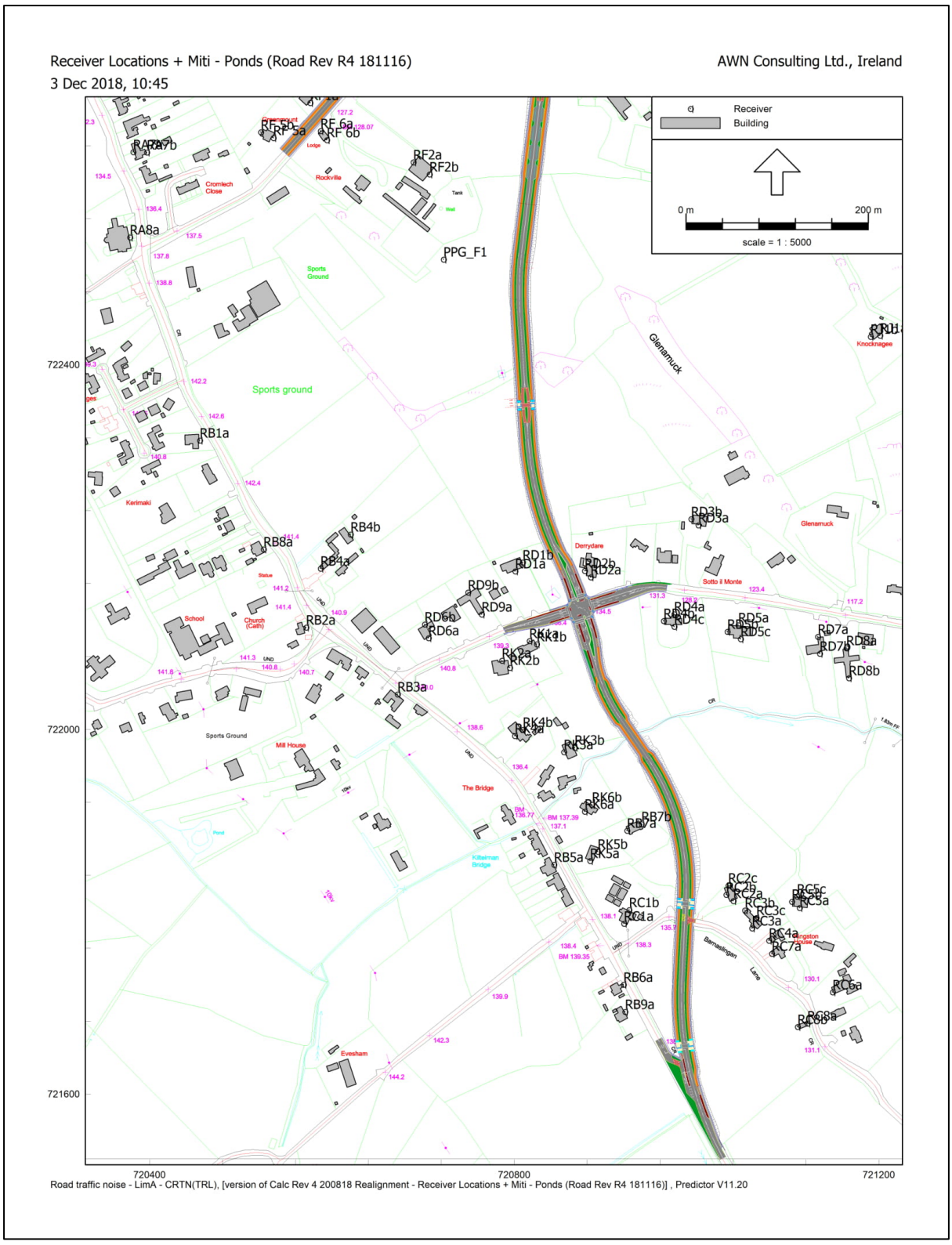

Figure 9-4: Receiver Location to the South West

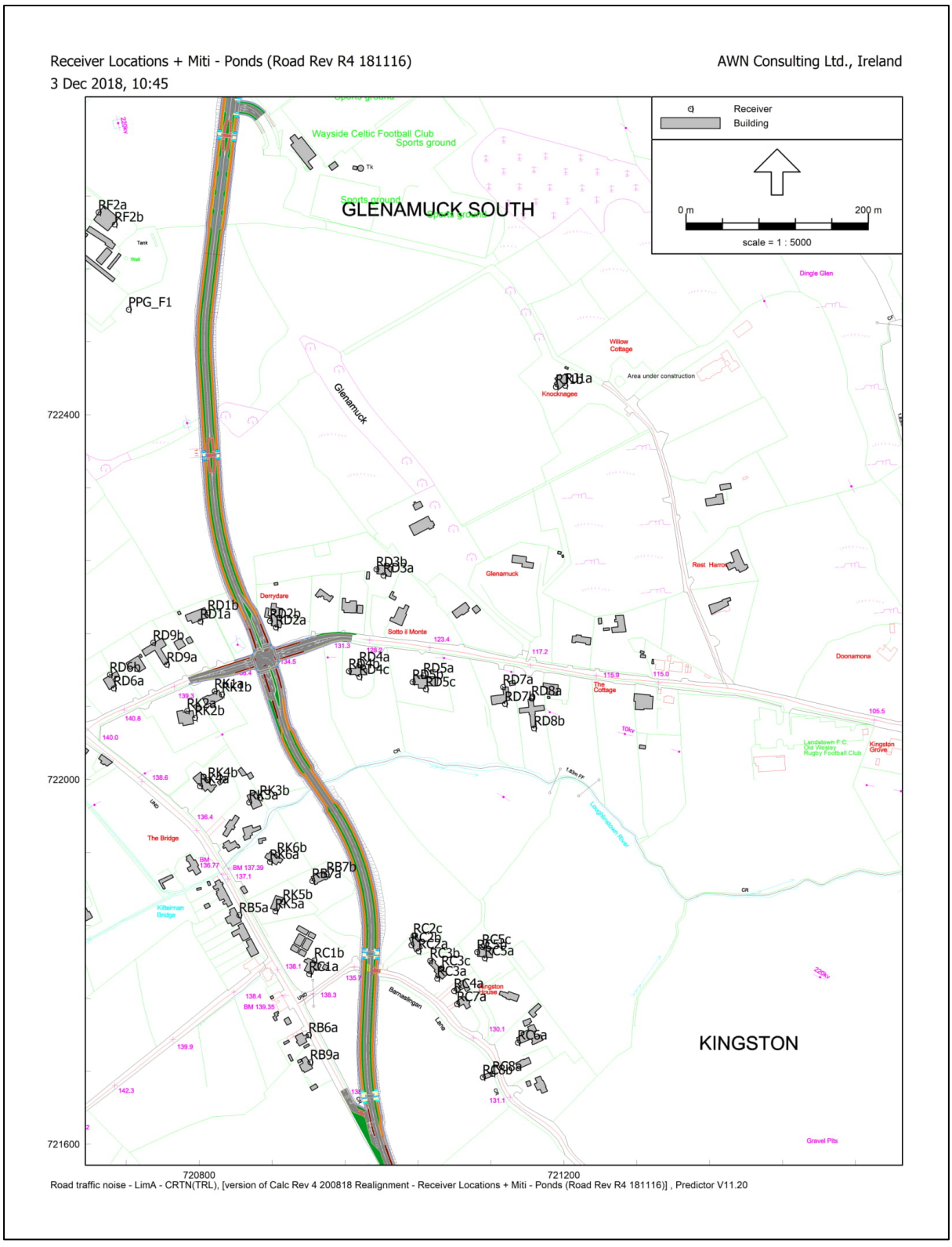

Figure 9-5: Receiver Locations to South East

Traffic Noise Predictions

Traffic noise predictions have been conducted for the operational phase of the scheme for two years, 2020, the proposed year of opening and 2035, the design year. A total of five scenarios have been considered as follows:

- Year 2020 – Do Nothing (i.e. proposed scheme is not built);
- Year 2020 – Do Something (i.e. proposed scheme is built);
- Year 2035 – Do Nothing (i.e. proposed scheme is not built);
- Year 2035 – Do Something (i.e. proposed scheme is built); and,
- Year 2035 – Do Something + Complementary Measures (i.e. proposed scheme is built).

In terms of the change in noise experienced at properties assessed, reference is made to the DMRB's Volume 11, Section 3 which prescribes a magnitude of impact relating to changes in road traffic noise.

Table 9-7 below summarises the classification of magnitude of impacts relating to traffic noise.

Table 9-7: Classification of Magnitude of Noise Impacts

Noise Change, dB	Magnitude of Impact
0	No Change
0.1 – 2.9	Negligible
3 – 4.9	Minor
5 – 9.9	Moderate
10+	Major

The results of the traffic noise predictions are presented in Table 9-8.

As the differences between the two Do Something 2035 noise predictions (with and without Complementary Measures) were less than 0.2dB, the prediction results without Complementary Measures are presented in the table i.e. worst case scenario.

Table 9-8: Predicted Noise Levels for Years 2020 and 2035 for "Do Nothing" and "Do Something" Scenarios

Receiver Location Reference	Opening Year 2020			Design Year 2035		
	Predicted Noise Level		Comment	Predicted Noise Level		Comment
	Do Nothing	Do Something		Do Nothing	Do Something	
	L_{den} (dB)	L_{den} (dB)		L_{den} (dB)	L_{den} (dB)	
RA1a	62	62	No Change	64	64	No Change
RA2a	57	56	Reduction[a]	59	58	Reduction[a]
RA3a	60	58	Reduction[a]	63	60	Reduction[a]
RA4a	53	50	Reduction[a]	55	51	Reduction[a]
RA4b	52	52	No Change[a]	54	54	No Change[a]
RA5a	53	50	Reduction[a]	55	52	Reduction[a]

Receiver Location Reference	Opening Year 2020			Design Year 2035		
	Predicted Noise Level		Comment	Predicted Noise Level		Comment
	Do Nothing	Do Something		Do Nothing	Do Something	
	L_{den} (dB)	L_{den} (dB)		L_{den} (dB)	L_{den} (dB)	
RA5b	50	49	Reduction[a]	52	52	No Change[a]
RA5c	51	50	Reduction[a]	53	52	Reduction[a]
RA6a	63	59	Reduction[a]	65	60	Reduction[a]
RA7a	64	61	Reduction	66	62	Reduction
RA7b	46	43	Reduction[a]	48	46	Reduction[a]
RA8a	68	64	Reduction	70	65	Reduction
RA9a	60	61	Negligible	63	63	No Change
RB1a	68	63	Reduction	70	64	Reduction
RB2a	68	62	Reduction	70	64	Reduction
RB3a	70	63	Reduction	73	66	Reduction
RB4a	64	60	Reduction[a]	66	61	Reduction
RB4b	48	48	No Change[a]	51	51	No Change[a]
RB5a	69	57	Reduction[a]	72	61	Reduction
RB6a	70	61	Reduction	73	64	Reduction
RB7a	55	53	Reduction[a]	57	55	Reduction[a]
RB7b	47	62	Major	49	63	Major
RB8a	68	63	Reduction	71	64	Reduction
RB9a	65	60	Reduction[a]	68	62	Reduction
RC1a	64	58	Reduction[a]	66	60	Reduction[a]
RC1b	48	56	Moderate[a]	50	58	Moderate[a]
RC2a	49	53	Minor[a]	52	55	Minor[a]
RC2b	50	57	Moderate[a]	52	59	Moderate[a]
RC2c	46	56	Major[a]	48	58	Major[a]
RC3a	53	57	Minor[a]	55	59	Minor[a]
RC3b	52	56	Moderate[a]	54	58	Minor[a]
RC3c	44	52	Moderate[a]	46	54	Moderate[a]
RC4a	52	55	Minor[a]	55	57	Negligible[a]
RC5a	47	49	Negligible[a]	49	50	Negligible[a]
RC5b	48	53	Moderate[a]	50	55	Moderate[a]
RC5c	45	52	Moderate[a]	48	54	Moderate[a]
RC6a	50	51	Negligible[a]	52	53	Negligible[a]
RC7a	51	53	Negligible[a]	54	55	Negligible[a]
RC8a	50	51	Negligible[a]	53	54	Negligible[a]
RC8b	52	54	Negligible[a]	54	55	Negligible[a]
RD1a	53	57	Minor[a]	55	60	Moderate[a]
RD1b	50	60	Major[a]	52	63	Major
RD2a	60	64	Minor	62	67	Moderate

Receiver Location Reference	Opening Year 2020			Design Year 2035		
	Predicted Noise Level		Comment	Predicted Noise Level		Comment
	Do Nothing	Do Something		Do Nothing	Do Something	
	L_{den} (dB)	L_{den} (dB)		L_{den} (dB)	L_{den} (dB)	
RD2b	56	64	Moderate	58	67	Moderate
RD3a	51	53	Negligible[a]	54	56	Negligible[a]
RD3b	49	52	Minor[a]	51	55	Minor[a]
RD4a	59	61	Negligible	62	64	Negligible
RD4b	56	60	Minor[a]	58	63	Moderate
RD4c	51	56	Moderate[a]	53	58	Moderate[a]
RD5a	58	58	No Change[a]	61	62	Negligible
RD5b	55	56	Negligible[a]	57	59	Negligible[a]
RD5c	49	53	Minor[a]	52	55	Minor[a]
RD6a	62	59	Reduction[a]	65	63	Reduction
RD6b	50	48	Reduction[a]	52	51	Reduction[a]
RD7a	57	57	No Change[a]	60	61	Negligible
RD7b	46	49	Minor[a]	49	51	Minor[a]
RD8a	55	54	Reduction[a]	57	58	Negligible[a]
RD8b	45	49	Minor[a]	47	50	Minor[a]
RD9a	60	60	No Change[a]	63	63	No Change
RD9b	49	50	Negligible[a]	51	52	Negligible[a]
RE1a	68	60	Reduction[a]	70	63	Reduction
RE2a	69	60	Reduction[a]	71	63	Reduction
RE3a	68	60	Reduction[a]	70	63	Reduction
RE4a	64	58	Reduction[a]	65	60	Reduction[a]
RE5a	55	56	Negligible[a]	57	59	Negligible[a]
RE6a	66	58	Reduction[a]	67	61	Reduction
RE6b	49	61	Major	51	64	Major
RE7a	61	54	Reduction[a]	63	57	Reduction[a]
RE7b	45	58	Major[a]	47	62	Major
RE8a	62	54	Reduction[a]	64	57	Reduction[a]
RE8b	49	56	Moderate[a]	51	59	Moderate[a]
RE9a	67	59	Reduction[a]	69	62	Reduction
RE9b	49	53	Minor[a]	51	56	Moderate[a]
RE10a	56	52	Reduction[a]	58	55	Reduction[a]
RE10b	43	52	Moderate[a]	45	55	Major[a]
RE11a	65	59	Reduction[a]	67	62	Reduction
RE12a	66	58	Reduction[a]	67	61	Reduction
RE13a	61	55	Reduction[a]	63	58	Reduction[a]
RE14a	65	58	Reduction[a]	67	60	Reduction[a]
RF1a	65	58	Reduction[a]	67	64	Reduction

Receiver Location Reference	Opening Year 2020			Design Year 2035		
	Predicted Noise Level		Comment	Predicted Noise Level		Comment
	Do Nothing	Do Something		Do Nothing	Do Something	
	L_{den} (dB)	L_{den} (dB)		L_{den} (dB)	L_{den} (dB)	
RF1b	48	48	No Change	50	51	Negligible[a]
RF2a	55	51	Reduction[a]	57	54	Reduction[a]
RF2b	44	54	Major[a]	46	56	Major[a]
RF3a	57	53	Reduction[a]	59	56	Reduction[a]
RF3b	57	53	Reduction[a]	59	57	Reduction[a]
RF 4a	64	58	Reduction[a]	66	63	Reduction
RF 4b	52	49	Reduction[a]	54	52	Reduction[a]
RF 5a	64	57	Reduction[a]	65	62	Reduction
RF 5b	51	48	Reduction[a]	53	51	Reduction[a]
RF 6a	68	59	Reduction[a]	70	65	Reduction
RF 6b	58	52	Reduction[a]	59	56	Reduction[a]
RI1a	54	56	Negligible[a]	56	58	Negligible[a]
RI1b	55	59	Minor[a]	57	62	Moderate
RI1c	51	57	Moderate[a]	52	59	Moderate[a]
RJ1a	45	46	Negligible[a]	48	49	Negligible[a]
RJ1b	48	49	Negligible[a]	50	52	Negligible[a]
RK1a	59	61	Negligible	62	65	Minor
RK1b	56	60	Minor[a]	59	63	Minor
RK2a	58	58	No Change[a]	61	62	Negligible
RK2b	50	54	Minor[a]	52	56	Minor[a]
RK3a	54	47	Reduction[a]	56	49	Reduction[a]
RK3b	48	59	Major[a]	50	61	Major
RK4a	60	51	Reduction[a]	62	53	Reduction[a]
RK4b	47	51	Minor[a]	49	53	Minor[a]
RK5a	64	52	Reduction[a]	66	56	Reduction[a]
RK5b	56	54	Reduction[a]	58	56	Reduction[a]
RK6a	59	51	Reduction[a]	61	53	Reduction[a]
RK6b	47	56	Moderate[a]	49	58	Moderate[a]
RM1a	66	67	Negligible	68	69	Negligible
RM1b	62	63	Negligible	65	65	No Change
PPG_F1	50	56	Moderate[a]	52	59	Moderate[a]
PPG_I1a	51	52	Negligible[a]	53	55	Negligible[a]
PPG_ I1b	44	57	Major[a]	46	60	Major[a]
PPG_ I1c	52	58	Moderate[a]	54	61	Moderate

[a] Denotes predicted noise level is below design goal of 60dB Lden.

[b] Receiver satisfies the criteria for noise mitigation.

PPG denotes planning permission granted but development may not have commenced construction at time of survey.

The results of the traffic noise assessment have indicated that for two-thirds of assessment locations, road traffic noise levels are reduced, have no change or are negligible.

The majority of assessment locations above 60dB L_{den} are properties located in close proximity to the existing roads edge during both the Do Minimum and Do Something scenarios, as confirmed during the baseline noise surveys.

In many cases there is a reduction of traffic on the existing roads in Do Something scenario at the front facades of the properties but an increase in noise levels at the rear of the facades due to the orientation of the dwelling i.e. rear/side facades are closer to the proposed link roads.

During the opening year of 2020, the assessment has determined that a total of 3 receivers (4 modeled locations) satisfy the requirements for noise mitigation as described in Section 9.2.1.

During the design year of 2035, the assessment has determined that a total of 10 receivers (11 modelled locations) satisfy the requirements for noise mitigation as described in Section 9.2.1.

Noise mitigation is therefore discussed and outlined at the modelled locations identified (highlighted in red) in Table 9-8. The mitigation measures are included in Section 9.5.1.

9.4.2 Construction Phase

Impacts Assessment

As per TII guidance noise levels associated with construction may be calculated in accordance with the methodology set out in BS5228: Part 1. This standard sets out sound power levels for plant items normally encountered on construction sites, which in turn enables the prediction of noise levels at selected locations. However, it is often not possible to conduct detailed prediction calculations for the construction phase of a project in support of the EIAR. This is due to the fact that the programme for construction works has not been established in detail. Under such circumstances, best practice involves the consideration of appropriate mitigation measures. The TII guidance document specifies noise levels that it typically deems acceptable in terms of construction noise. These limits are set out in Table 9-1

A variety of items of plant will be in use during the construction of the new road and road upgrade works. These will include excavators, dump trucks, compressors and generators in addition to general road surfacing and levelling equipment. Due to the nature of the activities undertaken on a road construction site, there is potential for generation of high levels of noise at nearby noise sensitive properties.

Due to the fact that the construction programme is not progressed to a detail level at this stage, it is not possible to calculate specific noise emissions to the local environment from different phases of works. However, the following tables present calculations of indicative noise levels for typical noise sources associated with road construction.

BS5228:2009 + A1 2014 *Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1 Noise* sets out typical noise levels for items of construction plant. Table 9-9 sets out assumed plant items during the key phases of construction with the associated source reference from BS5228– *Part 1 Noise*.

The closest properties to the proposed alignment are at distances of approximately 10m. Construction noise calculations have been conducted at distances of 10 to 80m from the works for different work phases, representing the nearest properties to the works.

The calculations assume that plant items are operating for 66%[2] of the time and that all plant items associated with the individual phases are operating simultaneously and at the same distance for any one scenario.

[2] This estimate that assumes that the plant will operate a full 8-hour shift over the proposed 12 hour working period which equates to a 66% on time over a daytime period or 40 minutes over a 1-hour period. The dynamic nature of construction sites is such that this is deemed to be a conservative estimate.

Table 9-9: Indicative Construction Noise Calculations at Closest Properties to Works

Construction Activities	Calculated Construction Noise Levels, dB $L_{Aeq,1hr}$				
	10m*	20m*	30m*	50m*	80m*
Site Clearance & Preparation					
Wheeled loader C2-26	69	66	63	58	54
Tracked excavator (loading dump truck) C1-10	75	72	69	64	60
Dozer C.2.10	70	67	64	59	55
Dump Truck (C2.30)	69	66	63	58	54
Combined L_{Aeq}	78	75	71	67	63
Fill works					
Tracked excavator (loading dump truck) C1-10	75	72	69	64	60
Articulated dump truck (dumping rubble) C1-11	70	67	64	59	55
Wheeled loader C2-26	69	66	63	58	54
Dozer C.2.10	70	67	64	59	55
Dump Truck Tipping fill (C2.30)	69	66	63	58	54
Combined L_{Aeq}	78	75	72	68	63
Piling Works					
Crawler Mounted Rig (C3.22)	70	67	64	59	55
Tracked Excavator inserting metal cage, (C3.24)	64	61	58	53	49
Concrete Pump & Cement Mixer Truck (C4.24)	57	54	51	46	42
Diesel Generator (C4.76)	51	48	45	40	36
Angle Grinder (C4.93)	70	67	64	59	55
Combined L_{Aeq}	74	71	67	63	59
Road Works					
Tracked excavator (C2.21)	61	58	55	50	46
Dump Truck (C2.30)	69	66	63	58	54
vibration rollers (C5.20)	65	62	59	54	50
Asphalt Paver & Tipping Lorry (C.5.31)	67	64	61	56	52
Diesel Generator (C4.76)	51	48	45	40	36
Road Rollers (C5.19)	70	67	64	59	55
Combined L_{Aeq}	74	72	68	64	60
Construction Compound Activities					
Tracked excavator (C2.21)	61	58	55	50	46
Dump Truck (C2.30)	69	66	63	58	54
Angle Grinder (C4.93)	70	67	64	59	55
Diesel Generator (C4.76)	51	48	45	40	36
Wheeled loader (C2-26)	69	66	63	58	54
Combined L_{Aeq}	74	72	68	64	59

Note: *Suitable 2.4m construction hoarding used as standard along all noise sensitive locations.

The reference values outlined in Table 9-1 indicate that at distances of up to 30m from the works, there is potential for the construction noise limit of 70dB L_{Aeq} to be exceeded from Monday through Friday (07:00 to 19:00hrs), depending on the number and type of equipment occurring at any one time. The calculations would also indicate that at distances of up to 50m from the works, there is potential for the construction noise limit of 65dB L_{Aeq} to be exceeded on Saturdays (between 08:00 and 16:30hrs), depending on the number and type of equipment occurring at any one time.

Please note the following:

- The 10m scenario applies only at two properties on the Ballycorus Road (RD2b and RK1a) and at four properties on the Glenamuck Road (W) (RF1a, RF4a, RF5a and RF6a).
- The 20m scenario applies only at two properties ; residential property West of the GLDR junction with Ballycorus Road (RD1b) and the De La Salle Palmerstown FC grounds located to the north of the GDDR(W) junction with Enniskerry Road (N).
- The 30m scenario applies at two properties, at the realigned junction on the Glenamuck Road East (RE3a) and at the GLDR junction with Barnaslingan Lane (RB7b).

At distances greater than 50m and beyond noise levels associated with construction plant items are further reduced and are typically within the daytime noise construction criteria.

It should be noted that the calculations set out in the above tables are indicative and are used for the purposes of comparison only with the adopted criteria. Where exceedance of the recommended criteria is expected, the use of noise mitigation measures will be used as part of the construction works. In this instance, where construction works are planned within 80m of noise sensitive properties, a schedule of noise mitigation measures will be required to ensure noise levels are minimised. Further details are set out in Section 9.5.2.

9.4.3 Vibration

Description of Existing Environment

A survey of vibration along the proposed scheme was not undertaken, as levels associated with existing roads would not be expected to be of a magnitude sufficient to cause disturbance to people or structural damage to property. Furthermore, vibration was not perceptible at any of the noise survey locations.

Potential Impacts – Operational Phase

As a vehicle travels along a road, vibration can be generated in the road and subsequently propagate towards nearby buildings. Such vibration is generated by the interaction of a vehicle's wheels and the road surface and by direct transmission through the air of energy waves. Some of these waves arise as a function of the size, shape and speed of the vehicle, and others from pressure fluctuations due to engine, exhaust and other noises generated by the vehicle.

It has been found that ground vibrations produced by road traffic are unlikely to cause perceptible structural vibration in properties located near to well-maintained and smooth road surfaces. Problems attributable to road traffic vibration can therefore be largely avoided by maintenance of the road

surface. Given that the existing road scheme does not generate any significant vibration levels at present, vibration levels associated with the proposed new road are not expected to generate any perceptible vibration levels.

Potential Impacts – Construction Phase

The potential for vibration at neighbouring sensitive locations during construction is typically limited to limited forms of excavation works and lorry movements on uneven road surfaces. Where ground breaking is required, this would generate higher potential for vibration, depending on the methodologies used. Given the nature of the scheme and the limited extent of excavation works below ground, however, there are no significant ground or rock breaking activities anticipated. The vibration limits in Table 9-10: Maximum Allowable Vibration Levels During Construction Phasewill apply at the nearest sensitive building which are set in order to avoid any form of structural or cosmetic damage to light-weight buildings. The choice of plant will be selected and controlled to ensure these limit values are not exceeded at the closest sensitive buildings.

Table 9-10: Maximum Allowable Vibration Levels During Construction Phase

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 10Hz	10 to 50Hz	50 to 100Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

9.5 Mitigation Measures

9.5.1 Mitigation Measures Operational Phase

The results of the modelling exercise show that noise mitigation should be considered for 10 receivers (11 modelled locations) along the proposed route.

The following section details the possible mitigation measures deemed practicable to achieve the design goals previously defined in Section 10.2. For the purposes of this assessment a PSMA road surface has been assumed for all new roads.

The mitigation measures will be specified based on the predicted noise levels for the design year of 2035.

The mitigation measures detailed here may be constructed as earth bunds, proprietary noise barriers or a combination of both. The mitigation requirements for the proposed road development will be further progressed during the detailed design and construction phase of the project, should approval be granted, taking into account the available construction techniques and technologies at the time of development.

Details of the proposed mitigation measures are outlined in Table 9-11 in order to meet the noise threshold set out in the TII guidance document.

Table 9-11: Proposed Acoustic Barriers

Barrier Ref.	Road Ref	Road Link	Chainage Start (m)	Chainage End (m)	Height (m)	Alignment
NB-001	L	GDDR (E)	1+072	1+360	2.0	South
NB-002	I	GLDR (N)	0+050	0+160	2.0	East
NB-003			0+160	0+265	2.0	West
NB-004	J	GLDR Junct. Glenamuck Road	1+055	1+108*	2.0	West
NB-005			1+050	1+108*	2.5	East
NB-006	P	GLDR Junct. Ballycorus Road	1+118	1+325	2.0	West
NB-007			1+118	1+205	2.0	East
NB-008			1+360	1+480	2.5	West

* Barriers proposed to extend to rear of property boundary as shown in Figure 9.8

The extent and location of these barriers are shown in Figure 9-6 to Figure 9-8 overleaf.

The predicted post mitigation noise levels at receptors requiring mitigation has been presented in Table 9-12.

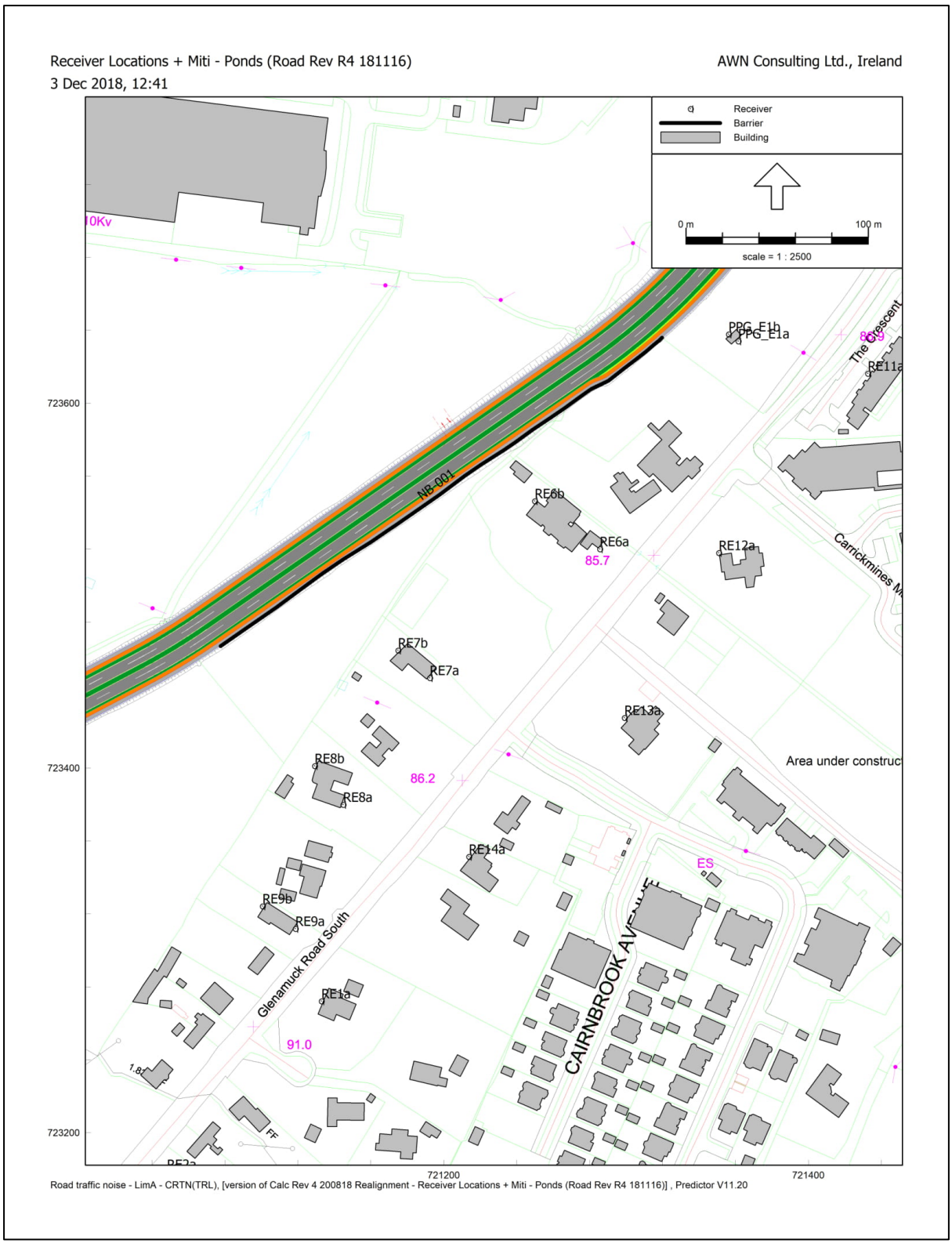

Figure 9-6: Barrier NB-001 to South of GDDR (E)

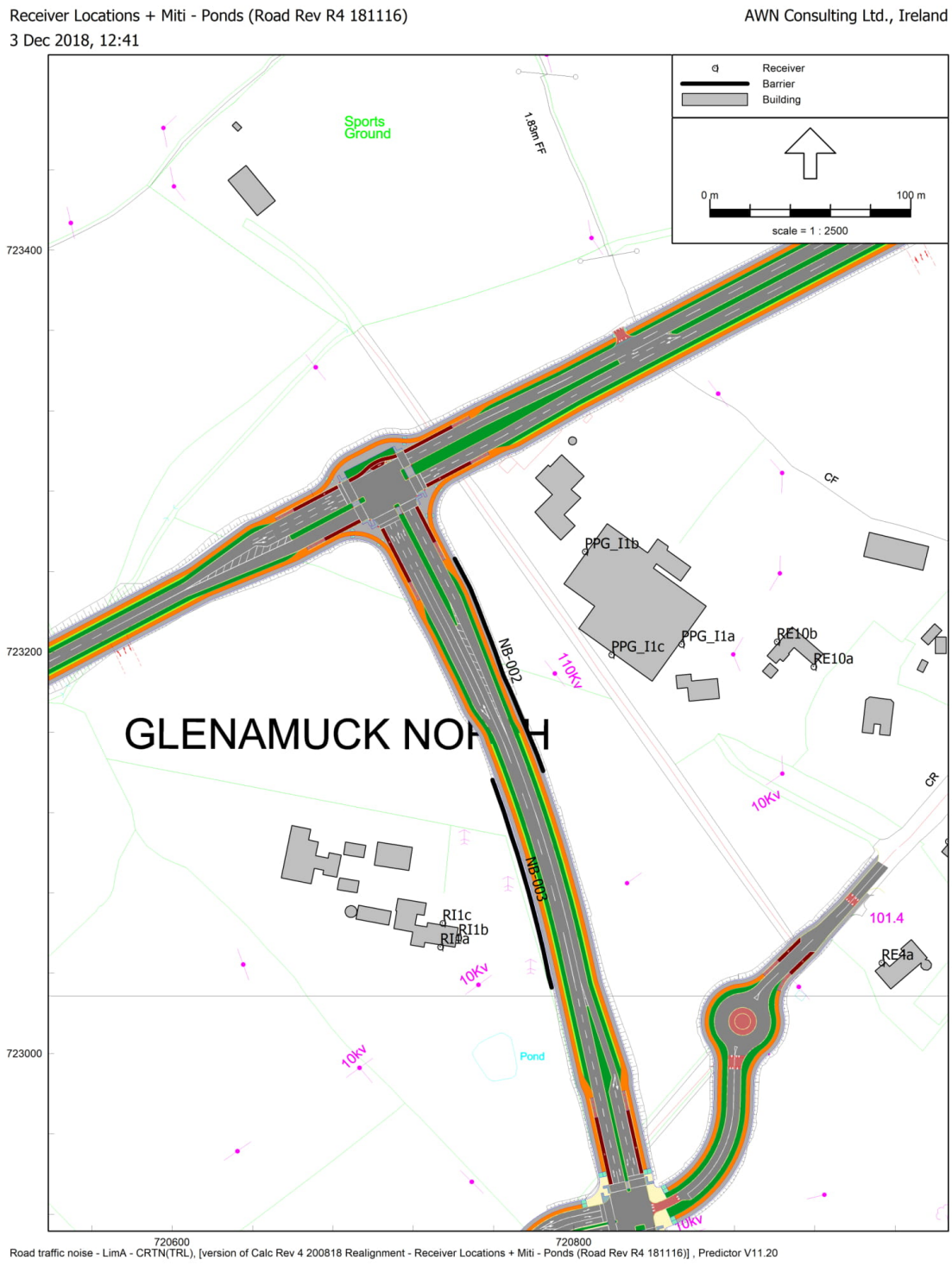

Figure 9-7: Barriers NB-002/NB-003 to West and East of GLDR (N)

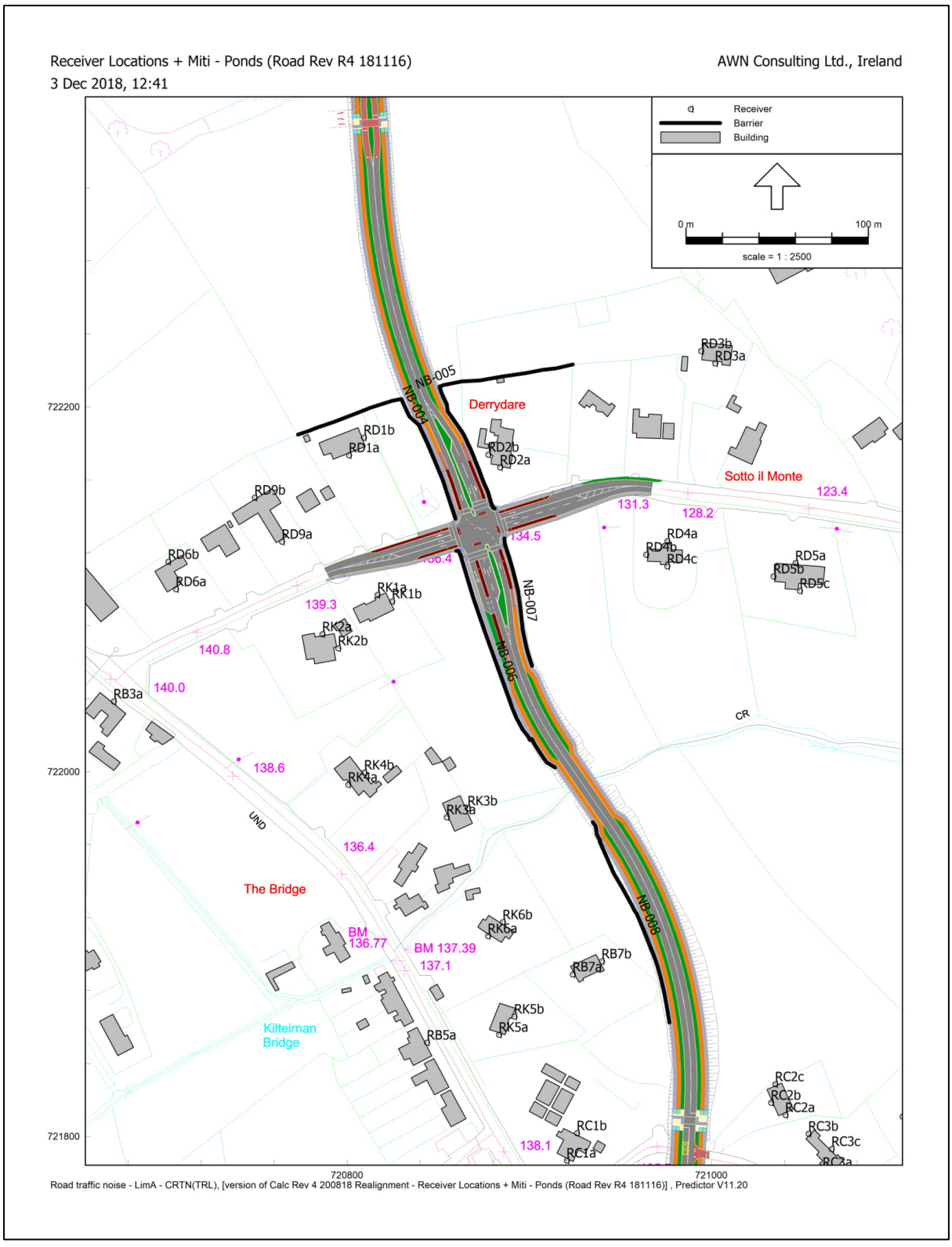

Figure 9-8: Barriers NB-004 to NB-008 West/East of GLDR (S)

Table 9-12: Predicted Post Mitigation Noise Levels at Receptors Requiring Mitigation

Receiver Location Reference	Design Year 2035 L_{den} (dB)		
	Unmitigated		Mitigated
	Do Minimum	Do Something	Do Something
RB7b	49	63	61
RD1b	52	63	60
RD2a	62	67	65
RD2b	58	67	65
RD4b	58	63	62
RE6b	51	64	61
RE7b	47	62	59
RI1b	57	62	61
RK1b	59	63	61
RK3b	50	61	59
PPG_I1c	54	61	60

In relation to 8 no. receivers (RB7b, RD1b, RE7b, RE7b, RI1b, RK1b, RK3b and PPG_1c) the proposed barriers are sufficient to reduce the variation in noise levels between the design goal of 60dB L_{den} and the mitigated Do Something Scenarios by equal or less than 1dB.

At 2 no. receivers (RD2a/b and RD4b), immediately to the East of the Ballycorus Road, the inclusion of a barrier along a section of the new road reduces the Mitigated Do Something to between 62dB to 65dB L_{den} respectively. It is important to note that the existing road contributes 58dB to 62dB L_{den} in the Do Minimum Scenario.

The guidance notes that the benefit gained by the insertion of a barrier is limited and notes that caution should be exercised specifying substantial screening where small benefits (<3dB) are only achieved, given a change of 3dB(A) is the smallest change that would give a reliable difference in public response.

It may also be prudent to consider if the benefit of the barriers in terms of noise reduction is proportionate to the potential visual intrusion and associated costs of such measures.

The most recent guidance from the TII in relation to Noise and Vibration has been published in the form of the *Good Practice Guide for the Treatment of Noise during the Planning of National Road Schemes (March 2014*). The TII/NRA GPG presents a discussion on the issue of "proportionality" and acknowledges that *"in some cases the attainment of the design goal may not be possible by sustainable means".*

In the context of the proposed mitigation measures, the above comments must be considered in the context of other issues relating to potential visual impacts and costs.

In terms of the change in noise experienced at properties assessed, reference is made to the DMRB's Volume 11, Section 3 which summarises the magnitude of impact relating to changes in road traffic noise, as previously outlined in Table 9-7.

Referring to the predicted impacts sets out in Table 9-8 and based on the classification of noise impacts outlined in Table 9-7, the following comments are made in relation to opening year 2020;

- Traffic noise level reductions or no changes were calculated between the Do Minimum and Do Something scenarios for the opening year at 47 receivers (59 modelled locations). These receivers were located on the existing roads e.g. North and South on the Enniskerry Road, the front facades of receivers East and West on the Glenamuck Road and the front facades of receivers to the West on Ballycorus Road.

- Traffic noise level increases of between 0.1 and 4.9dB L_{den} are calculated between the Do Minimum and Do Something scenarios for the opening year at 25 receivers (34 modelled locations). The magnitude of change in noise levels is deemed to be negligible to minor. The overall noise levels are, however, calculated to be below/meet the TII design goal for national roads of 60dB L_{den} for the majority of the receivers, with the exception of some properties along the R117 Enniskerry Road (N) Junct. To GDDR, Ballycorus Road and GLDR Link Junct. with R117 (S) link road.

- Traffic noise level increases of between 5 and 9.9dB L_{den} are calculated between the Do Minimum and Do Something scenarios for the opening year at 12 receivers (13 modelled locations). The magnitude of change in noise levels is deemed to be moderate. The overall noise levels are, however, calculated to be below/meet the TII design goal for national roads of 60dB L_{den} for the majority of the receivers, including the receiver (PPG_F1) granted planning permission (planning ref: DA18A/0566) to West of GLDR Junct. Glenamuck Road. The rear façade of RD2b, located on the Ballycorus Road is the only locations whereby the TII design goal is exceeded (64 dB L_{den}).

- Traffic noise level increases of above 10dB L_{den} are calculated between the Do Minimum and Do Something scenarios for the opening year at 8 receivers. The magnitude of change in noise levels is deemed to be major. The overall noise levels are calculated to be below/meet the TII design goal of 60dB L_{den} for the majority of the receivers, including the receiver (PPG_I) granted planning permission (planning ref: DA09A/0316) to West of GLDR (N) GLDR Road. There are two locations whereby the TII design goal is exceeded, namely the rear façade of RB7b, located on the GLDR Junct. Barnaslingan Lane (62 dB L_{den}) and the rear façade of RE6b, located on Glenamuck Road (E) (61 dB L_{den}).

On analysis of the Do Something Scenario 2020, a total of 3 receivers (4 modelled locations) met the TII criteria for noise mitigation i.e. RB7b, RD2a/b and RE6b. The suitable mitigation, as outlined inTable 9-8 enables the noise threshold set out in the TII guidance document to be met at all 3 receivers. The provision and type of barrier used will be determined in conjunction with relevant landowners at accommodation works stage.

Based on the classification of noise impacts outlined in Table 9-7, the following comments are made in relation to design year 2035;

- Traffic noise level reductions or no changes were calculated between the Do Minimum and Do Something scenarios for the opening year at 45 receivers (57 modelled locations). These receivers were located on the existing roads e.g. North and South on the Enniskerry Road, and the front facades of receivers East and West on the Glenamuck Road.

- A negligible increase in traffic noise (0.1 – 2.9dB increase) is calculated at 17 of the receivers (21 modelled locations). The overall noise levels are, however, calculated to be below/meet the TII

design goal for national roads of 60dB L_{den} for the majority of the receivers, with the exception of some front facades of properties along the R117 Enniskerry Road (N) Junct. To GDDR and the Ballycorus Road.

- A minor increase in traffic noise (3 – 4.9dB increase) is calculated at 9 of the receivers (11 modelled locations). The overall noise levels are calculated to be below/meet the TII design goal of 60dB L_{den} for 8 of the receivers. The front and rear façade of RK1a/b, located 45m to the West of the GLDR Junction with Ballycorus Road, is the only receiver whereby the TII design goal is exceeded (63 dB and 65dB respectively).

- A moderate increase in traffic noise (5 – 9.9dB increase) is calculated at 12 of the receivers (16 modelled locations). The overall noise levels are calculated to be above the TII design goal of 60dB L_{den} for 5 receivers, namely the properties immediately to the East of the Ballycorus Road (RD2a/b and RD4b), the closest façade to the GLDR (N) Road (RI1b) and the rear façade of the receiver (PPG_Ic) at the site granted planning permission (planning ref: DA09A/0316) to East of GLDR (N) Road.

- A major increase in traffic noise (+10dB increase) is calculated at 9 of the receivers. The overall noise levels are calculated to be below/meet the TII design goal of 60dB L_{den} at four of the receivers, with the major increase in traffic noise particularly along the rear facade of properties located on the Glenamuck Road (RE6b, RE7b) and at those properties closest to the GLDR link road (RB7b, RD1b, and RK3b).

As the "Do Something" noise level at 10 no. receivers (11 modelled locations) is above 60dB L_{den} and is increased by 1dB or more as a direct result of the proposed road development, the criteria is met for mitigation at these locations based on the TII/NRA criteria for noise mitigation measures. Suitable mitigation, as outlined in Table 9-11 previously, enables the noise threshold set out in the TII guidance document to be met at 8 no. receivers, as illustrated in Table 9-12. The provision and type of barrier used will be determined in conjunction with relevant landowners at accommodation works stage.

Two receivers (RD2a/b and RD4b) have predicted L_{den} values between 3dB to 7dB above the TII design goal of 60dB L_{den}. The benefits gained by a 2.5m barrier is minimal (<3dB) due to the existing contribution of noise from the existing Ballycorus Road, however privacy from new road layout to rear of properties may be an important factor considered by the landowners at these locations. As per the TII guidance in relation to "proportionality" it may not be possible to attain the design goal of 60dB L_{den} at these two receivers through sustainable means. The mitigation benefits gained increasing the barrier height in these two locations greater than 2.5m is disproportionate to the potential visual intrusion of the barriers. Again, the provision and type of barrier used will be determined in conjunction with relevant landowners at accommodation works stage.

9.5.2 Construction Noise Mitigation Measures

The contract documents will clearly specify that the Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures and comply with the recommendations of BS5228-1 2009 +A1 2014. These measures will typically include:

- No plant used on site will be permitted to cause an ongoing public nuisance due to noise.

- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate before 07:00hrs or after 19:00hrs will be surrounded by an acoustic enclosure or portable screen.
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Table 9-1 using methods outlined in BS5228:2009 *Part 1.*
- Erecting portable screens around noisy items of plant in noise sensitive areas, where required.

Working Hours

Normal working times will be 07:00 to 19:00hrs Monday to 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 Contracting Authority.

Works other than the pumping out of excavations, security and emergency works will not be undertaken at night and on Sundays without the written permission of the Contracting Authority.

Emergency Work

The emergency work referred to above may include the replacement of warning lights, signs and other safety items on public roads, the repair of damaged fences, repair of water supplies and other services which have been interrupted, repair to any damaged temporary works and all repairs associated with working on public roads.

9.6 Residual Impacts

9.6.1 Construction Phase

During the construction phase of the project there is potential for some temporary moderate to major impacts on a limited number of properties between 10m to 50m distance from construction works. The application of binding noise limits and hours of operation, along with implementation of appropriate noise control measures, will ensure that noise impact is controlled to within the relevant criteria.

The probability of effects from construction noise are considered and a description of the effects are summarised in Table 9-13.

Table 9-13: Description of Construction Phase Effects

Quality	Significance	Duration
Negative	Moderate/Major	Short-term

9.6.3 Operational Phase

For two thirds of the modelled locations in the vicinity of the proposed development, residual noise levels will result in reduced, no change or negligible noise impacts. At 19 no. receivers where the residual impacts result in minor to major noise impacts, the operational noise levels at these properties are calculated to be below or within 1dB of the traffic noise design goal set for national road schemes of 60dB L_{den}.

During the course of the assessment, it was shown that the predicted noise levels at 10 receivers meet the specified TII Noise Mitigation Criteria. In this instance, mitigation measures have been specified for the design year 2035. Once such measures are implemented, it was shown that at 9 receivers comply with the adopted criterion. The probability of effects from the operational phase of the proposed road are likely and a description of effects are summarised in Table 9-14.

Table 9-14: Description of Operational Phase Effects at 9 no. Receivers Meeting TII Mitigation Criteria

Quality	Significance	Duration
Negative	Negligible	Long-Term

One receiver (RD2a/b) along the Ballycorus road does not comply with the 60dB L_{den} criteria without the use of dipropionate height barriers. The TII's *Good Practice Guidance to the Treatment of Noise during the Planning of National Road Proposed Road Schemes* (2014) provides guidance that *"above a height of 3m, a structure becomes a significant structure, requiring engineering to be considered. This does not rule out the use of higher barriers, but it may be necessary to use professional judgement to compare."* In this instance, the use of proportionality with respect to engineering and other environmental considerations should be carefully considered when assessing the justification for noise barriers with limited acoustic benefit.

The probability of effects from the operational phase of the proposed road on the receiver at RD2a/b are likely and a description of effects are summarised in Table 9-15.

Table 9-15: Description of Operational Phase Effects at 1 no. Receiver Meeting TII Mitigation Criteria

Quality	Significance	Duration
Negative	Moderate	Long-Term

It may be concluded that the project complies with the appropriate guidance in relation to noise, hence the associated impact in the Operational Phase is Negligible, with the exception of one receiver on the Ballycorus Road.

Difficulties Encountered

No difficulties noted.

References

- British Standards (2009a) BS 5228 – 1: 2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise.*
- British Standards (2009b) BS 5228-2:2009+A1 2014: *Code of practice for noise and vibration control on construction and open sites – Vibration.*
- Department for Transport, Tourism and Sports (2013) *Design Manual for Urban Roads and Streets* (DMRUS).
- Environmental Protection Agency (EPA) (Draft August 2017) *Guidelines on the Information to be contained in Environmental Impact Assessment Reports.*
- EPA (Draft, September 2015) *Advice Notes for Preparing Environmental Impact Statements.*
- National Roads Authority/TII (2004) *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*
- National Roads Authority/TII (2014) *Good Practice Guide for the Treatment of Noise during the Planning on National Road Schemes*.

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10 Biodiversity

10.1 Introduction

This report has been prepared by Padraic Fogarty of OPENFIELD Ecological Services. Pádraic Fogarty has worked for over 20 years in the environmental field and in 2007 was awarded an MSc from Sligo Institute of Technology for research into Ecological Impact Assessment (EcIA) in Ireland. He has an honours degree in Analytical Science from DCU, and diplomas in Environment and Geography (Open University) and Field Ecology (UCC). Pádraic is a full member of the Institute of Environmental Management and Assessment (IEMA).

This section provides for an assessment of the potential effects of the proposed development to biodiversity.

10.2 Assessment Methodology

The assessment was carried out in accordance with the following best practice methodology: 'Guidelines to be contained in Environmental Impact Assessment Reports' from the Environmental Protection Agency (EPA, 2017), and 'Guidelines for Ecological Impact Assessment in the United Kingdom and Ireland' by the Chartered Institute of Ecology and Environmental Management (IEEM, 2016).

Site visits were carried out on the 22nd and 26th of January, and the 22nd and 26th of June 2018. The site was surveyed in accordance with the Heritage Council's Best Practice Guidance for Habitat Survey and Mapping (Smith et al., 2010). Habitats were identified in accordance with Fossitt's Guide to Habitats in Ireland (Fossitt, 2000). A species list for each habitat was compiled and these are presented in Appendix 2 of this report. Species abundance was determined using the DAFOR scale (D = Dominant; A = Abundant; F = Frequent; O = Occasional; R = Rare), a subjective estimation but nevertheless a useful mode of habitat description. Sample digital photos were also taken. Data were then uploaded to the ArcView 9.2 GIS software suite.

The nomenclature for vascular plants is taken from The New Flora of the British Isles (Stace, 2010) and for mosses and liverworts A Checklist and Census Catalogue of British and Irish Bryophytes (Hill et al., 2009).

January lies within the optimal survey period for surveying large mammals and especially badgers. June is within the optimal season for general habitat surveys (Smith et al., 2010), breeding birds and bats. Data deficiencies will be highlighted further in this report within relevant sections. A dedicated bat survey was carried out by Brian Keeley and this report is presented separately in Appendix 10-2, while its findings are incorporated in this chapter.

10.3 Baseline Environment

10.3.1 Zone of influence

Best practice guidance suggests that an initial zone of influence be set at a radius of 2km for non-linear projects (IEA, 1995). However, some impacts are not limited to this distance and so sensitive receptors further from the project footprint may need to be considered as this assessment progresses. This is shown in Figure 10-1.

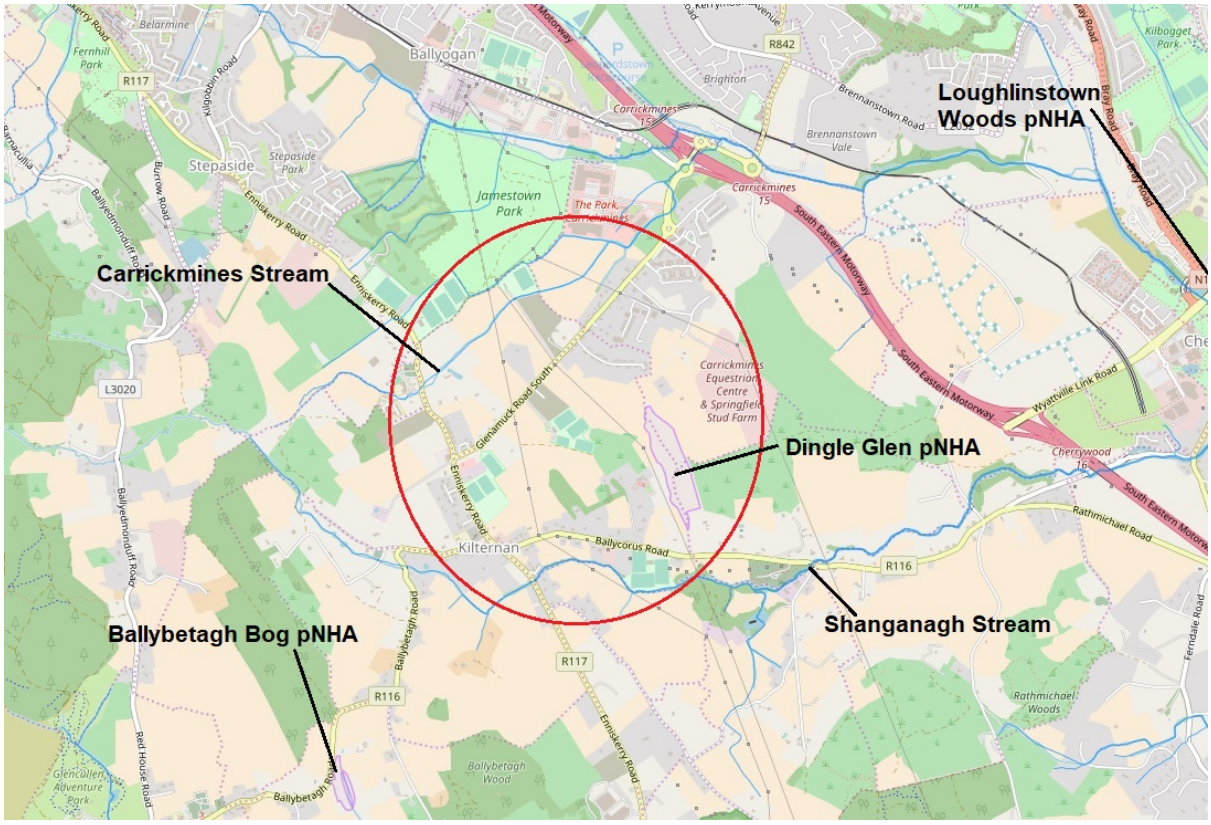

Figure 10-1 Indicative study area

Indicative study Area (in large circle) and approximate 2km radius showing areas designated for nature conservation and water courses (from www.epa.ie).

There are a number of designations for nature conservation in Ireland including National Park, National Nature Reserve, RAMSAR site, UNESCO Biosphere reserves, Special Protection Areas (SPA – Birds Directive), Special Areas of Conservation (SAC – Habitats Directive); and Natural Heritage Areas. The mechanism for these designations is through national or international legislation. Proposed NHAs (pNHA) are areas that have yet to gain full legislative protection. They are generally protected through the relevant County Development Plan. There is no system in Ireland for the designation of sites at a local or county level. The following areas were found to be located within an approximate 2km radius of the application site, while the Dalkey Coastal Zone and Killiney Hill pNHA is connected to the site via a hydrological link:

Dingle Glen pNHA (site code: 1207): This is a small area of regenerating native woodland that is of value for its relatively undisturbed character.

Ballybetagh Bog pNHA (site code: 1202). This area is composed of three separate marsh areas 5km north-west of Enniskerry. It is an important wetland site and is well known for the quantity of archaeological remnants, especially relicts of Giant Irish Elk.

Loughlinstown Wood pNHA (site code: 1211). This is a woodland site which straddles the Loughlinstown Stream and, while it is of planted origin, it has developed semi-natural characteristics.

Dalkey Coastal Zone and Killiney Hill (pNHA: 1206). The following information is available for this area:

This site includes the coastal stretch from Scotman's Bay to south of White Rock, the Dalkey Island group and Dalkey Sound, and Killiney Hill. Killiney Hill is at the edge of the Wicklow mountain intrusion and so it is formed of a mixture of granite and mica schist. It provides one of the best exposed junctions of these rock types, on the beach at White Rock, at which minerization has taken place due to contact metamorphism. The minerals include biotite, andelusite and garnet, with aplite and pegmatite veins also exposed. The seaward parts of Killiney Hill have in addition a covering of calareous glacial drift. The rocky shore is mainly of granite.

Dalkey Sound and its environs have been highly regarded as a valuable marine collecting area for many years. The Sound is especially noteworthy for the occurrence of west and south coast invertebrates. Species taken include Squat Lobsters (Galathea spp.), Swimming Crabs (Portunus spp.) and the Crawfish (Palinurus vulgaris). The area is also noted for the occurrence of gymnoblastic hydroids, with the rate Antedon bifida being taken regularly. Some rare European species which occur are members of the Order Nudibrachia and the Spiny Starfish (Marthasterias glacialis).

Dalkey Island lies c. 400m off Sorrento Point. The island is low-lying, the highest point at c.15m is dominated by a Martello Tower. Soil cover consists mainly of a thin peaty layer, though in a few places there are boulder clay deposits. Vegetation cover is low, consisting mainly of grasses. No woody plants have become established, probably due to constant grazing by goats. Dense patches of bracken (Pteridium aquilinum and Hogweed (Heracleun sphondylium) occur in places.

Lamb Island lies to the north of Dalkey Island, attached at low-tide by a line of rocks. It has a thin soil cover and some vegetation, mainly grasses, Nettles (Urtica dioica) and Hogweed (Heracleum sphondylium). Further north lies Mainden's Rock, a bare angular granite rock up to 5m high. There is no vegetation cover. Muglins, a small granite rock, lies about 1km north-east of Dalkey Island. A small lighthouse is on the rock.

Herring Gulls nest on Dalkey Island (17 pairs in 1986), Lamb Island (29 pairs in 1986) and Muglins (207 nests in 1982). Great Black-backed Gull nests on Dalkey Island (maximum 62 nests in 1982-88), and two pairs of Lesser Black-backed Gull nested there in 1981.

Common Terns breed annually on Maiden's Rock, with a maximum of 54 nests between 1980 and 1986. One pair of Arctic Tern bred on Mainden's Rock in several years and in 1986 two pairs of Roseate Terns nested but were unsuccessful. Manx Shearwater is suspected of breeding on Dalkey Island.

Sheluck, Mallard and Oystercatcher nest on Dalkey and Lamb Island. Meadow and Rock Pipits breed on Dalkey Island. Maiden's Rock is an important autumn roosting site for up to 2,000 terns, including Roseates from the Rockabill colony. In autumn and winter Dalkey Island is an evening roosting site for Cormorants, Shags, Curlew and large gulls. Up to 50 Turnstones and 15 Purple Sandpipers occur in winter.

Killiney Hill is a complex of coastal heath and mixed woodland. The woods are mostly planted and include Sycamore (Acer pseudoplatanus), Horse Chestnut (Aesculus hipposcastanum), some Oak (Quercus spp.), Ash (Fraxinus excelsior) and Holly (Ilex aquilinum). The ground flora is mainly Ivy (Hedera helix) and Brambles (Rubus spp.) but there are some areas with more typical woodland species such as Wood Sorrel (Oxalis acetosella) and Herb Robert (Geranium robertianum).

Many of the rock surfaces on the open and bushy areas on the east side of the summit of the hill are roches mountonnes while near the summit spodumene is found in a small scarp exposure. This results in an interesting flora, with Wood Vetch (Vicia sylvatica), Yellow Fumitory (Corydalis claiculata) and Madder (Rubis peregrina) growing amongst the Gorse (Ulex europaeus). The shallow soils overlying the rock support a community of winter annuals and early flowering perennials such as Spring Squill (Scilla verna) and Crow Garlic (Allium vineale).

The drift banks above and below the railway have warm shallow soils. Here grow scarce plants such as Bloody Cranesbill (Geranium sanguineum), Bee Orchid (Ophrys apifera), Sea Storksbill (Erodium maritimum) and Clovers (Trifolium ornithopodioides, T. striatum and T. scabrum). The naturalized Silver ragwort (Senecio cineraria) is widespread.

Up to five pairs of Fulmar breed on the cliffs below the railway line. Kestrel breeds in the area, as well as Stonechat. (NPWS, 1995).

The NPWS web site (www.npws.ie) contains a mapping tool that indicates historic records of legally protected species within a selected Ordnance Survey (OS) 10km grid square. The study area is located within the square O22 and seven species of protected mammal, and flowering plant are highlighted.

These species are detailed in Table 10-1. It must be noted that this list cannot be seen as exhaustive as suitable habitat may be available for other important and protected species.

In summary it can be seen that none of the previous records of protected plants is extant within this square. The mammals however are known to be present and may be of relevance to this study.

Table 10-1 Known records for protected species within the O22 10km square

Species	Habitat[1] [2]	Current status
Clinopodium acinos Basil thyme	Field margins and sandy or gravelly places	Record pre-1970[3]
Galeopsis angustifolia Red Hemp-nettle	Calcareous gravels	
Misopates orontium Lesser snapdragon	Arable fields	
Puccinellia fasciculata Borrer's salt-marsh grass	Muddy inlets on the coast	
Cervus nippon Sika deer	Coniferous woodland and adjacent heaths	Current[4]
Lutra lutra Otter	Rivers and wetlands	Not recorded
Sciurus vulgaris Red squirrel	Woodlands	Present[5]

Additional records of protected species are available from the database of the National Biodiversity Data Centre. Table 10-2 lists mammal species that are protected under the Wildlife Act 1976 and highlights those for which there are current records in this 10km square.

[1] Parnell et al., 2012
[2] Hayden & Harrington, 2001
[3] Preston et al., 2002
[4] Harris & Yalden, 2008
[5] Carey et al., 2007

Table 10-2 Protected mammals in Ireland

Protected Mammals in Ireland and their known status within the zone of influence[6]. Those cells that are greyed out indicate no records for this species in the O22 square.

Species	Level of Protection	Habitat	Red List Status[7]
Otter *Lutra lutra*	Annex II & IV Habitats Directive; Wildlife (Amendment) Act, 2000	Rivers and wetlands	Near Threatened
Lesser horseshoe bat *Rhinolophus hipposideros*		Disused, undisturbed old buildings, caves and mines	Least Concern
Grey seal *Halichoerus grypus*	Annex II & V Habitats Directive; Wildlife (Amendment) Act, 2000	Coastal habitats	-
Common seal *Phocaena phocaena*			-
Whiskered bat *Myotis mystacinus*	Annex IV Habitats Directive; Wildlife (Amendment) Act, 2000	Gardens, parks and riparian habitats	Least Concern
Natterer's bat *Myotis nattereri*		Woodland	Least Concern
Brown long-eared bat *Plecotus auritus*		Woodland	Near Threatened
Leisler's bat *Nyctalus leisleri*		Woodlands and buildings	Least Concern
Common pipistrelle Pipistrellus pipistrellus		Farmland, woodland and urban areas	Least Concern
Soprano pipistrelle *P. pygmaeus*		Rivers, lakes & riparian woodland	Least Concern
Daubenton's bat *Myotis daubentonii*		Woodlands and bridges associated with open water	Least Concern

[6] Excludes marine mammals
[7] Marnell et al., 2009

Nathusius' pipistrelle *P. nathusii*		Parkland, mixed and pine forests, riparian habitats	Least Concern
Irish hare *Lepus timidus hibernicus*	Annex V Habitats Directive; Wildlife (Amendment) Act, 2000	Wide range of habitats	Least Concern
Pine Marten *Martes martes*		Broad-leaved and coniferous forest	Least Concern
Hedgehog *Erinaceus europaeus*	Wildlife (Amendment) Act, 2000	Woodlands and hedgerows	Least Concern
Pygmy shrew *Sorex minutus*		Woodlands, heathland, and wetlands	Least Concern
Red squirrel *Sciurus vulgaris*		Woodlands	Near Threatened
Irish stoat *Mustela erminea hibernica*		Wide range of habitats	Least Concern
Badger *Meles meles*		Farmland, woodland and urban areas	Least Concern
Red deer *Cervus elaphus*		Woodland and open moorland	Least Concern
Fallow deer *Dama dama*		Mixed woodland but feeding in open habitat	Least Concern
Sika deer *Cervus nippon*		Coniferous woodland and adjacent heaths	-

As can be seen there are a number of species of bat as well as larger mammal species for which there are current records in this area. Records of Badger are available from the National Biodiversity Data Centre. These date from 1968 at the resolution of the O22 10km square. More recent records date from 2007 and are confined to the two 2km squares centered on the townland of Glenamuck South, between the Glenamuck Road and the Ballycorus Road.

The Kiltiernan Local Area Plan 2013-2018 includes background information and specific objectives in relation to natural heritage (chapter 3). The following extracts are among those which are of relevance to this study.

The CDP currently identifies significant trees/woodlands in a location in the extreme northern portion of the LAP area immediately east and west of Glenamuck Road. There are no formal statutory Tree Preservation Orders in the LAP area. Of additional significance is a wooded strip, located along the south-eastern perimeter of the LAP area and zoned 'Objective G' (see Map No. 7), which contains a small stand of pure blackthorn. This blackthorn forms a dense stand of ten metre tall bushes that diminish to bushes of about one metre in the adjacent field. […]

The most significant habitat type in the LAP area is hedgerow. Many of the hedgerows have a high biodiversity value and preliminary inspection undertaken during the HLCA study identified those classified as mature as being over one hundred years old. In general, the condition of the hedgerows ranges from very good to excellent. While lands within the LAP area which have been zoned for future development, contain mature hedgerows, it is acknowledged that it may not be possible to retain all these hedgerows. […]

The Heritage and Planning Division, DoECLG, advise that as part of any significant development proposals, Badger and Bat surveys should be conducted, particularly in the townlands of Jamestown, Glenamuck North and Glenamuck South.

Objectives

LHC10: Conserve, enhance and manage the natural heritage within the LAP area including its biodiversity, landscapes and geological heritage and promote understanding of and sustainable access to it.

LHC19: To carry out a detailed ranking survey of the hedgerows be undertaken as part of any future development proposals, and where possible to incorporate these hedgerows within the development. It is acknowledged, however, that it will not be possible to retain all of the current hedgerows.

LHC20: To recognise and contribute towards protection of habitats from alien / invasive species (e.g. Japanese knotweed, giant hogweed, Himalayan balsam, etc.) in accordance with Action Number 4.7 of the Dun Laoghaire-Rathdown Biodiversity Plan 2009-2013.

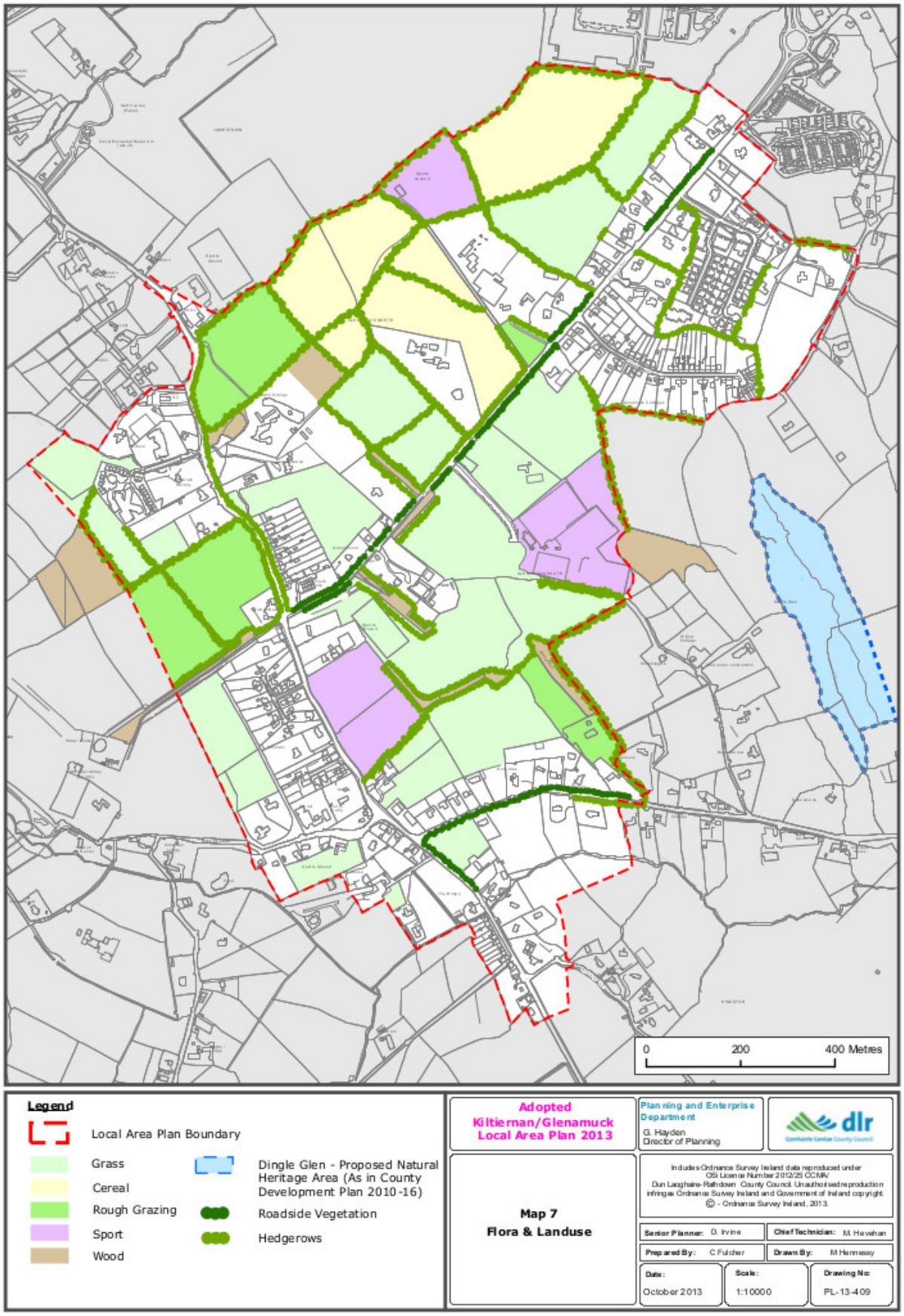

Figure 10-2 Habitats map (Extract from the Kiltiernan Local Area Plan)

Water quality in rivers is monitored on an on-going basis by the Environmental Protection Agency (EPA). They assess the pollution status of a stretch of water by analysing the invertebrates living in the substrate as different species show varying sensitivities to pollution. They arrive at a 'Q-Value' where Q1 = pristine quality and Q5 = grossly polluted (Toner et al., 2005). OSI mapping shows a number of streams in the vicinity of the lands that pass into the Loughlinstown River, ultimately draining into the Irish Sea south of Killiney, including the Glenamuck Stream and the Shanganagh Stream. There are no monitoring points upstream of the development site and the nearest downstream station is on the Carrickmines Stream where it crosses the N11 dual carriageway. At this point the river was most recently (2012) assessed as Q3-4 indicating slightly polluted status. This is unchanged since the previous samples in both 2009 and 2004. Further downstream water quality improves and is Q4 (unpolluted) in Loughlinstown. These data are taken from www.epa.ie.

Figure 10-3 Local water quality

WFD status: Yellow = moderate; Green = good. Sampling points on the Shanganagh Stream are shown with Q-value and most recent year of sampling (from www.epa.ie). Q3 = moderate pollution; Q3-4 = slight pollution; Q4 = unpolluted.

10.3.2 Stakeholder Consultation

The Development Applications Unit (DAU) of the Department of the Culture, Heritage, the Gaeltacht, was contacted for nature conservation observations. A response to this was received on February 12th 2018 (reference no. GPre00016/2018). In addition to general information on the preparation of ecological reports there is specific content relating to the subject development, it states:

This Department notes from your letter dated 24th January that a habitat survey is currently underway. January could not be considered an adequate time to carry out a habitat survey or indeed most botanical work. A flora survey should be carried out at appropriate times in Spring and Summer to enable a complete list of flora to be compiled.

It is noted that only a winter survey had been carried out at the time of response and a summer survey was subsequently completed as described in Section 10.2.

This Department also notes two streams running through the study area. And note that care should be taken to ensure there are no negative impacts on these streams and their flood plains to ensure no loss of biodiversity and request that the impact of the proposed development on the biodiversity of the site and on the nearby Dingle Glen pNHA should also be assessed (An Bord Pleanála reference TC0028).

Details were also sent to Inland Fisheries Ireland. A written response to this was received on January 25th 2018:

The proposed road development is located on the in the catchment of the Carrickmines and Shanganagh system. These two systems support a resident population of Brown trout (and several other fish species) while further downstream they support a migratory population of Sea trout (both Salmo trutta). The coastal waters of the area currently retain a "high" water quality status. The Glenamuck and Shanganagh Rivers represent a valuable resource both in terms of local natural heritage (biological diversity value) and particularly from a native fisheries perspective. Both these systems constitute a local natural heritage feature warranting careful protection and conservation.

Ground preparation and associated construction works, including large-scale topographic alteration and the creation of roads and infrastructure have significant potential to cause the release of sediments and pollutants into surrounding watercourses. Pollution of the adjacent freshwaters from poor on-site construction practices could have a significantly negative impact on the fauna and flora of this freshwater system. A comprehensive and integrated approach for achieving freshwater ecological protection during road construction and operation should be implemented.

In-stream works in salmonid systems can only be untaken during the period July to September of each year. Of particular concern to IFI are the proposed river crossings. Any crossings must ensure the unhindered passage of fish. Therefore, IFI recommend a clear spanning of these rivers. It is essential that the detail design for all associated river works including crossings are agreed in advance with IFI.

It is recommended that the "Guidelines on protection of fisheries during construction works in and adjacent to water" be consulted when undertaking any works in the vicinity of surface water features. It is important to highlight the following key constraints (all included in our guidelines document which can be found on the IFI website) at this time:

All watercourses should be maintained in their natural open state

Disturbance of in-stream habitats should be minimised.

A method statement for all riparian / in-stream works must first be submitted to IFI for approval.

Comprehensive surface water management measures must be implemented at the construction and residential stage to prevent any pollution of the Glenamuck and Shanganagh rivers. Policies and recommendations made under the Greater Dublin Strategic Drainage Study (GDSDS) should be applied in development of a drainage strategy for this site.

Best practice should be implemented at all times in relation to any construction activities that may impact on riverine or riparian habitats. Any discharges to surface streams present on the site must not impact negatively on the salmonid status of the system. Comprehensive surface water management measures must be implemented at the construction stage to prevent any pollution of streams in the area. On-site attenuation ponds may be required to allow for the settlement of fine/particulate materials out of potentially discharging surface waters from works areas. Good housekeeping measures are integral to achieving prevention of excessive turbid run-off to surface water systems. Silt fencing of discharge streams would also be essential during construction and possibly during operation.

The short-term storage and removal / disposal of excavated material must be considered and planned such that risk of pollution from these activities is minimised.

Details were also sent to the Biodiversity Officer for Dún Laoghaire-Rathdown County Council.

The response referenced the Kiltiernan/Glenamuck Local Area Plan 2013 and in particular Section 3.2. Natural Environment which contains a number of objectives there in relation to Biodiversity. Also, the Landscape, geology and water elements of the same chapter have relevance for biodiversity. For example, any pathways to groundwater or surface water to protected sites including watercourses and also Dingle Glen pNHA. It referenced the importance of checking for any protected habitats and species including tufa springs.

The response also summarized bryophyte surveys and noted that Dingle Glen pNHA was found to support a number of bryophyte species which are rare/ very rare in Co. Dublin (Vice-county H21). These include:

- 2 species for which this is the first recorded site in Co. Dublin;
- 2 species for which this is the first recent (post 1950) record in Co. Dublin;
- 6 species for which this is only the second site in Co. Dublin; and
- 21 species which have less than 10 records within Co. Dublin.

On June 7th An Taisce made a written submission which primarily focused on the issue of biodiversity:

The Scoping Report at Section 8.2.5 rightly refers to Dingle Glen pNHA (site code 1207) as an area of value for its relatively undisturbed character. However, there is another area which has the Zoning Objective G 'To protect and improve high amenity areas' and which is to the west of Dingle Glen, closer to the proposed route of the Link Distributor Road. This is the glen called "Glenamuck" on Map 9 of the County Development Plan 2016-2022, also known locally as "The Little Dingle". It is identified as parcel 24b on the map of the LAP reproduced at Figure 4.1 of the Scoping Report. At its north-west

corner there is an adjacent small High Amenity area which is called parcel 24a on the LAP map. This almost touches the Link Distributor Road route.

Chapter 11 of the Written Statement for the LAP says the following regarding Parcels 24a + b:

'Special' natural open space – important to retain biodiversity and walking route linkages. Is however privately owned.

We have more detailed information as follows:

The glen is very much a wilderness area with old beech trees, holly, thorn trees, bramble, etc.. It is a haven for birds and animals. In its N.W. corner there is a significant number of badger setts.

We think that a special study will be required to assess the implications of constructing the Link Distributor Road so close to this High Amenity area and its habitat. In particular the potential disturbance of wildlife corridors will need to be taken into account. The Scoping Report at 6c on page 31 acknowledges that the road system will sever lands and prevent any movement between Badger populations in the region. Special care and protection should be given to the badger population in the Glenamuck glen.

10.3.3 Site survey

Aerial photography from the OSI shows that the predominant land use in this area remains agricultural. However, in recent years significant built development has been underway which has seen land use change to more urban uses.

The site survey included incidental sightings or proxy signs (prints, scats etc.) of faunal activity, while the presence of certain species can be concluded where there is suitable habitat within the known range of that species. Table 10-2 details those mammals that are protected under national or international legislation in Ireland.

Habitats/Flora

The study area can be broadly described as agricultural lands divided by traditional field boundaries. There are also areas of woodland and artificial habitats (including homes and gardens) which are all drained by a network of ditches and small streams. These are shown as a habitat map in Figure 10-5.

Agricultural fields are a combination of **arable crops – BC1** and **improved agricultural grassland – GA2**. These are intensively managed and are of negligible biodiversity value. Where agriculture has ceased, grassland develops into **dry meadow – GS2** and this can contain some diversity of grasses and broad-leaved plants including Thistles *Cirsium sp.*, Willowherbs *Epilobium sp.*, Docks *Rumex sp*, Clovers *Trifolium sp*. etc. Meadows are generally nutrient-rich and have low diversity when compared with low intensity, semi-natural grassland habitats, and so are of low biodiversity value. Nevertheless, they do provide some habitat for invertebrates and small mammals. Where agriculture has been abandoned for many years, young trees become established in a natural process which ultimately leads to high woodland. This intermediate stage is known as **scrub – WS1** and on the study lands is typically groves of young or sapling Willow *Salix sp*. or Alder *Alnus glutinosa*, or bands of Brambles *Rubus fruticosus agg*. or Blackthorn *Prunus spinosa* expanding out from hedgerows.

Immature woodland – WS2 is found in three small areas to the north of the study area. These are generally planted, even aged stands of Ash *Fraxinus excelsior*. One is associated with a private garden and includes non-native conifers and Birch *Betula sp*. For a small stretch along the Glenamuck Stream there is a more developed **broad-leaved woodland – WD1**. This is shown on historic OSI maps and is associated with Glenamuck House. It is therefore likely to be 200 years old or older. There are tall Birch, and Ash along with Hazel *Corylus avellana*, Holly *Ilex aquifolium* and Cherry Laurel *Prunus laurocerasus*. At ground level there is Primrose *Primula vulgaris*, Soft-shield Fern *Polystichum setiferum*, Male-fern *Dryopteris filix-mas* and Herb Robert *Geranium robertianum*. Another area of this woodland type is found in a small valley north of the Ballycorus Road. This is more developed, with a greater number of tall trees. It is locally known as the 'little Dingle'. It was found to have a mature canopy of Ash and Sycamore *Acer pseudoplatanus* and an understorey of Elder *Sambucus nigra,* Blackthorn *Prunus spinosa* and Holly. The ground level meanwhile was found to consist of abundant Ivy *Hedera helix* with Brambles, Soft-shield Fern, Ground Ivy *Glechoma hederacea,* Hogweed *Heracleum sphondylium,* Primrose and Wood Avens *Geum urbanum.* There was a reasonable quantity of dead wood (an essential component of healthy woodland habitats) while the bryophyte component was not visually significant. These habitats are of high local value.

Occasional patches of **spoil and bare ground – ED3**, **buildings and artificial surfaces – BL3** – which include gardens with mostly horticultural shrubs – and **amenity grassland – GA2** are of negligible biodiversity value.

Field boundaries generally date from the mid-18th Century however those laid down as townland boundary can be much older (8th Century). Within the study area these boundaries are a combination of **hedgerow – WL1** and **treeline – WL2**, habitats which can be of similar species composition and are differentiated by the average tree height (treelines are composed of trees over 5m in height). These features are further subdivided into those of 'higher significance' or 'lower significance'. This classification is set out as a scoring system in guidelines from the Heritage Council and is based on the feature's historical significance, species diversity (trees and woody species/ground flora), structure

and associated features (Foulkes et al., 2013). Within the study area, 'higher significance' field boundaries are marked on the first edition OSI maps (and so of historical significance), are dominated by native species, and are associated with field drains or water courses. 'Lower significance' boundaries meanwhile are mostly composed of non-native species (e.g. Leyland Cypress *Cuprocyparis leylandii* or Poplar *Populus sp.*), recently planted or have very low species diversity with poor structure (e.g. dominated by Brambles and/or with large gaps).

Many fields are accompanied by **drainage ditches – FW4** and these are common features of agricultural landscapes in Ireland. They lead into one of two streams, the Glenamuck Stream, to the north, or the Shananagh Stream, to the south. They can both be described as **eroding rivers – FW1**.

A number of plant species listed as alien invasive under SI No. 477 of 2011 were recorded in the wider study area, namely: Japanese Knotweed *Fallopia japonica*, Giant Hogweed *Heracleum mantegazzianum*, Giant Rhubarb *Gunnera tinctorial* and Three-cornered Garlic *Allium triquetrum*. Their locations are given in Figure 10-5. The Japanese Knotweed appeared to have been chemically treated at the time of the June survey. Of these plants, only the Three-cornered Garlic falls within the construction zone of the project.

Mammals

No evidence for Otter was recorded from the sections of streams to be crossed by the proposed road (note (Bailey et al., 2006). Nevertheless, there are records of Otter from along the Shanganagh Stream, including one from as recently as 2010. According to the NPWS in their response to the EIAR scoping report:

As part of the national otter survey carried out by National Parks & Wildlife Service staff in 2010 otter spraint was identified at the site where it is proposed the Link Distributor Road is to cross the Bride's Glen branch of the Loughlinstown River; altogether 7 sprainting sites were identified in the 600 m stretch of this river downstream of Kiltiernan Bridge. A survey by Scott Cawley Ltd for the Biodiversity Office of Dún Laoghaire-Rathdown Co. Council in 2012 found otter sprainting sites every 150 m along this branch of the Loughlinstown River, from the Ballyedmonduff Road to the sea. Otters have also recently been reported from Carrickmines. This Department recommends that a comprehensive otter survey of the Glenamuck Stream, the Bride's Glen branch of the Loughlinstown River and connecting waters should be carried out as soon as possible in order to assess the potential impact of the proposed road scheme on this species, which is afforded a regime of special protection under the Habitats Directive.

Note that due to issues with land accessibility, a full survey of the Glenamuck Stream was not carried out and only those (relatively short) sections to be directly affected by the road scheme were surveyed. Based on NPWS input, otters are assumed to be present along both the Glenamuck Stream and Loughlinstown/Shanganagh River and mitigation measures are applied accordingly.

January is an ideal time for surveying for Badgers as vegetation has died back, making it easier to follow trails or notice field signs. Evidence for Badger activity was recorded at the edge of woodland north of the Ballycorus Road (Little Dingle). It could be seen that trails were leading into the adjacent area of dry meadow and scrub. A sett was found near the edge of the woodland and two entrances were located. Well-worn trails were noted although no other setts were found. Elsewhere no evidence

of Badger activity was recorded. To the east, an affected landowner remarked that Badgers once visited her garden but had not been seen recently. This location is adjacent to a number of gardens which were not surveyed as part of this study. Trails nearby could not be definitively assigned to Badgers and may have been of Fox origin.

A dedicated bat survey was carried out by Brian Keeley of Wildlife Surveys Ireland during the summer of 2018. This included field surveys in July and September. It found that "there were 8 species of bat noted within the area with evidence of roosts of no less than 3 species in close proximity to the route. No roosts were noted within the land-take. There will be a loss of mature trees that may serve as roost sites." Field boundaries and meadows provide ample foraging opportunities within the study area while buildings and older trees may act as roosting sites. All species of bat are protected under national and EU legislation.

Woodlands provide habitat for Red Squirrel *Sciurus vulgaris* and the non-native, invasive Grey Squirrel *S. carolinensis*. There is a record for Red Squirrel from within the study area from 2016 (but not from any of the woodland habitats). Pine Marten is not recorded from this area but is known to have expanded its range in recent years.

While limited data are available on the distribution of Hedgehog, Pygmy Shrew and Irish Stoat, they are considered ubiquitous in the Irish countryside and suitable habitat is available for them (Marnell & Lysaght, 2016).

Sika Deer *Cervus nippon* are known from the Glenamuck/Kiltiernan area and field signs were noted during the winter survey near the woodland north of the Ballycorus Road. Deer were also seen during the summer survey.

Rabbits *Oryctolagus cuniculus* and Fox *Vulpes vulpes* were noted throughout (including direct sightings). These are not protected species. Other common and widespread small mammals that are likely to be present include Wood Mouse *Apodemus sylvatica*, House Mouse *Mus domesticus*, Brown Rat *Rattus norvegicus*, and the invasive American Mink *Neovison vison*.

Birds

January is not a suitable month for surveying breeding birds. The following birds were recorded and may be breeding on these lands: Jackdaw *Corvus monedula*, Blue Tit *Parus caeruleus*, Song Thrush *Turdus philomenus*, Wren *Troglodytes troglodytes*, Magpie *Pica pica*, Hooded Crow *Corvus corone*, Wood Pigeon *Columba palumbus*, Starling *Sturnus vulgaris*, Chaffinch *Fringilla coelobs*, Raven *Corvus corax* Blackbird *T. merula*, Buzzard *Buteo buteo*, Robin *Ertithacus rubecula*, Long-tailed Tit *Aegithalos caudatus*, Pheasant *Phasianus colchicus*, Sparrowhawk *Accipiter nisus* and Goldfinch *Carduelis carduelis*. These are all species listed on the 'green' list – birds of low conservation concern- from BirdWatch Ireland (Colhuon & Cummins, 2013).

A breeding bird survey was undertaken in June 2018. Species recorded are listed in Table **10-3** and these data are represented graphically in Figure 10-4. All species noted are listed on BirdWatch Ireland's 'green' list. In addition to those listed, Barn Swallow Hirundo rustica was noted foraging across fields. This bird is on the 'amber' list and so is of medium conservation concern.

Barn Owl *Tyto alba* is listed as of high conservation concern (red list). The records of the National Biodiversity Data Centre indicate a historical presence, with a 'possible breeding' record from this 10km square. Barn Owls are nocturnal and elusive however are known to nest in buildings and outhouses where signs of their activity can be easily detected. There are no such nesting sites available within the study area. There was no indication that Barn Owls are using the land from either the summer or winter surveys, including the bat survey (which took place at night time).

Amphibians and reptiles

Common Frog *Rana temporaria* and Common Lizard *Lacerta vivipara* are protected under the Wildlife Act 1976 and are likely to be present on this site. Suitable habitat for spawning Frogs is present in drainage ditches. Smooth Newts *Lissotriton vulgaris* are to be found in Dublin but there are no permanent ponds on this site in which they are likely to be breeding.

Fish

IFI has confirmed that Brown Trout and Sea Trout are present in the Ballyogan (Shanganagh) Stream. River Lamprey *Lampetra fluviatilis* and Brook Lamprey *L. planeri* may also be present (NPWS, 2008). Extensive existing culverting of the Glenamuck Stream severely limits its suitability for fish in the vicinity of the subject lands.

Invertebrates

Protected species of aquatic invertebrates are not recorded from the streams in the subject area. The Marsh Fritillary *Euphrydras aurinia* is the only insect protected by law in Ireland. Suitable grassland habitat is not present and there are no available records from the study area. The following butterflies were recorded during the summer survey: Meadow Brown *Maniola jurtina* (frequent), Speckled Wood *Pararge aegeria tircis* (occasional), Small Tortoiseshell *Aglais utricae* (occasional), Common Blue *Polyommatus icarus* (rare), Ringlet *Aphantopus hyperantus* (frequent), and Peacock *Inachis io* (rare). The conservation status of each of these species is listed as of 'least concern' in the red data list.

Table 10-3 Breeding birds of Glenamuck

Species		BoCCI Status	CBS Code8	Birds Directive
Aegithalos caudatus	Long-tailed tit	Green	LT	-
Carduelis carduelis	Goldfinch	Green	GO	
Columba palumbus	Wood pigeon	Green	WP	-
Corvus corone	Hooded crow	Green	HC	
Corvus frugilegus	Rook	Green	RO	
Corvus monedula	Jackdaw	Green	JD	-
Erithacus rubecula	Robin	Green	R.	-
Fringilla coelobs	Chaffinch	Green	CH	-
Garrulus glandarius	Jay	Green	J.	
Parus major	Great tit	Green	GT	-
Parus caeruleus	Blue tit	Green	BT	-
Passer domesticus	House sparrow	Green	HS	
Periparus ater	Coal tit	Green	CT	-
Phasianus colchicus	Pheasant	Green	PH	
Phylloscopus collybita	Chiffchaff	Green	CC	-
Pica pica	Magpie	Green	MG	-
Prunella modularis	Dunnock	Green	D.	-
Pyrrhula pyrrhula	Bullfinch	Green	BF	
Regulus regulus	Goldcrest	Green	GC	-
Streptopelia decaocto	Collared dove	Green	CD	
Sturnus vulgaris	Starling	Green	SG	
Sylvia atricapilla	Blackcap	Green	BC	-
Troglodytes troglodytes	Wren	Green	WR	-

[8] Countryside bird survey, RSPB, BirdWatch Ireland

Turdus merula	Blackbird	Green	B.	-
Turdus philomelos	Song thrush	Green	ST	-

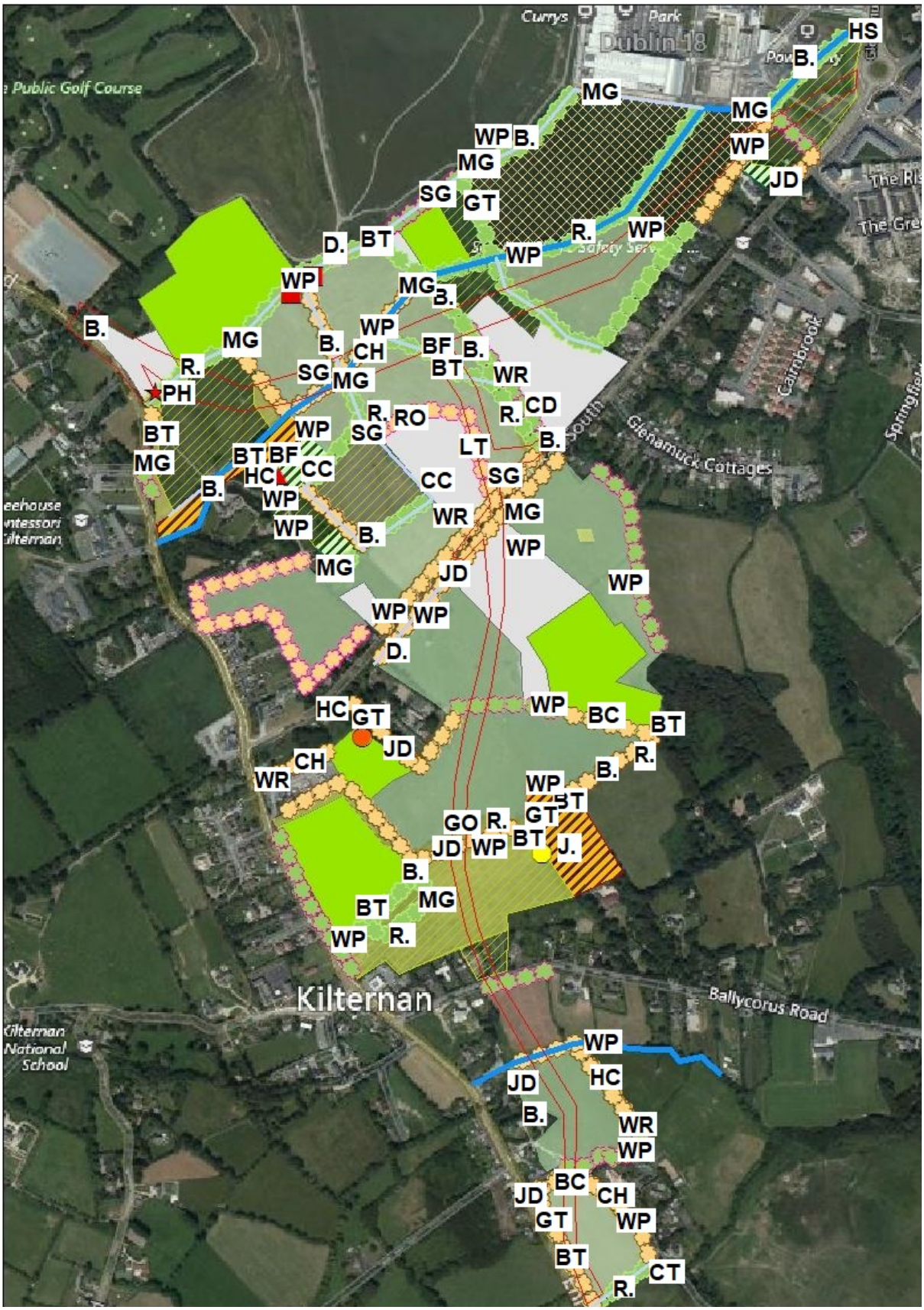

Figure 10-4 Breeding birds of Glenamuck

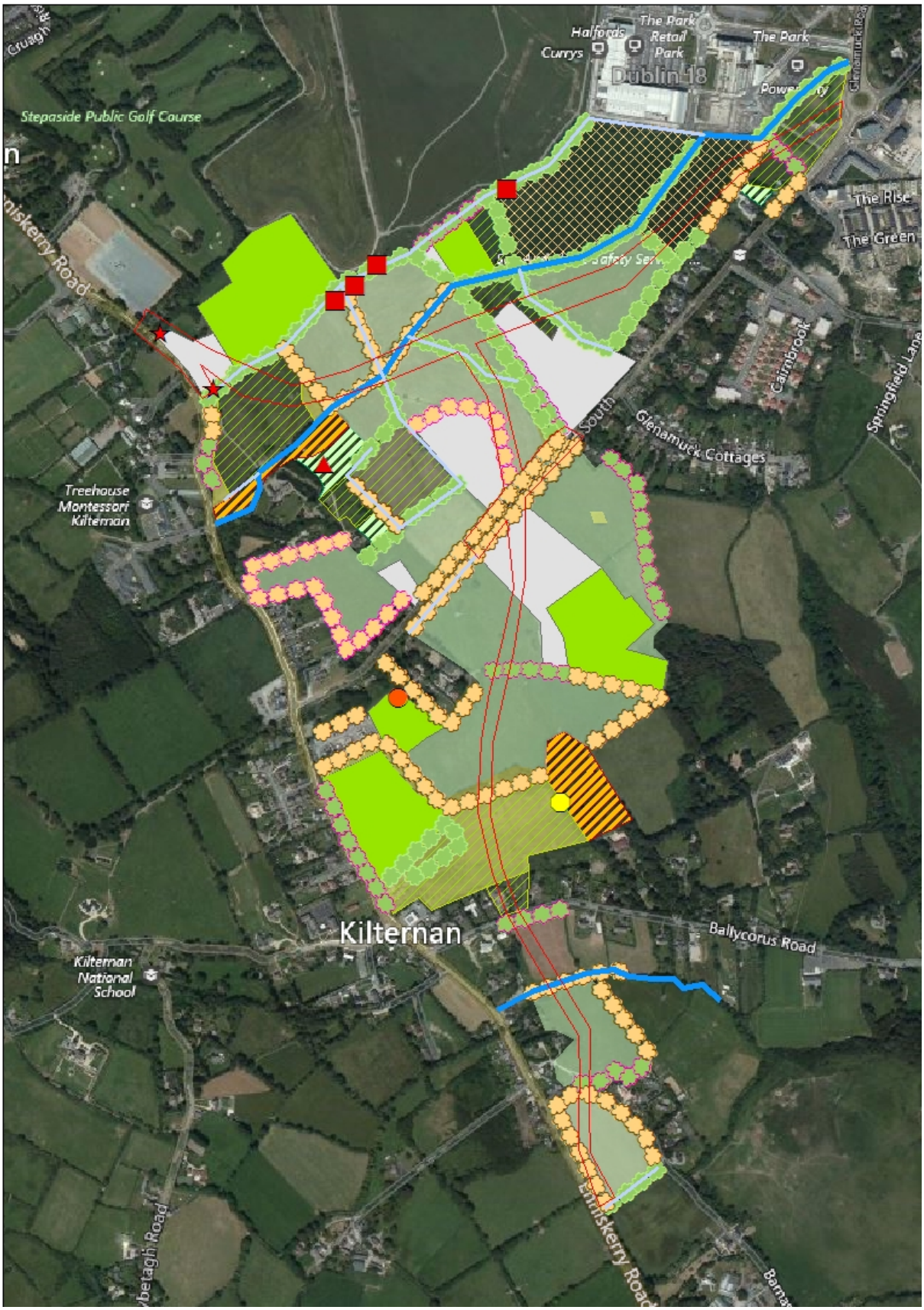

Figure 10-5 Habitat map of the subject lands
(see Figure 10-6 for legend)

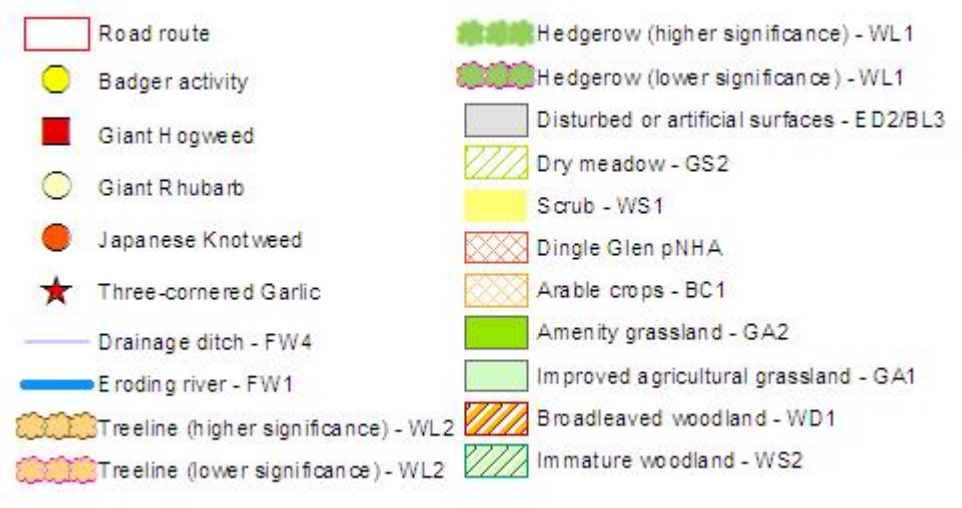

Figure 10-6 Habitat map legend

10.3.4 Overall Evaluation

An Overall Evaluation of the Context, Character, Significance and Sensitivity of the Proposed Development Site has been carried out.

In summary, it has been seen that the application site is not within or adjacent to any area that has been designated for nature conservation at a national or international level. There are no examples of habitats listed on Annex I of the Habitats Directive or records of rare or protected plants. There is Three-cornered Garlic, an alien invasive species. growing on the site (other invasive species were encountered in the wider study area as described in Section 10.3.3). Significance criteria are available from guidance published by the National Roads Authority (NRA, 2009). From this an evaluation of the various habitats and ecological features on the site has been made and this is shown in Table 10-4.

Table 10-4 Evaluation of the importance of habitats and species on the Study Area

Higher significance hedgerows and treeline – WL1/WL2 with drainage ditches – FW4 or accompanying an eroding river – FW1 Broadleaved woodland – WD1	Local Importance (higher value) Foraging habitat for badgers and bats as well as breeding habitat for birds Streams with at least Salmonid potential
Lower significance hedgerow and treeline – WL1/WL2 Dry meadow – GS2 Scrub – WS1 Immature woodland – WS2	Local Importance (lower value)
Spoil and bare ground – ED2 Buildings and artificial surfaces – BL3 Improved agricultural grassland – GA1 Amenity grassland – GA2 Arable crops – BC1	Negligible ecological value

10.4 Predicted Impacts

This section provides a description of the potential impacts that the proposed development may have on biodiversity in the absence of mitigation. Methodology for determining the significance of an impact has been published by the NRA (NRA, 2009).

10.4.1 Construction Phase

The following potential impacts are likely to occur during the construction phase in the absence of mitigation:

Habitat Loss

The removal of habitats including agricultural fields, scrub, field boundaries, artificial surfaces, drainage ditches and eroding rivers.

Higher value habitat loss is estimated as follows:

- Higher significance treeline: 960m (including 280m of townland boundary);
- Higher significance hedgerow: 320m.

The permanent loss of these habitats is assessed as being a SIGNIFICANT EFFECT.

- Lower significance hedgerow: 180m;
- Scrub: 9,950m2.

The permanent loss of these habitats is assessed as being a SLIGHT EFFECT.

- Length of Glenamuck Stream to be directly affected: 80m;
- Length of Shanganagh Stream to be directly affected: 60m.

The temporary loss of these habitats is assessed as being a SLIGHT EFFECT.

The direct mortality/disturbance of species during land clearance

The scale of this impact depends upon the timing of works as mortality principally arises when vegetation is cleared during the breeding season and when young in nests, dens, etc. are not mobile. No bat roosts were identified from the construction zone. However, mature trees provide potential roosts and eight species of bat were found foraging across the landscape. All bat roosts are protected by law and can only be disturbed under license from the National Parks and Wildlife Service. Since 2018, the bird breeding season is defined in law as commencing on March 1st and ending on July 31st. Under the Wildlife Act all birds' eggs and nests are protected at all times. No evidence of Otter holts was found along the sections of stream to be directly impacted by the road. However, new holt site may develop in time. As Otters are a protected species, this impact is potentially SIGNIFICANT.

The loss of such features is therefore assessed as potentially SIGNIFICANT.

There will be no direct disturbance to Badger setts in the Little Dingle woodland. However, sett tunnels can stretch for substantial distances underground and construction works may involve activity within

50m of sett entrances. Badgers and their setts are protected species and so potential disturbance must be assessed as a SIGNIFICANT effect.

The installation of culverts along water courses has the potential to directly affect aquatic life throughout a river's catchment, not only in the area directly affected by works but upstream (through blocking of migration pathways) and downstream (through the release of pollutants, especially sediment). Inland Fisheries Ireland confine instream works to the months between July and August to minimize these effects.

This temporary impact to aquatic life is assessed as SIGNIFICANT.

Pollution of water courses through the ingress of silt, oils and other toxic substances.

The loss of pollutants to water courses from the disturbance of soils can affect aquatic habitats by fouling fish spawning beds and directly affecting species, particularly fish. Pollutants can include oils and fuels, toxic substances such as concrete and cement, and especially sediment. Inland Fisheries Ireland has produced guidelines to minimize the effects to fish habitats during construction works.

This temporary impact to aquatic life is assessed as SIGNIFICANT

Spread of invasive species.

Japanese Knotweed, Giant Hogweed, Giant Rhubarb and Three-cornered Garlic where recorded within the study area. With the exception of Three-cornered Garlic none is within the direct footprint of the road. Nevertheless, extreme caution will be required.

The effect to biodiversity from the spread of alien invasive species is potentially long-term, albeit reversible, and so is assessed as SIGNIFICANT.

Protected Areas

There are no areas protected for nature conservation within the zone of influence of this project. The Dingle Glen pNHA is found approximately 600m from the work zone and there is no pathway for negative impacts to occur to this area. The area known as the 'Little Dingle' is closer and will be adjacent to the construction zone. Nevertheless, there can be no direct negative effects to this habitat arising from the project. The stand of tall Blackthorn identified in the LAP will not be affected by the project.

Indirect effects may occur through the loss of ecological connectivity, disturbance to Badgers or artificial lighting and these impacts have been addressed. The boundary of this area will be fenced and labelled 'sensitive ecological zone' for the duration of the project and this will help to ensure accidental damage does not occur (e.g. through the use of machinery or storage of materials).

10.4.2 Operation Phase

The following potential impacts are likely to occur during the operation phase in the absence of mitigation:

Impacts to species through the disruption of ecological corridors:

A. Bats

Bats will be impacted through the loss of foraging routes (hedgerows/treelines). The following is from the bat report:

Bats may be killed while feeding along roads or flying across them to feeding areas or roosts. This is most significant close to major roosts. All Irish bat species have been noted as road fatalities within their European range, but lower-flying bats are more at risk.

Vegetation removal to construct the road will interrupt hedgerow continuity and lead to loss of mature trees and scrub. This will lead to loss of feeding for bats.

The impact of this effect is SIGNIFICANT

B. River Corridors

River crossings will be maintained passable for fish and Otters. These have been designed in accordance with guidelines from Inland Fisheries Ireland (fish) and the National Roads Authority (Otter). The Water chapter details the four new culverts which are to be installed. There will be one each along the Glenamuck and Loughlinstown Streams and one on a drainage ditch. A fourth is proposed to replace an existing pipe culvert on the Glenamuck Stream. All culverts are 'box' design and will be both fish and mammal passable, designed in accordance with guidelines from IFI and the NRA respectively. The crossing of the Loughlinstown River will be clear span and will retain the existing stream banks. Because of these design features the impact to ecological corridors will be NEUTRAL.

C. Badger Corridors

The road does not cut across any known Badger territory (albeit Badgers are known from the Little Dingle to the north of the road route). However, the road will traverse across the lands and may prevent any movement between Badger populations in the region.

To avoid this impact underpasses have been incorporated at two points. These are envisaged as features which will allow for the movement of wildlife under the road. They are especially designed to facilitate the continued movement of Badgers in the wider region but will benefit other species of small mammal such as Hedgehog, Pygmy Shrew, mice etc. It is intended that landscape planting will mimic native linear woodlands to integrate these features with the surrounding countryside. In addition the proposed watercourse crossings will be passable by mammals. The locations of mammal passes have been aligned with existing streams and existing HV overhead ESB lines (which preclude development underneath) in order to maintain key wildlife corridors.

The impact to biodiversity (with the exception of bats) is assessed as short-term and will be a SLIGHT EFFECT

D. Deer Corridors

Deer are known from throughout this locality. Transport corridors can present barriers to deer where insurmountable fences or walls are erected. In this instance no such barriers are planned. While the movement of deer across the road may present health and safety issues (see traffic chapter), the road is not likely to negatively impact upon the wider movement of deer in this locality.

The impact to deer will be IMPERCEPTIBLE.

Pollution of water from surface water run-off

The Greater Dublin Strategic Drainage Study (2005) identified issues of urban expansion leading to an increased risk of flooding in the city and a deterioration of water quality. This arises where soil and natural vegetation, which is permeable to rainwater and slows its flow, is replaced with impermeable hard surfaces. Surface water drainage measures comply with SUDS principles (See Chapter 14).

The effect to biodiversity from this aspect of the project will be IMPERCEPTIBLE.

Disturbance to species from increased human activity

Limited data is available on the impact of artificial lighting to wildlife and it is believed that many species have become habituated to the level of lighting which exists near our towns and cities. Research has focused on bats as they are nocturnal and all species are protected by law. Bat Conservation Ireland lists a number of species which are considered to be especially sensitive to this effect including Brown Long-eared Bat, Whiskered Bat, Natterer' Bat, Daubenton's Bat and the Lesser Horseshoe Bat. The first three species on this list were noted from the site. Lighting should be designed so that it minimised impacts to Bats. The following is taken from the bat report:

Road lighting must not overspill on to the surrounding vegetation. Lighting must not increase the level of illumination of tree canopy level by greater than 3 lux to ensure that bats do not lose feeding and commuting areas. This has greatest impacts on species such as brown long-eared bat, Natterer's and whiskered bats.

The effect to bats from lighting is potentially SIGNIFICANT.

Given the already built up nature of the surroundings, with roads and residential development, it is not considered that the likely increase in ambient noise or human activity can impact negatively on biodiversity in general. With regard to bat, the bat report states that noise "may affect the ability of species such as brown long-eared bat to use audible sound for hunting and will affect the ability of bats to hear lower frequency social calls with interference from car brakes etc."

The effect to biodiversity from this aspect of the project will be SLIGHT.

10.5 Mitigation Measures

10.5.1 Construction Phase

The following potential impacts are likely to occur during the construction phase in the absence of mitigation:

Habitat Loss

New areas of land where semi-natural habitats can develop, either through natural regeneration or the planting of native species, have been identified. If it can be assumed that the width of the linear habitats to be lost is a maximum of 10m, then the total area to be lost is calculated at 12,800 m2 (~1.3 hectares). New areas identified for habitat compensation are shown in Figure 10-7. These are wetland/attenuation areas for surface water run-off or severed land portions not affected by the proposed scheme but within the proposed land take and which are to be allowed to develop natural vegetation with minimal management. The total area to be provided will be in excess of 4.5 hectare and so – in area terms – will be well in excess of the habitat area to be lost.

The landscaping scheme will include the erection of 14 new bat roosting boxes which will provide new habitat for these species. Preliminary/indicative locations of these are given in Figure 10-7. These are intended to avail of existing semi-natural corridors (treelines and hedgerows) as well as new habitat compensation areas.

Prior to works taking place along the Shanganagh Stream the riparian zone to be affected should be surveyed for Otters, and in particular for the potential presence of any holt sites.

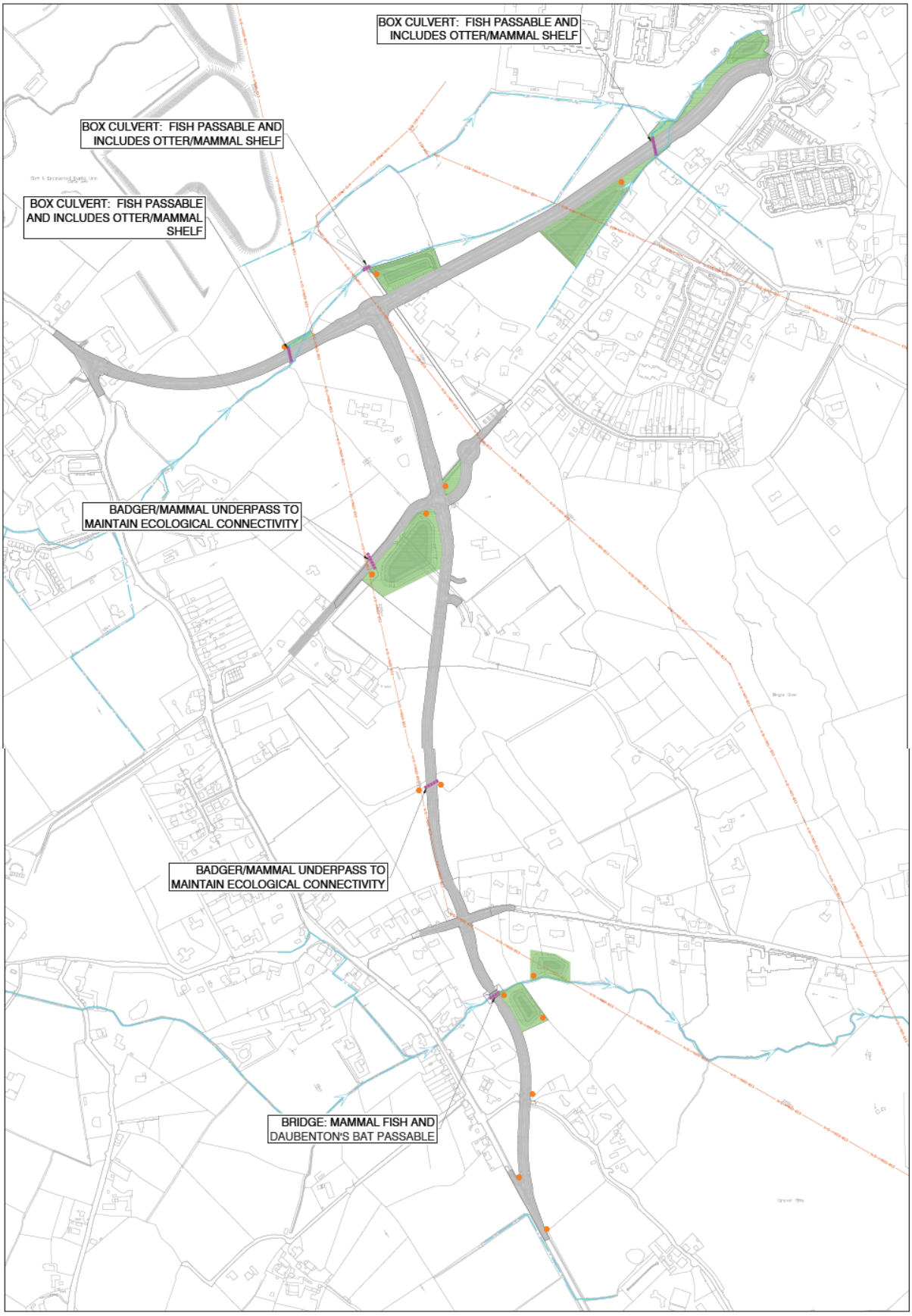

Figure 10-7 Ecology mitigation measures

Green areas show compensation habitat. Orange dots show indicative locations of bat boxes to be erected.

The direct mortality/disturbance of species during land clearance

Woody vegetation (scrub, hedgerows etc.) should not be cleared during the bird nesting season (March to July).

All mature trees should be checked by a bat specialist prior to felling.

Pollution of water courses through the ingress of silt, oils and other toxic substances.

A Construction Management Plan should be prepared which includes full details of all pollution prevention measures. This should include consultation with Inland Fisheries Ireland at all stages of the project. Dangerous substances should be stored away from water courses and in bunded areas at all times. Measures must be taken to ensure that loss of sediment to water course is minimized to the greatest degree possible and only attenuated, silt-free water should be directed towards ditches or streams. This can be achieved through the use of silt fencing, screening berms and/or settlement ponds. Full details should be contained within the CMP. The contractor will be responsible for ensuring that pollution to water courses does not occur. A record will be kept of daily inspections and any incidents which may occur, along with the action taken. Additional mitigation measures to protect the water environment are included in Chapter 14.

Spread of invasive species

Appropriate measures should be taken to eradicate invasive species within the zone of influence of the project. The stands of Three-cornered Garlic should be treated with standard herbicide prior to the commencement of works. The Construction Management Plan for the project should recognize the presence of this species, as well as the proximity of other noxious weeds in the study area, and adopt appropriate control measures to ensure there can be no spread of any invasive species.

10.5.2 Operation Phase

The following is taken from the bat report:

Disruption of ecological corridors – effects to bats

Culvert cross-sectional area of no less than 47m2 is considered adequate to allow pipistrelles to avail of culverts while smaller sizes such as 7m2 can facilitate Daubenton's bats (based on a probability of 95% that a culvert is used). Low culverts may be used by bats to pass under roads but the taller the culvert the more beneficial to bats.

The culvert over the Loughlinstown River will be passable for Daubenton's Bats at it will have an aperture greater than 7m^2. However other culverts will not meet this requirement.

Disturbance to bats from artificial lighting

A lighting plan will be prepared in consultation with the bat ecologist in order to minimize the negative impact of artificial lighting on bat foraging behavior. The following is taken from the bat report:

Road lighting must not overspill on to the surrounding vegetation. Lighting must not increase the level of illumination of tree canopy level by greater than 3 lux to ensure that bats do not lose feeding and commuting areas. This has greatest impacts on species such as brown long-eared bat, Natterer's and whiskered bats.

This requirement is satisfied within the lighting design.

10.6 Residual Impact

It is not possible to fully compensate for the loss of high significant field boundaries due to their age and complexity. It is likely however that the range of species will be maintained while the area of mitigation will exceed that of the habitat to be lost. Nevertheless, the loss of treelines and hedgerows will result in a residual impact to biodiversity. There will also be an effect to bats from the disruption of ecological corridors. These is assessed as SLIGHT.

There will also be a SLIGHT residual effect to water courses during the construction phase as it will not be possible to completely eliminate the likelihood of pollution entering the water.

10.7 Difficulties Encountered

Some areas of land were inaccessible for surveys. From aerial photography it was seen that these are agricultural fields with traditional boundaries. These boundaries have been taken into account in evaluating the impact of this project. A full set of ecological surveys were carried out for the project at appropriate seasons. A lack of data, or uncertainty in the results, is not a factor in assessing the impact of this development on biodiversity.

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