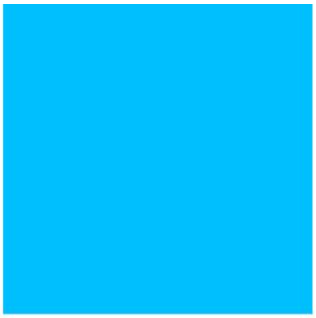
Foynes to Limerick Road Improvement Scheme

Route Selection Report

Volume 1 – Main Text






PRS Reference:	*LC/14/10965*
Phase:	*2 – Route Options*
Issue Date:	*May 2016*

Foynes to Limerick Road Improvement Scheme

Route Selection Report

Volume 1 - Text

TABLE OF CONTENTS

Chapter 3 Constraints Study

Chapter 4 Traffic Assessment

Chapter 5 Do-Nothing and Do-Minimum Alternatives

Chapter 6 Options Assessment

Chapter 1 Introduction & Description

1.1 Introduction

In August 2013 the National Roads Authority requested Limerick County Council to commence the planning and design of the Foynes to Limerick Road Improvement Scheme. This followed the publication of the National Ports Policy in 2013 which categorised Shannon Foynes Port Company as a Port of National Significance (Tier 1) and clearly identified as a matter of reasonable priority the improvement of the road and rail freight connection to Shannon Foynes Port. The Trans-European Transport Network regulations (European Union Regulation No. 1315/2013), published in December 2013, identified Shannon-Foynes Port and the road access connecting it as part of the Core Trans-European Transport Network which consequently required upgrading.

Limerick City and County Council commenced the planning and design of the scheme with the appointment of Engineering Consultants, Roughan & O'Donovan – AECOM Alliance, in April 2014 for Phases 1 to 4 of the TII (Transport Infrastructure Ireland) Project Management Guidelines. Phase 1 Scheme Concept and Feasibility Study was completed in 2014 with Phase 2 Route Selection undertaken during 2015 culminating with the publication of this Report.

The Trans-European Transport (TEN-T) Network consists of the infrastructure for railway transport, inland waterway transport, road transport, maritime transport, air transport and multimodal transport.

The planning, development and operation of the Trans-European Transport Networks supports the objectives as set out in, inter alia the Europe 2020 Strategy and the Commission White Paper entitled "Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system". The high-level objectives include the smooth functioning of the internal market and the strengthening of economic, social and territorial cohesion. Their specific objectives also include allowing the seamless, safe and sustainable mobility of persons and goods, ensuring accessibility and connectivity for all regions of the Union, and contributing to further economic growth and competitiveness in a global perspective.

European Union Regulation No. 1315/2013 establishes guidelines for the development of a Trans European Transport Network. The regulations identify projects of common interest, and specify the requirements to be complied with for the management of the infrastructure of the TEN-T.

The Port of Shannon – Foynes is identified in Part 2 of Annex II of the directive as a Core Port forming part of the European Union TEN-T Transportation Network, and lies approximately 35km west of Limerick City on the River Shannon Estuary.

For suitable road access to the port, the route between Foynes, Limerick and Dublin has been identified as part of the Core Road Network within the TEN-T system. The EU TEN-T Regulations provide standards that the core road network must meet by 2030.

The proposed scheme will be a high quality road in accordance with TEN-T Requirements. Due to the substantial capital investment envisaged, full consideration of the existing road network in the area is warranted in terms of any infrastructural deficits which arise in order to achieve optimal value for money. Existing congested

conditions at Adare, taken in combination with future planning requirements for the road corridors to Cork and Tralee, must be considered in this regard.

The purpose of this report is to outline the process undertaken to identify a suitable Study Area, to identify key constraints within that Study Area, to develop feasible route options and to carry out a systematic assessment of these options leading to the selection of a Preferred Route Corridor.

The report also describes the public consultation and public display that occurred during the Route Selection Stage. The general requirements which inform the preparation of a Route Corridor Selection Report are outlined in the 2010 TII Project Management Guidelines.

1.2 Core Port

Under the TEN-T Directive Shannon-Foynes Port was identified as one of four core ports within the island of Ireland, alongside Belfast, Dublin and Cork Ports.

Article 41(2) of the Regulations (EU) No 1315/2013 states that:

> *"Maritime ports of the core network ... shall be connected with the railway and road and, where possible, inland waterway transport infrastructure of the trans-European transport network by 31 December 2030, except where physical constraints prevent such connection."*

In terms of supporting the development of the TEN-T corridors, ports will be encouraged to act as enablers of inter-modality, by making the necessary arrangements in order to provide information on traffic flows allowing the better organisation of intermodal logistics.

Actions of the policy include providing attention to projects which contribute to the coordinated development and management of ports, rail and inland waterways infrastructure and those which enhance port and shipping environmental performances.

Recognition of the the core port status of Shannon-Foynes is also evidenced in the Government's National Ports Policy 2013 which aims to facilitate a competitive and effective market for maritime transport services. Shannon – Foynes Port is identified as a Port of National Significance (Tier 1) in this policy document.

1.3 The Core Road Network

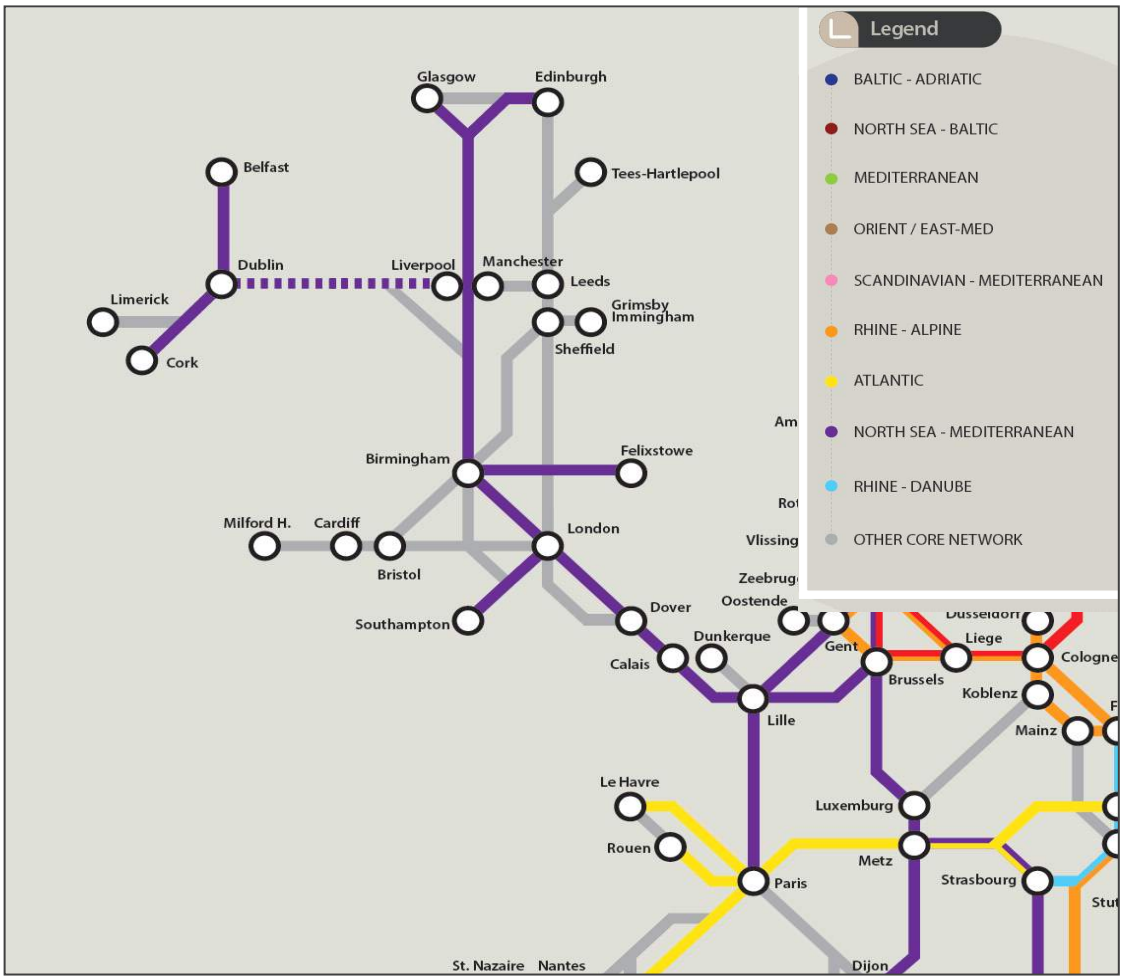
The TEN-T Network consists of two layers:

- the Core Network, and
- the Comprehensive Network.

The Core Network will form the backbone for transportation in Europe's Single Market. By 2030, it will remove bottlenecks, upgrade infrastructure and streamline cross border transport operations for passengers and businesses throughout the EU. Its implementation will be progressed by the setting up of 9 major transport corridors that will bring together Member States and stakeholders.

The Core Network in Ireland forms part of one of these major transport corridors, which is referred to as the North Sea-Mediterranean Corridor. This corridor stretches from Ireland through the UK, Netherlands, Belgium, Luxembourg and onto the Mediterranean Sea in the south of France. Figure 1.1 highlights the TEN-T Core Network in Ireland and the UK including the Limerick connection to the Cork - Dublin corridor.

Figure 1.1 - Ireland and the EU TEN-T Core Road Network

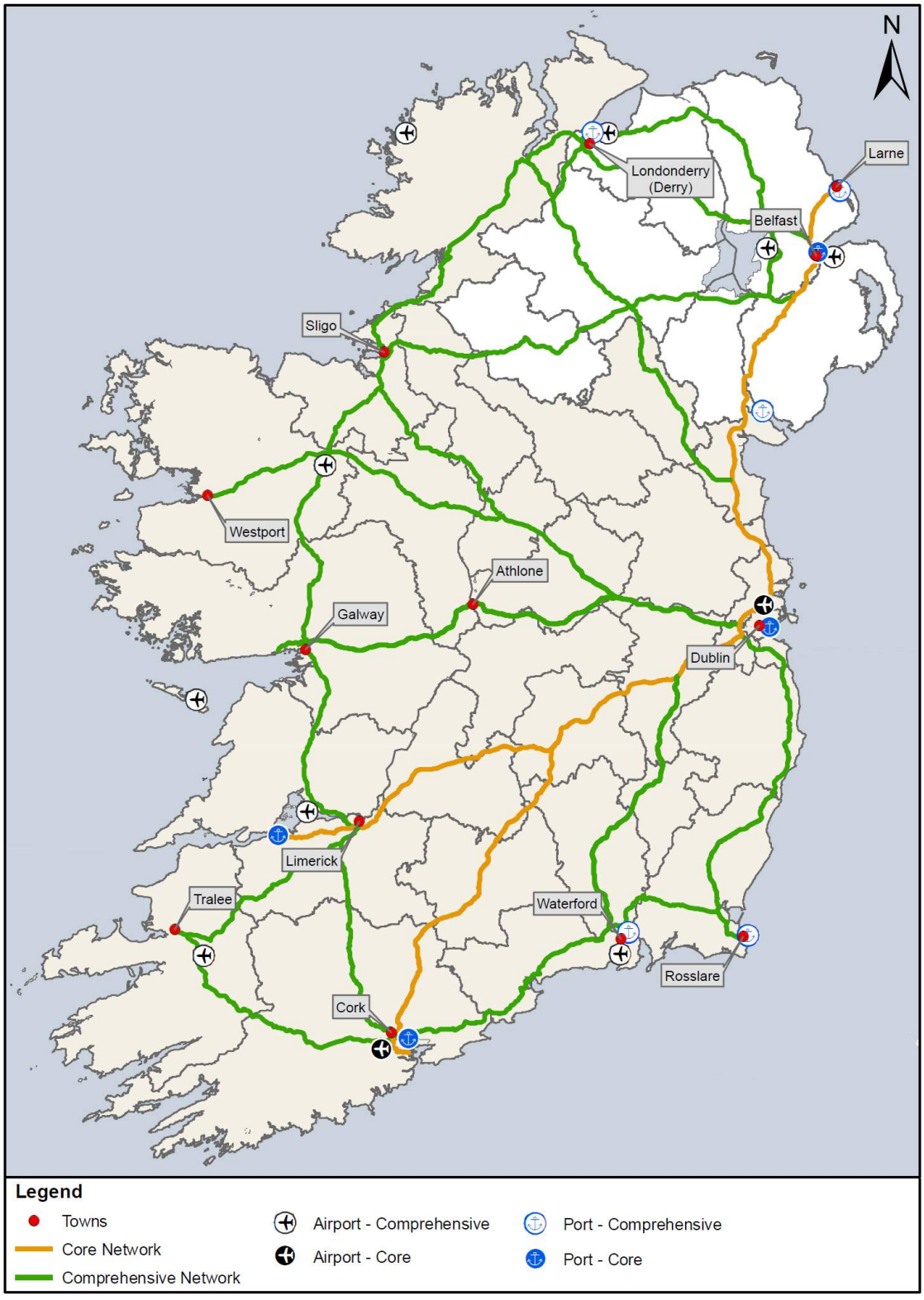


Source: TENtec eGovernance of TEN-T

The new TEN-T Core Network will be supported by a Network of Comprehensive routes, feeding into the Core Network at regional and national level. The target for completion of the Comprehensive Network is 2050. The aim is to ensure that progressively, throughout the entire EU, the TEN-T network will contribute to enhancing internal markets, strengthening economic, social and territorial cohesion and reducing greenhouse gas emissions through better transport efficiency.

Figure 1.2 shows the extent of both the Core and Comprehensive Networks in relation to roads, ports and airports within Ireland, including the Foynes to Limerick connection.

Figure 1.2 - TEN-T Core and Comprehensive Road Network Ireland[1]



The overall requirement of TEN-T in this case is to provide an improved connection from the existing motorway network in the vicinity of Limerick City to Foynes which will support the planned growth of Shannon Foynes Port.

[1] Map produced by ROD/AECOM based on data extracted from EU Regulations 1315/2013 and 1316/2013.

The notional Core Network road between Foynes and Limerick is indicated in the vicinity of the existing N69 national secondary road. To the south of this corridor is the current N21 national primary road to Tralee which forms part of the Comprehensive Network.

In terms of geographical location both road corridors are within 10 kilometres of one another in the vicinity of Askeaton and Rathkeale. Synergies therefore exist between the objectives of the Foynes to Limerick Road Improvement scheme and any developmental requirements for the N69 and N21 corridors.

1.4 Railway Network

The TEN-T Regulations provide a multimodal approach to the development of transport infrastructure which requires the transport network serving the core ports to consist of both a road and a rail link as noted in Article 41(2) of the Regulations (EU) No 1315/2013.

In the case of the core port of Shannon - Foynes in addition to the requirement for a suitable connection to the national motorway network, a connection to the rail network is also required. The existing Foynes – Limerick Rail line is currently the subject of ongoing studies by Shannon Foynes Port Company and Irish Rail. The Route Selection process for the development of the road scheme has taken account of the railway as a constraint in the development of route options whilst not compromising the future necessary reinstatement and development of this line.

Some of the future growth in freight traffic at Shannon-Foynes Port may be catered for by rail transport where suitable in terms of the nature of the freight and the origin or destination inland from the port.

1.5 Scheme Operational Goals and Design Strategies

Government policy recognises the importance of the Core and Comprehensive Road Network in Ireland and its role in enhancing the internal market and strengthening economic, social and territorial cohesion in Ireland and Europe.

As such, improvements to the road network will strengthen and support Shannon-Foynes as a Core Port within the TEN-T Network and in so doing will support the key objectives of both the TEN-T and government policy. This will be complemented by the planned upgrade of the Foynes to Limerick rail link which is also in accordance with TEN-T policy.

Given the existing congested road conditions at Adare, and the requirement for effective future planning of the road corridors to Cork and Tralee, it is appropriate that possible upgrades of the N21 corridor, together with possible links to the N20 corridor, are considered in the design strategy for the Foynes to Limerick Road Improvement scheme. This is in order to examine how optimal return for investment would be achieved for the scheme.

1.6 Structure of this Report

This Route Selection Report consists of three volumes.

Volume 1 – Main Text

Volume 2 – Drawings

Volume 3 - Appendices

Chapter 2 Need for the Scheme

2.1 Existing Road Conditions

Shannon Foynes Port is currently accessed by the existing N69 National Secondary Route which is a single carriageway road that extends from Limerick City through to Tralee. Over a distance of 32km between Foynes and the Dock Road Junction on the N18 Limerick Southern Ring Road, 3km west of Limerick City Centre, the N69 bypasses the town of Askeaton and Mungret Village, and passes through the three villages of Kilcornan, Kildimo and Clarina where there are local speed limits of 60 km/h or 50 km/h respectively. On the rural sections of the route the speed limit is 100 km/h, although the effective speed is lower in many places due to poor horizontal alignment and narrow cross section.

The width of the carriageway varies considerably from a minimum of less than 7m on unimproved sections, to 12.5m or more on the Askeaton Bypass where there are hard shoulders. There are numerous horizontal bends with radii as low as 125m which is well below the desirable minimum radius of 720m for a design speed of 100 km/h. On the vertical alignment there are many sharp crest curves that limit forward visibility. Overtaking opportunities are rare due to the poor standard of alignment. There are 63 side road junctions, an average of 2 per kilometre, and approximately 430 accesses to properties of various kinds. Chapter 5 provides a more detailed assessment of the existing road conditions on the N69, N21 and M20.

In summary, apart from a few short improved sections, the existing N69 between Foynes and Limerick is a low quality road that poorly serves its purpose for access by Heavy Goods Vehicles (HGV's) to the port of Shannon Foynes. Existing traffic impacts negatively upon the local population along the route, both the villages it passes through and the extensive rural housing in between. The N69 also serves as the main access road for a wide rural hinterland extending for about 5km on either side, toward the Shannon Estuary to the north, and mid-way towards the N21 corridor to the south.

2.2 European, National and Regional Policy Context

The following are the various policies relevant to this scheme which identify the need for a higher quality access road to Shannon Foynes Port for reasons defined in the full range of policies from the European Union down to local county level:

European Policy Context

Trans- European Transport Network (TEN-T) Policy: Regulation (EU) No 1315/2013 in relation to:

- TEN-T Ports
- TEN-T Road Network
- TEN-T Rest Areas

National, Regional & Local Policy Context

The following are relevant national and regional policies that have influenced the planning for this scheme:

i) Building on Recovery: Infrastructure and Capital Investment 2016 - 2021

ii) Limerick County Development Plan 2010 – 2016

iii) Mid-West Regional Planning Guidelines 2010-2022
iv) National Ports Policy (2013)
v) Shannon-Foynes Port Company Masterplan – Vision 2041(2013)
vi) Strategic Integrated Framework Plan for the Shannon Estuary 2013 – 2020
vii) The National Secondary Road Needs study (2011)
viii) Road Safety Strategy 2013 -2020
ix) Mid-West Area Strategic Plan (MWASP) 2012 – 2030
x) Smarter Travel: A Sustainable Transport Future 2009 - 2020
xi) Harnessing our Ocean Wealth (2012)
xii) The National Spatial Strategy 2002 - 2020

2.2.1 European Union Trans European Transport Network

On the 11th of December 2013 EU Regulation No 1315/2013 came into effect. This defines and provides legal guidance for the provision of the Trans European Transport Network (TEN-T). TEN-T consists of two planning layers:

- Core transport network; and
- Comprehensive transport network.

The Core Network will form the backbone for transportation in the European Single Market. Targeted for completion by 2030, it will remove bottlenecks, upgrade infrastructure and streamline cross border transport operations for passengers and businesses throughout the EU. Implementation will be progressed by the setting up of 9 major transport corridors that will bring together Member States. The TEN-T will contribute to enhancing internal markets, strengthening economic, social and territorial cohesion and reducing greenhouse gas emissions.

The Core Network in Ireland forms part of 1 of these 9 major transport corridors, which is referred to as the *North Sea-Mediterranean Corridor*. This corridor stretches from Ireland through the UK, Netherlands, Belgium, Luxembourg and onto the Mediterranean Sea in the south of France. Figure 1.1 in Chapter 1 highlights the TEN-T Core Network in Ireland and the UK including the Limerick connection to the Cork - Dublin corridor.

The TEN-T Core Network will be supported by a Comprehensive Network of routes, feeding into the Core Network at regional and national level. The target for completion of the Comprehensive Network is 2050.

Figures 2.1 overleaf shows the extent of both the Core and Comprehensive Transport Networks in relation to roads, ports and airports within the Limerick Region.

Figure 2.1 - TEN-T Core and Comprehensive Network in Limerick Region

2.2.2 TEN-T Policy for Ports

The four Core Ports identified within Ireland are:

- Belfast;
- Dublin;
- Cork; and
- Shannon-Foynes.

Article 41(2) of the Regulations (EU) No 1315/2013 with regard to transport infrastructure requirements states that Member States shall ensure that

> *"Maritime ports of the core network ... shall be connected with the railway and road and, where possible, inland waterway transport infrastructure of the trans-European transport network by 31 December 2030, except where physical constraints prevent such connection."*

Actions of the policy include providing support to projects which contribute to the coordinated development and management of ports, rail and inland waterways infrastructure and those which enhance port and shipping environmental performances.

The European Commission has published an implementation plan "*Ports 2030 - Gateways for the Trans European Network".* This states that in partnership with the Member States, the Commission will streamline transport projects funded under the Structural and Cohesion Funds with the TEN-T, promoting priority to projects for port access and hinterland connections.

2.2.3 Ports 2030 - Gateways for the Trans European Transport Network

The Ports 2030 - Gateways for the Trans European Transport Network, published in 2014 examines the drivers behind port development and what steps need to be taken to address the deficiencies in the port network. The report recognises that the success of a good port is a solid connection to its immediate surrounding inland area (its hinterland).

The report recognises that investment in port facilities is required now to remain competitive for the future and to make the best possible use of our port assets, which require efficient and quality port services. The report states that:

> *"If nothing is done an opportunity will be missed to increase options available to transport operators and shippers and create growth and jobs in coastal areas and across the Union as a whole."*

The policy in relation to ports therefore recognises the important role that the development of ports and their surrounding infrastructure has as a driver for economic growth and employment in the surrounding region.

2.2.4 TEN-T Policy for Roads

Regulation (EU) No 1315/2013 sets out the requirements for high quality roads that shall form part of the TEN-T network, both Core and Comprehensive, and states under Article 17(3), the following:

> *"High-quality roads shall be specially designed and built for motor traffic, and shall be either motorways, express roads or conventional strategic roads.*
>
> *(a) A motorway is a road specially designed and built for motor traffic, which does not serve properties bordering on it and which:*
>
> *(i) is provided, except at special points or temporarily, with separate carriageways for the two directions of traffic, separated from each other by a dividing strip not intended for traffic or, exceptionally, by other means;*
>
> *(ii) does not cross at grade with any road, railway or tramway track, bicycle path or footpath; and*
>
> *(iii) is specially sign-posted as a motorway.*
>
> *(b) An express road is a road designed for motor traffic, which is accessible primarily from interchanges or controlled junctions and which:*
>
> *(i) prohibits stopping and parking on the running carriageway; and*
>
> *(ii) does not cross at grade with any railway or tramway track.*
>
> *(c) A conventional strategic road is a road which is not a motorway or express road but which is still a high-quality road*."

Article 39(2) of the Regulations sets out that for the Core Network only options (a), a motorway, or (b) an express road, may be considered as road option types. However Article 39 (3) states further that:

> *"At the request of a Member State, as regards road transport infrastructure, exemptions from the provisions of points (a) or (b) of Article 17(3) may be granted by the Commission in duly justified cases as long as an appropriate level of safety is ensured.*
>
> *The duly justified cases referred to in this paragraph shall include cases where investment in infrastructure cannot be justified in socio-economic cost-benefit terms."*

Article 17(4) of the Regulations lists the associated infrastructure which may be included with the above high quality roads as follows:

> *"Equipment associated with roads may include, in particular, equipment for traffic management, information and route guidance, for the levying of user charges, for safety, for reducing negative environmental effects, for refuelling or recharging of vehicles with alternative propulsion, and for secure parking areas for commercial vehicles."*

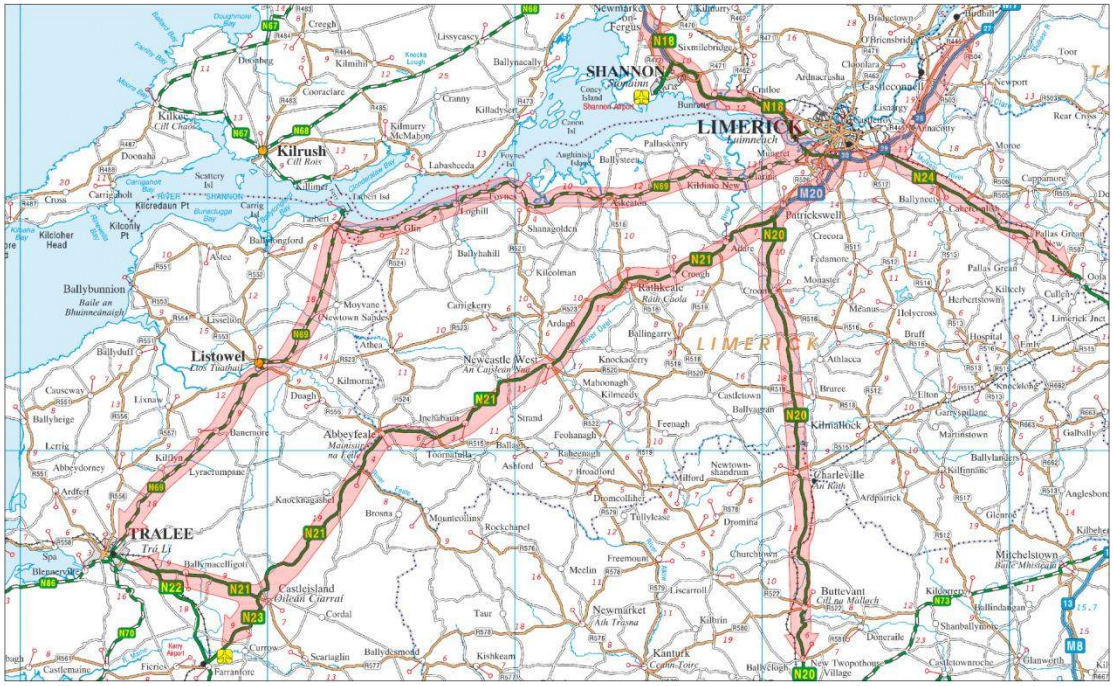
2.2.5 TEN-T Road Network in Limerick Region

The existing national road network in the Limerick Region that may form parts of the TEN-T Network is shown in Figure 2.2 below and includes the following routes:

- N69 national secondary road between Tarbert and Limerick City; and
- N21 national primary road between Abbeyfeale and Attyflin.

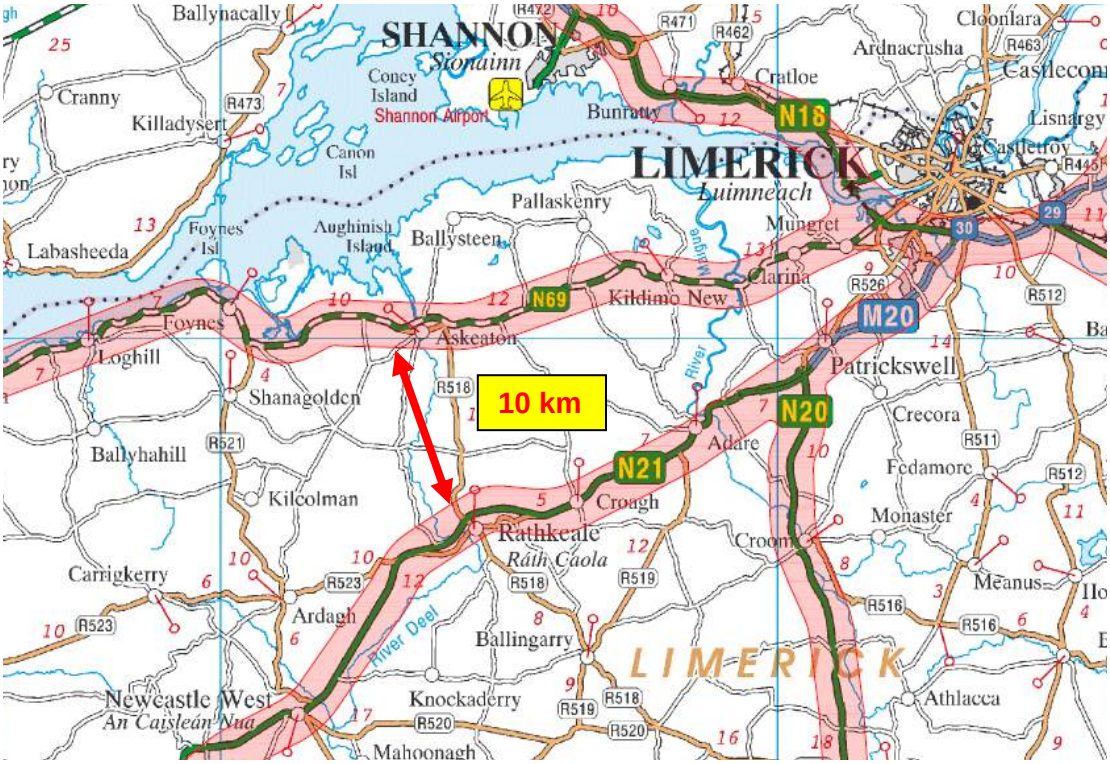
These national routes may be augmented or modified in future improvement schemes to fulfil the requirements of the TEN-T Network.

Figure 2.2 National Road Network in Limerick Region



In terms of geographical location the N69 and N21 road corridors are within 10 kilometres of one another in the vicinity of Askeaton and Rathkeale as illustrated in Figure 2.3. Synergies may therefore exist between the Core and Comprehensive elements of the TEN-T Network in this region. The study area for this project has been defined to include a wide region served by both the N69 and N21 routes so as to fully evaluate the scope for synergy between the Core and Comprehensive Network elements.

Figure 2.3 Proximity of National Routes in Western Limerick



2.2.6 TEN-T Policy for Rest Areas

Article 39(2)(c) of Regulation (EU) No 1315/2013 sets out the requirements for rest areas on the TEN-T Network to include:

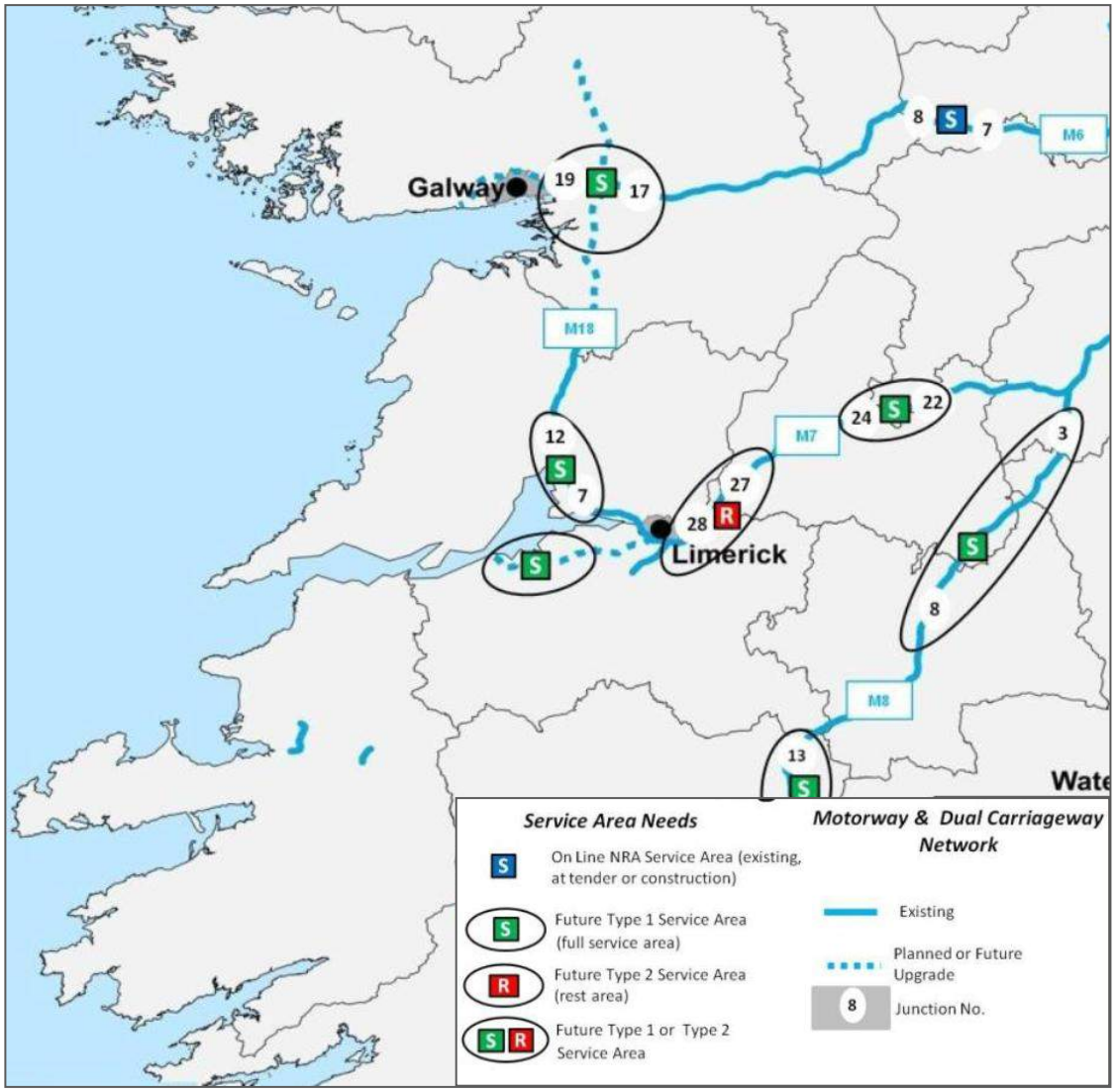
> *"the development of rest areas on motorways approximately every 100 km in line with the needs of society, of the market and of the environment, in order inter alia to provide appropriate parking space for commercial road users with an appropriate level of safety and security;"*

In August 2014 the TII published its Service Area Policy which addresses the application of the TEN-T policy in relation to service and rest areas within Ireland. The policy lists the major interurban routes including the Core and Comprehensive Road Network and lists the location and types of service and rest areas proposed. In relation to the Foynes to Limerick route the policy states the following:

> *"A Type 1 Service Area is proposed for the Limerick to Foynes route. This may be near the port in Foynes, but depending on how the scheme evolves may be some distance from the port. Limerick County Council, in consultation with the Authority, will include consideration of the appropriate location for this service area as part of the scheme planning, currently underway"*

Figure 2.4 below is extracted from the Service Area Policy. It should be noted that consideration is currently being given to amending this policy to remove the requirement for a Type 1 Service Area (full service area) along the Foynes to Limerick Scheme and replace that with a requirement for a Type 2 Service Area (rest area) at the western end of the scheme that is designed specifically to provide secure parking for Port traffic. This facility will also meet the TEN-T requirements for safe and secure parking for Heavy Commercial Vehicles.

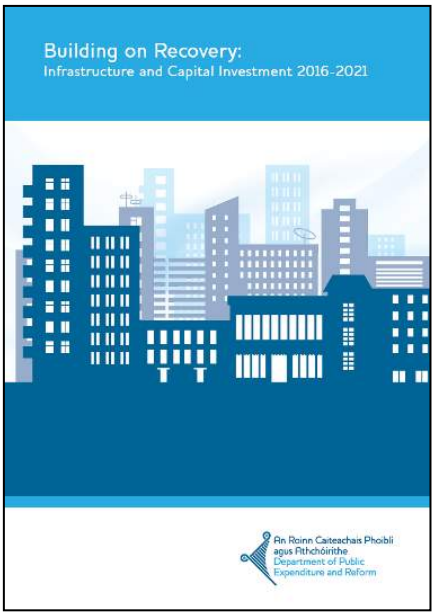
Figure 2.4 Service Area Needs - Limerick Region



2.3 National Policy Context

2.3.1 Building on Recovery: Infrastructure and Capital Investment 2016 - 2021

Building on Recovery is a 6 year capital investment framework which aims to invest €27 billion in the key areas of transport, education, health and enterprise, with €10 billion targeted at transport elements of the plan. The plan was launched in September 2015 and recognises that high-quality infrastructure is an important element of a modern society and economy. It seeks to strengthen economic growth through enhancing efficiency, productivity and competitiveness and will underpin social cohesion.



The plan provides €6 billion for investment in the roads network with a budget of €4.4 billion to ensure the existing extensive network throughout the country is maintained and strengthened. The remaining €1.6 billion is allocated to new projects including those targeted at removing bottlenecks, which included the N69 Shannon to Foynes Road and the Adare Bypass.

2.3.2 Harnessing our Ocean Wealth (2012)

'Harnessing Our Ocean Wealth: An Integrated Marine Plan for Ireland' (IMP) was published in July 2012 by the Department of Agriculture, Food and the Marine. It sets out a roadmap for the government's vision, high level goals and integrated actions across policy, governance and business for the marine sector.

Harnessing Our Ocean Wealth recognises that the country's ocean wealth will be a key element of our economic recovery and sustainable growth, generating benefits for all our citizens. The initiative also recognises the contribution the 'blue economy' can make to global economic growth and the need for appropriate policies, strategies and funding mechanisms to achieve this objective while setting the following targets for Ireland by 2020:

- Double the value of our ocean wealth to 2.4% of GDP by 2030.
- Increase the turnover from our ocean economy to €6.4bn by 2020.

To achieve these targets the plan identifies that enabling infrastructure (e.g. ports, piers, the electricity grid and research initiatives) is essential for harnessing our ocean wealth at national, regional and local levels.

Future growth opportunities identified within the plan which will enable the growth of the port of Foynes include offshore oil and gas activity, cruise tourism and offshore renewable energy.

Harnessing Our Ocean Wealth identifies key actions that need to be taken including:

1. Maximising the utilisation of existing state maritime infrastructure through multi-purpose usage and sharing, in support of operational programmes, research, test, demonstration and monitoring.
2. Carrying out national, regional and local initiatives aimed at tapping into the potential of new and existing coastal infrastructure to develop sustainable products, services and jobs. This would encourage investment along the coast. Initiatives include supporting major national seaports in the implementation of their master plans to provide additional capacity and greater draught using their own resources.

The road transport network provided by the Foynes to Limerick Road Improvement scheme will support the aims and targets of Harnessing Our Ocean Wealth by improving transport connectivity between the port and the core road network.

2.3.3 National Ports Policy (2013)

The core objective of the National Ports Policy is to facilitate a competitive and effective market for maritime transport services. The long-term international trend in ports and shipping is toward increased consolidation of resources in order to achieve optimum efficiencies of scale. This has knock-on effects in terms of vessel size, the depths of water required at ports and the type and scale of port hinterland transport connections.

In recognition of this, the National Ports Policy introduces clear categorisation of the ports sector into

- Ports of National Significance (Tier 1)
- Ports of National Significance (Tier 2), and
- Ports of Regional Significance.

Ports of National Significance (Tier 1) are ports that:

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

The three ports which fulfil these criteria are:

- Dublin Port;
- Port of Cork; and
- Shannon-Foynes Port.

Shannon-Foynes Port is the largest bulk port in the country and handles approximately 20% of all seaborne trade in the State. The port's dominance in the dry-bulk sector is particularly pronounced, with a market share of around 63% in this sector. The National Ports Policy has as a key strategic objective the continued commercial development of Shannon Foynes Port Company, and clearly identifies as a matter of reasonable priority the improvement of the road and rail freight connections.

The European Union TEN-T network policy recognises that for inclusion in the Core Network, ports must enjoy significant volumes of freight and/or passenger traffic, have a high level of international connectivity and, by 2030, be connected to the core European rail and road network.

The National Ports Policy notes that efficient hinterland connections are critically important to any port's ability to facilitate large volumes of traffic. It states that all TEN-T core ports must have a connection to both TEN-T core road and rail networks, while recognising that:

"*The vast majority of Ireland's freight movements to and from ports are via road. As acknowledged in the European Commission's White Paper, Roadmap to a Single European Transport Area – Towards a Competitive and Resource-Efficient Transport System, it is likely that "freight movements over short and medium distances (below some 300km) will to a considerable extent remain on trucks" (Commission of the European Communities 2011c)."*

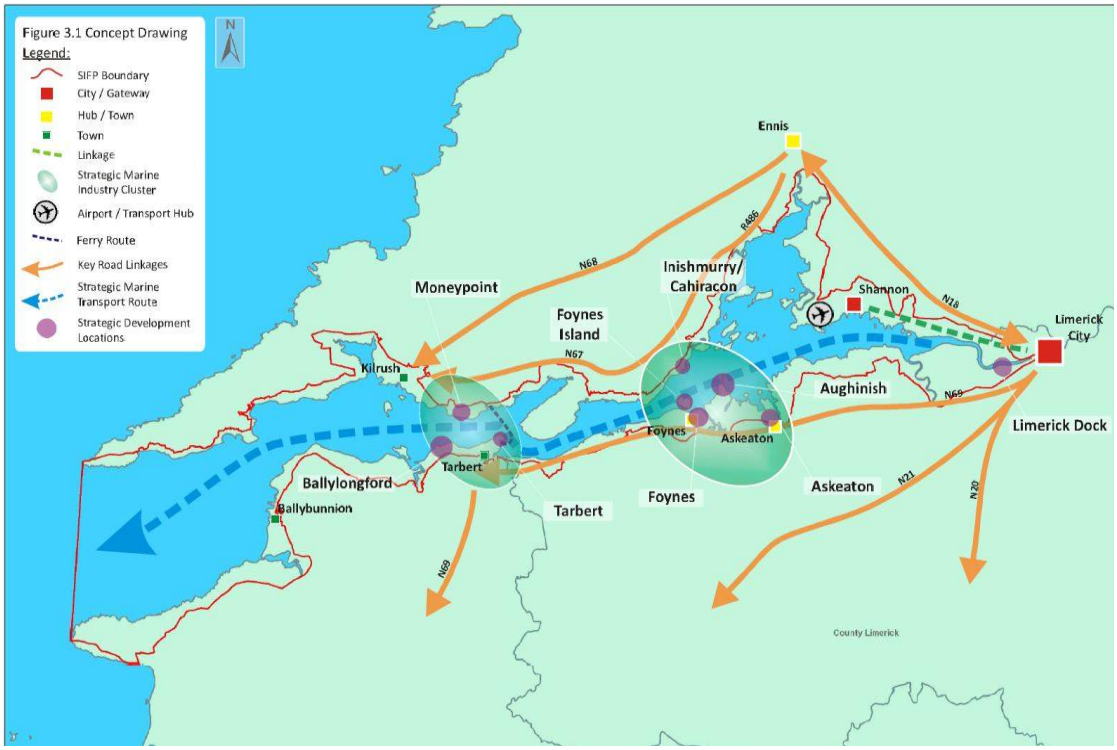
The provision of the improved Foynes to Limerick Road Improvement scheme will support the Tier 1 status of Shannon-Foynes Port under the National Ports Policy.

2.3.4 Strategic Integrated Framework Plan for the Shannon Estuary 2013 – 2020

The Strategic Integrated Framework Plan (SIFP) sets out an overall strategy for the proper sustainable growth, development and environmental management of the Shannon Estuary Region for the next 30 years. The plan was commissioned by Clare County Council, Kerry County Council, the then Limerick City and County Councils, Shannon Development and Shannon Foynes Port Company.

Figure 2.5 below shows the key links identified within the SIFP.

Figure 2.5 Strategic Integrated Framework Plan (SIFP) Concept



Source Figure 3.1 SIFP

In terms of transportation infrastructure the plan recognises the importance of quality transport corridors for port activity and the economic growth of the Estuary and notes in particular the following:

"The N69 is a particularly important route, and is highlighted as being a strategic transport corridor providing key connections and linkages between key settlements, the Port of Foynes, the Gateway of Limerick / Shannon and the wider region. The NRA has instructed Limerick City and County Council to progress the Foynes to Limerick Major Road Improvement Scheme. Limerick City and County Council has therefore recently announced a major upgrade scheme for the N69 connecting the Port of Foynes with the M7/N18 at Limerick. The proposal for a high quality road aims to provide improved access to the Port and supports the envisaged expansion of its capacity and usage outlined in the National Ports Policy 2013."

2.3.5 Shannon-Foynes Port Company Masterplan – Vision 2041 (2013)

Vision 2041, Shannon-Foynes Port Company's Masterplan, published in February 2013, sets out the strategy for development of the Shannon Estuary ports, with Foynes port as one of the key drivers for further development and expansion.

Shannon-Foynes Port Company's facilities are of national importance and this is reflected in the fact that 37% (CSO 2011) of Ireland's bulk traffic now transits the Estuary, making Shannon-Foynes Port Company's the largest bulk port in the country and the second largest port based on overall tonnage after Dublin Port. Shannon-Foynes Port Company handles the largest vessels entering Irish waters, and handled some 10 million tonnes of cargo passing through its six port facilities on the Shannon Estuary in 2011. The Shannon-Foynes Port Company's ambition to provide a new deepwater berth (circa 15m draught) at Foynes and the continued expansion of existing infrastructure at Foynes in order to capitalise on the trend toward larger vessels will all lead to increases in traffic at the port. The Masterplan makes specific references to land transportation infrastructure needs in relation to their areas of activity and the potential for the expansion of Shannon Foynes Port.

Chapter 8 of the Masterplan, Transport and Connectivity, discusses the deficiencies of the existing N69 road. The Masterplan also indicates in its findings that the existing N69 will experience capacity shortfalls even ignoring additional port related traffic.

Vision 2041 indicates that cargo volumes in the port of Foynes were at 1.7 million tonnes in 2011. Based on the Shannon-Foynes Port Company's medium growth scenarios for the port and their activities, this is anticipated to reach 3.3 million tonnes by 2025 and 4.1 million tonnes by 2041. The corresponding Heavy Goods Vehicle (HGV) movements in and out of the port are expected to increase from 2011 figures of approximately 530 vehicles per day to between 1025 and 1870 per day by 2041 using base line growth and high line growth scenarios respectively. This equates to a growth projection factor of between 1.9 and 3.5 approximately.

Provision of improved road access to Foynes Port will provide a key support for the growth of the port and associated industries. The Tier 1 Port status of Foynes indicates the national and regional importance of the port as a major factor in the economic life of the Mid-West Region and the national economy. Growth of the port is currently constrained by the poor quality road access that discourages industrial and commercial development relative to the opportunities associated with the port.

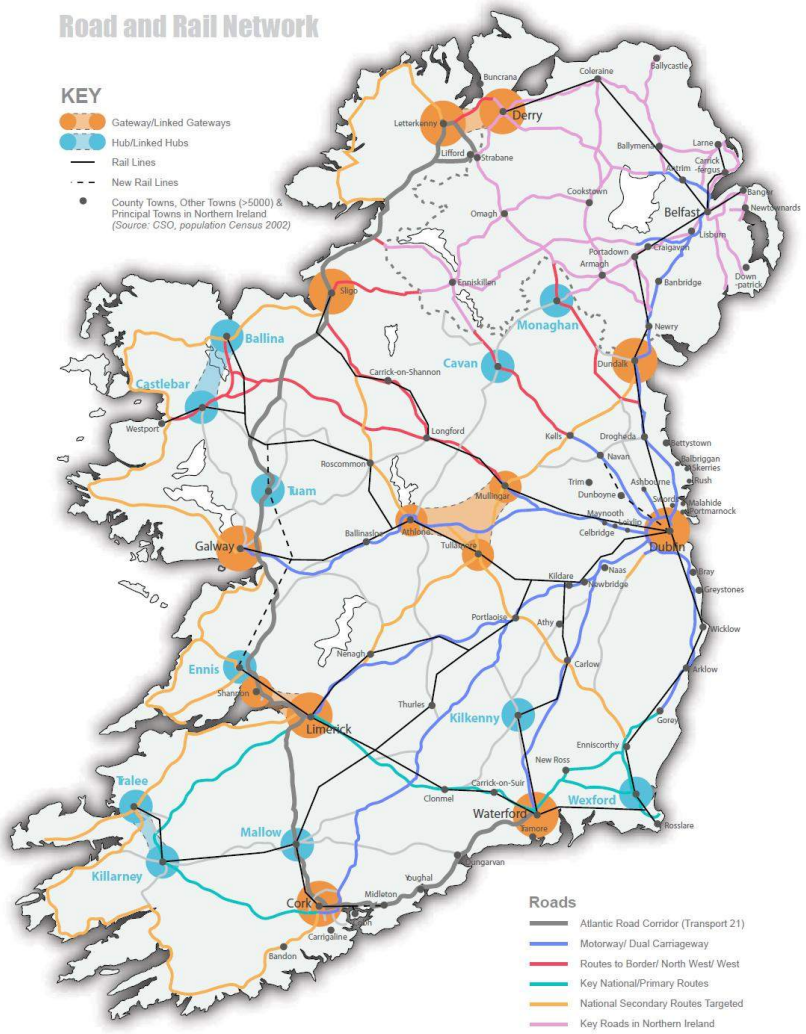
2.3.6 The National Spatial Strategy 2002 – 2020

The National Spatial Strategy (NSS) for Ireland is a 20 year planning framework designed to achieve a better balance of social, economic, physical development and population growth between regions. It has relevance for the region in that it focused on people, on places and on building communities. Through closer matching of where people live with where they work, different parts of Ireland would in the future be able to sustain:

- A better quality of life for people;
- A strong, competitive economic position; and
- An environment of the highest quality.

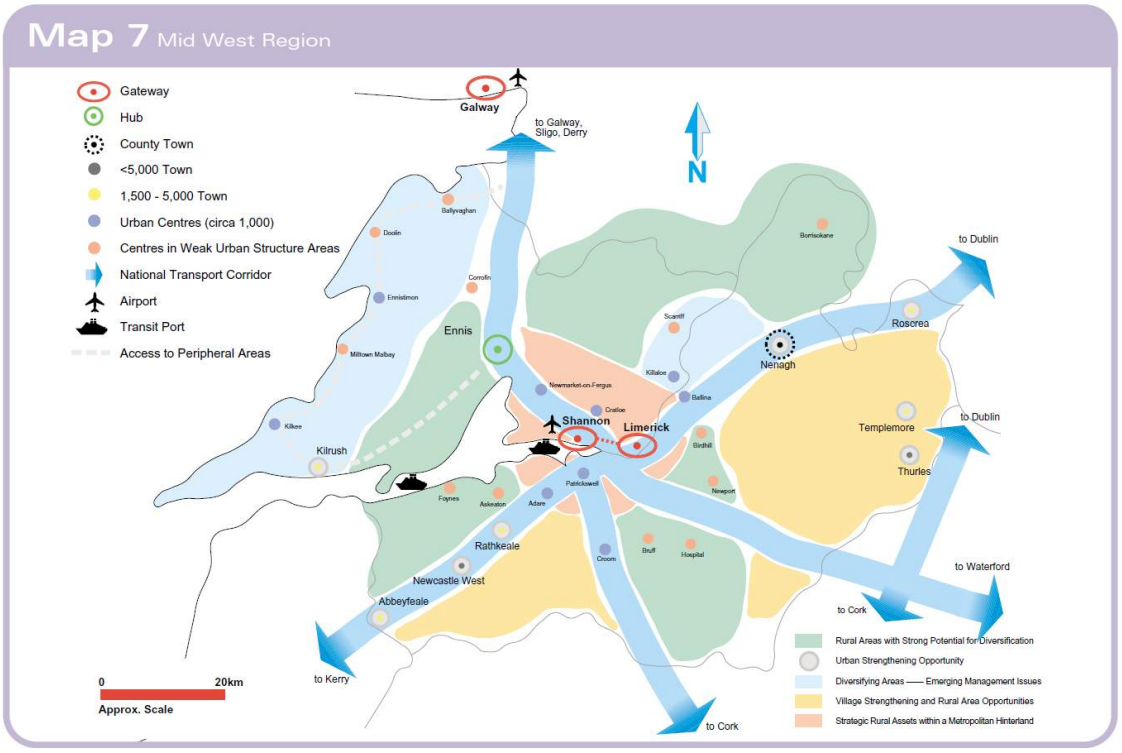
The plan recognised that the Limerick-Shannon gateway would need enhancement at national and international level to improve the performance of the Mid-West Region. This would be required to lever additional investment for the overall region, through its critical mass, strategic location, capacity for innovation and development and connections within the national transport framework. The development of the Foynes - Limerick road would contribute to the aim of improving connectivity from the region to the national and international transport network.

Figure 2.6 National Spatial Strategy, Road and Rail Networks



Source: NDP 2007 - 2013

Figure 2.7 National Spatial Strategy, Mid-West Region



Source: National Spatial Strategy

2.3.7 Mid-West Regional Planning Guidelines 2010-2022

The Mid-West Regional Planning Guidelines 2010-2022 provide a planning framework for the future physical, economic and social development of the Mid-West Region.

These guidelines reflect other national social, economic and environmental policies which affect the Mid-West Region, as well as a range of existing regional strategies.

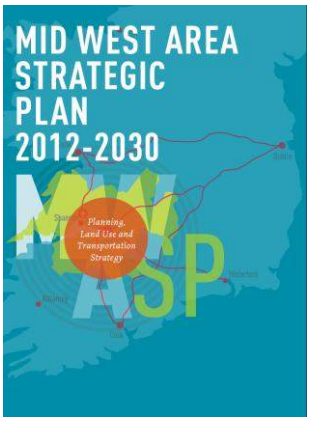
Specific regional priorities in terms of roads included within the guidelines:

- *"The N21 road link from Tralee via Newcastlewest to Limerick City to facilitate access to the City from that zone of the Region. In the event of funding for the provision of a motorway link between Tralee and Newcastlewest not being provided in the immediate future, by-passes will be required as a matter of immediate priority for Adare, Abbeyfeale and Newcastlewest;"* and
- *"The N69 road link between Askeaton and Adare to provide effective access to road freight traffic from Foynes to the N20/21 (linking Limerick with Cork and Tralee)".*

The guidelines also recognise that the following roads should be regarded as regional priorities considered crucial for the Region's long-term integration:

- *"The condition and standard of the N69 between Foynes and Limerick City to provide efficient access to the ports; and*
- *Upgraded road links along the Shannon Estuary in order to facilitate employment and tourism development."*

2.3.8 Mid-West Area Strategic Plan (MWASP) 2012 – 2030



The Mid-West Area Strategic Plan (MWASP) is a strategic planning, land use and transportation strategy for the Mid-West region and includes the County Councils of Limerick, North Tipperary and Clare along with Limerick City Council. MWASP provides for a Comprehensive integrated plan for Land Use Planning and Transportation in the Mid-West Region over an 18 year period. The MWASP sets out a series of economic, land-use and transport recommendations including a proposed transportation investment programme, a public transport feasibility report, spatial and economic strategies and recommendations to achieve balanced regional development and an enhanced quality of life for the citizens of the Mid-West region.

Key Objectives from the Plan that support the development of the Foynes to Limerick road include the following:

- *Identify and promote investment in key infrastructural projects identified to serve the needs of the region including new roads and improvements to the National Secondary and Regional road network, rail, air, port, infrastructure and water services. Such proposals to include an equitable distribution of resources throughout the region; and*
- *Support opportunities that the Shannon Estuary Integrated Framework Plan can sustainably deliver, through optimising the deep water berthage opportunities and the infrastructural, commercial and recreational resources which prevail in the estuary and its surrounds."*

Specific recommendations with regard to major road corridors within the plan are as follows:

National Road Recommendations		
3.	*M21*	*Review the corridor improvements and connection to Newcastle West, giving consideration to N69 connection (refer to point 9 below)*
9.	*N69*	*Primary access route to Shannon-Foynes Port requires complete upgrade and consideration of connection with M21 (refer to point 3 above)*
13.	*N69*	*Upgrade the road access to Foynes Port to motorway standard*

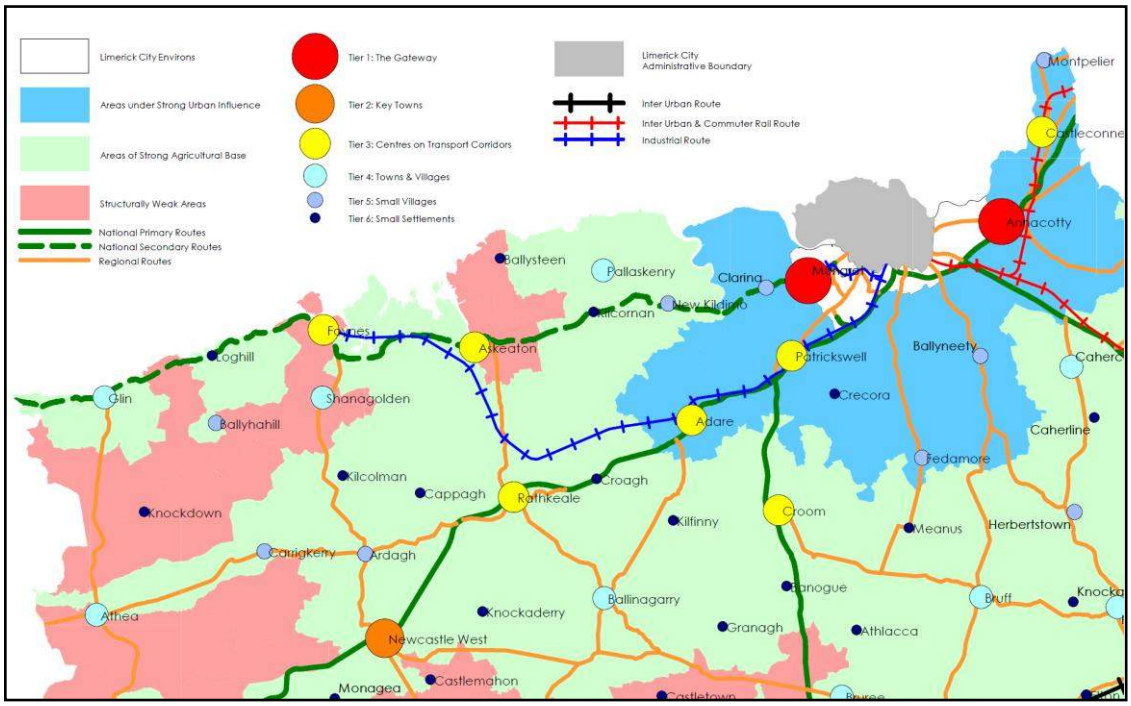
2.3.9 Limerick County Development Plan 2010 – 2016

The Limerick County Development Plan 2010 - 2016 includes transport and development objectives to ensure that the transportation, infrastructure, natural and energy resources shall be developed in a sustainable and efficient manner to promote the social and economic wellbeing of the county and its population. The plan is still in force notwithstanding the amalgamation of Limerick City Council and Limerick County Council to form Limerick City and County Council in 2014. Following the merger it was confirmed that the County and City Development Plans would not be reviewed in 2015 and they will stay in force until a new joint plan is prepared, thereby extending the life of the Plans beyond 2016.

The plan recognises the importance of linkages throughout the County and beyond as key features in achieving balanced regional development objectives.

Figure 2.8 below shows the key transportation links identified within the County Development Plan.

Figure 2.8 County Development Plan, Transportation



Source: Map 2.1 Core Strategy – December 2011 (LCC CDP)

Regarding transport policies the implementation of national and EU regulations is recognised under the following:

Policy CP 01:	*To implement relevant European, national and regional regulations, guidelines and strategies at County level.*
Policy CP 03:	*To provide for an enhanced quality of life for all, based on high quality, sustainable residential, working and recreational environments and transportation networks.*

In terms of transport infrastructure improvements the following have been identified in the County Development Plan:

N21 Tralee Road (and Killarney Road)	*Design, reserve land for and commence construction of N21 Route Improvements from Adare to the County boundary, as resources become available.*
N69 Tarbert (Foynes) Road	*Design, reserve land for and commence construction of N69 Route Improvements from Limerick to Glin as resources become available.*

In support for the Foynes-Limerick project and transport facilities generally, the plan includes the following policy and objectives:

Objective IN O13: Reservation of corridors for major road improvements:	*It is an objective of the Council to support major improvements by reserving such corridors of any such proposed routes free of developments that would interfere with such improvements.*
Objective IN O21: Promotion of improvements to the N69 Limerick to Foynes	*It is the objective of the Council to promote the strategic improvement of the N69 between Limerick City and Foynes to facilitate traffic by heavy goods vehicles into this important port from an easterly direction.*
Objective IN O23 Enhancing Connectivity with the Estuary	*It is an objective of the Council, as resources become available and in consultation with the NRA, to examine sustainable route options from the N69 to the national primary road network and Limerick Gateway to provide for improved vehicular connectivity*

2.3.10 Smarter Travel: A Sustainable Transport Future 2009 – 2020

Smarter Travel, A Sustainable Transport Future 2009 - 2020, presents a transport policy framework for Ireland covering the period up to 2020. The policy, launched by the Department of Transport in 2009, sets out a vision, goals and targets to be achieved, and outlines 49 actions that form the basis for achieving a more sustainable transport future.

In terms of movement of goods and freight Smarter Travel notes that:

- *"The efficient movement of goods is vital to our competitiveness and economic welfare"*

Action 10 of Smarter Travel states that we will:

- *"Ensure that the Department of Transport deals with freight policy issues in a more integrated manner and prepares a specific strategy for the freight sector. We will set a target aimed at reducing the environmental impact of freight while at the same time improving efficiency in the movement of goods and promoting economic competitiveness";*
- *"Explore the development of key logistics centres to transfer goods to more sustainable forms of transport for final delivery in urban areas"*
- *"Explore the potential of Intelligent Transport Systems and Services to improve efficiency."*

One of the key actions is aimed at improving the fuel efficiency of motorised transport through improved fleet structure, energy efficient driving and alternative technologies. Actions under this heading are more related to vehicles and driving methods. However improved fuel efficiencies will result from reduced queuing and braking related to traffic which would have passed through villages and towns before being bypassed.

2.3.11 RSA Road Safety Strategy 2013 – 2020

The Road Safety Authority (RSA) Road Safety Strategy 2013 – 2020, sets out targets to be achieved in terms of road safety in Ireland as well as policy to achieve these targets. The primary target of this strategy is defined as follows:

> *"A reduction of road collision fatalities on Irish roads to 25 per million population or less by 2020 is required to close the gap between Ireland and the safest countries. This means reducing deaths from 162 in 2012 to 124 or fewer by 2020.*
> *A provisional target for the reduction of serious injuries by 30% from 472 (2011) to 330 or fewer by 2020 or 61 per million population has also been set."*

The plan sets out strategies for engineering and infrastructure in terms of the benefits that they can have in terms of reducing collisions. The provision of the improved road between Foynes and Limerick will support this strategy in terms of improving the road infrastructure and achieving accident reduction.

The policy also aims to extend measures in the EU Road Infrastructure Safety Management Directive 2008/96/EC relating to road safety inspection and traffic management, which currently apply to the TEN-T routes, to the entire national road network by 2016. As this scheme will form part of the TEN-T network it fundamentally supports this objective.

2.3.12 The National Secondary Road Needs Study (2011)

The National Secondary Roads Needs Study (NSRNS) published in 2011 by TII recognises the importance of National Secondary roads within Ireland in terms of their function for connecting towns to each other and to the National Primary Roads network. The study accepts that in investment terms, the National Secondary Roads (NSRs) have suffered relative neglect and that improvements are required.

The study identifies the deficiencies within individual lengths of National Secondary Roads and provides a range of proposals for dealing with these deficiencies. The N69 between Foynes and Limerick has been identified as requiring improvements along most of its length with specific upgrades recommended as follows:

- Mungret to west of Kilcornan (with bypasses of Clarina, New Kildimo & Kilcornan); upgrade to Type 1 Single Carriageway;
- Kilcornan to Askeaton Bypass: upgrade to Type 2 Single Carriageway; and
- Askeaton Bypass to Foynes, upgrade to Type 2 Single Carriageway

The deficiencies of the existing N69 route identified in the National Secondary Roads Needs Study give support to the need for the proposed Foynes to Limerick Road Improvement Scheme. These proposed upgrades predate the adoption of the EU TEN-T Regulations.

2.4 Existing Traffic Conditions

2.4.1 Existing Traffic Flows on the Main Road Network

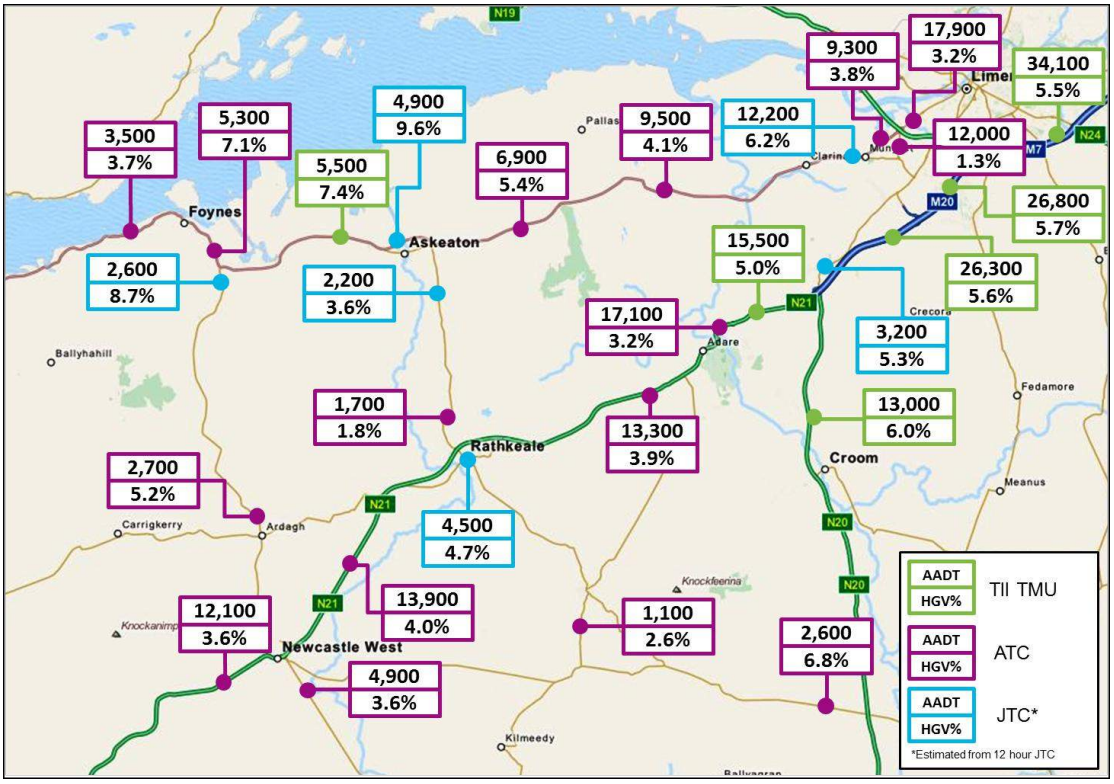
Annual Average Daily Traffic (AADT) flow and the percentage of Heavy Goods Vehicles (HGV) on various sections of the main road network in the study area are presented in Figure 2.9. The data presented is based on traffic surveys undertaken in May 2014, including Automatic Traffic Counts (ATCs) and Junction Turning Counts (JTCs).

Data from TII permanent Traffic Monitoring Units (TMU) located on various sections of the national road network was also utilised. A roadside interview survey was also undertaken at Shannon-Foynes Port to help establish the distribution of freight from the Port and the road corridors used by freight in the region.

Traffic flows on the N69 range from 5,300 AADT at Foynes at the western end to 12,200 AADT at Mungret at the eastern end near Limerick City.

Traffic levels along the section of the N21 range between 13,300 AADT near Rathkeale at the western end to 17,100 AADT east of Adare.

Figure 2.9 2014 Estimated AADT & HGV%



2.4.2 Existing Journey Times

Data on journey times throughout the study area was collected in May 2014 and October 2015. The data was collected using Automatic Number Plate Registration (ANPR) cameras and Bluetooth tracking devices. ANPR cameras recorded the registration plate number alongside the time at which the registration was recorded at various points throughout the network. Bluetooth tracking devices capture the

Bluetooth signal emanating from mobile phones and car kits in vehicles travelling along a selected route.

Journey time results and average speeds are presented in Table 2.1 along 12 key sections in the study area which are shown graphically in Figures 2.10 & 2.11.

Figure 2.10 Key Section Journey Times (ANPR)

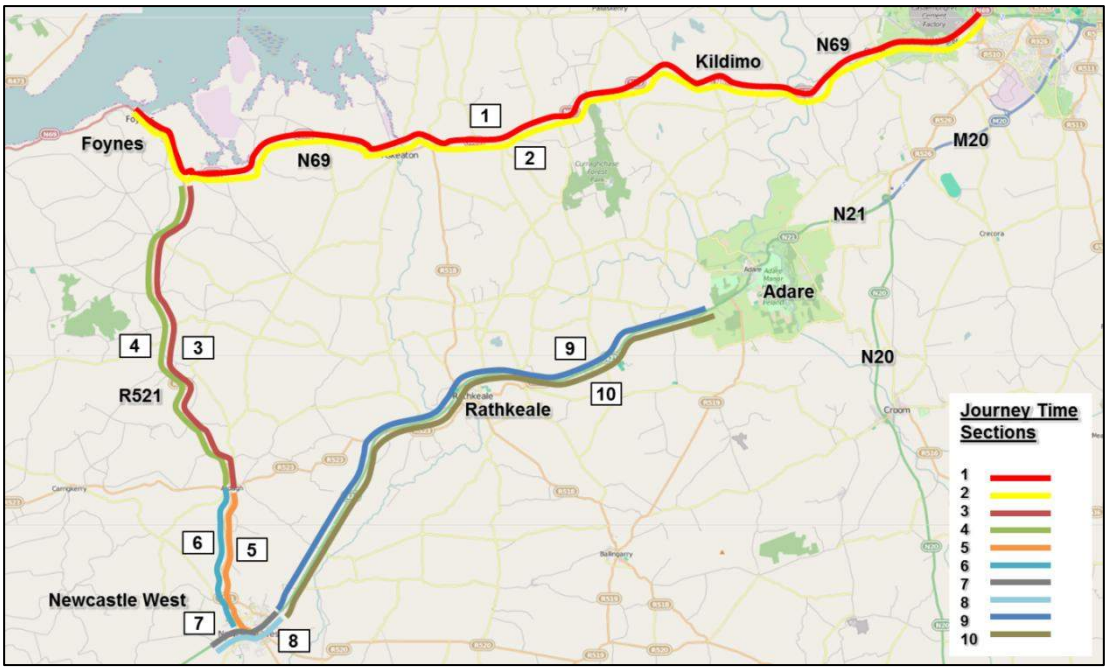


Figure 2.11 Key Section Journey Times (Bluetooth)

It should be noted that journey time survey data was collected during the months of May and October, both of which are considered to be neutral months for traffic data collection. Traffic delays and congestion through the village of Adare are regularly reported. In order to capture the delay through Adare across an extended period (2 weeks), Bluetooth devices were utilised so the variation in flow as a result of congestion could be captured and assessed.

Average weekday journey times are reported in Table 2.1.The most significant delay recorded in the network occurs in Adare travelling westbound in the evening peak where the journey time increases to 9 minutes from the daily average of 5 minutes. However delays of 20 to 30 minutes have been recorded on Friday evenings, and on one bank holiday weekend a delay of an hour was reported.

In 2012, the Road Safety Authority (RSA) produced the report Free Speed Survey 2011 (Urban and Rural). Free speeds are speeds at which drivers choose to travel when unconstrained by road geometry (e.g. sharp bends, intersections or hills), weather conditions (e.g. rain) or traffic conditions (e.g. congestion).

The average free speed for national secondary single carriageways was measured as 82km/h, while national primary roads were measured at 90km/h. The results in Table 2.1 show that the N69 between Foynes and N18 Dock Road junction has an average speed of approximately 71km/h while the N21 varies considerably. Average speeds of approximately 37km/h were recorded on the N21 through Newcastle West, while speeds between Newcastle West to the west of Adare increase to approximately 86km/h. However, significant delays are noted through Adare Village during peak times, resulting in average speeds of approximately 29km/h through the village.

Table 2.1 Average Journey Time Data

Route No.	Section	Direction	Distance (km)	Average Journey Times (mins)			Average Speeds (kph)		
				AM	Inter-Peak	PM	AM	Inter-Peak	PM
1	N69 Foynes to Limerick	EB	32.3	28	28	26	70	69	74
2		WB	32.3	27	28	27	72	68	71
3	R521 Foynes to Ardagh	SB	13.5	12	11	12	70	74	66
4		NB	13.5	11	12	12	71	69	67
5	R521 Ardagh to Newcastle West	SB	7.4	11	11	12	42	40	37
6		NB	7.4	11	12	10	42	37	42
7	N21 through Newcastle West	EB	2.1	03	04	03	42	35	38
8		WB	2.1	03	04	03	38	31	38
9	N21 East of Newcastle West to West of Adare	EB	20.0	14	13	14	84	90	86
10		WB	20.0	14	14	14	88	85	85
11	N21 Through Adare	EB	2.5	06	05	04	24	32	35
12		WB	2.5	04	05	09	36	30	16

2.5 Road Safety Conditions

2.5.1 Collision Statistics

The Road Safety Authority (RSA) Personal Injury Accident (PIA) database has been consulted regarding collisions along the N69 between Limerick and Foynes and along the N21 between M20/N20/N21 junction at Attyflin and Rathkeale.

Figure 2.12 below provides the locations of all collisions along the N69 between Foynes and N18 Junction 2 (Dock Road Junction) and along the N21 between M20/N20/N21 Junction and Rathkeale between 2005 and 2012. The numbers of collisions on the relevant sections of the N69 and N21 over the 8 year period are presented in Table 2.2. It should be noted that the RSA collision data below indicates the number of collisions that involve fatal, serious or minor injuries and that the number of people who were killed or injured on these sections of road are typically higher as collisions often involve multiple casualties.

Table 2.2 Collision Data (2005 – 2012)

Data	N69			N21		
	Fatal	Serious	Minor	Fatal	Serious	Minor
Collisions	5	9	74	3	10	53
Annual Average Collisions*	0.63	1.13	9.25	0.38	1.25	6.63
Casualties	6	11	122	5	14	104
Annual Average Casualties**	0.75	1.38	15.25	0.63	1.75	13

* *Annual Average Collisions – Number of collisions per year, averaged over the 8 year data collection period 2005 to 2012.*

** *Annual Average Casualties – Number of casualty types per year resulting from collisions, averaged over the 8 year data collection period 2005 to 2012.*

2.5.2 Network Safety Ranking - TII HD 15/12

TII Standard HD 15 is used to identify sections of the national road network which have a high concentration of collisions and to rank the safety of the road network. The ranking is based on the collision rate (number of collisions per 100 million vehicle kilometres travelled) on road sections of approximately 1km compared against the national average collision rate for a similar road type.

Figure 2.13 below shows the ranking of both the N69 and N21 corridor sections under consideration based on HD 15 for 2009 to 2011. Both roads are considered to be "Rural Single Carriageways" and the ranking of collisions is categorised as follows:

- Twice above national average collision rate;
- Above national average collision rate;
- Below national average collision rate; and
- Twice below national average collision rate.

Figure 2.13 demonstrates that there are several sections on both corridors which have a ranking of above or twice above the national average collision rate for a rural single carriageway road. Under HD15 sections of road with a ranking of twice above the national average would require rectification as a priority.

Based on these figures for the N69, 37% of the route is classified as having an accident rate greater than the national average. Of this 16% of the road is above the national average rate with a further 21% of the route twice above the national average.

For the N21, 36% of the route is classified as having an accident rate greater than the national average. Of this 24% of the road is above the national average rate with a further 12% of the route twice above the national average.

Figure 2.12 RSA Collision Data

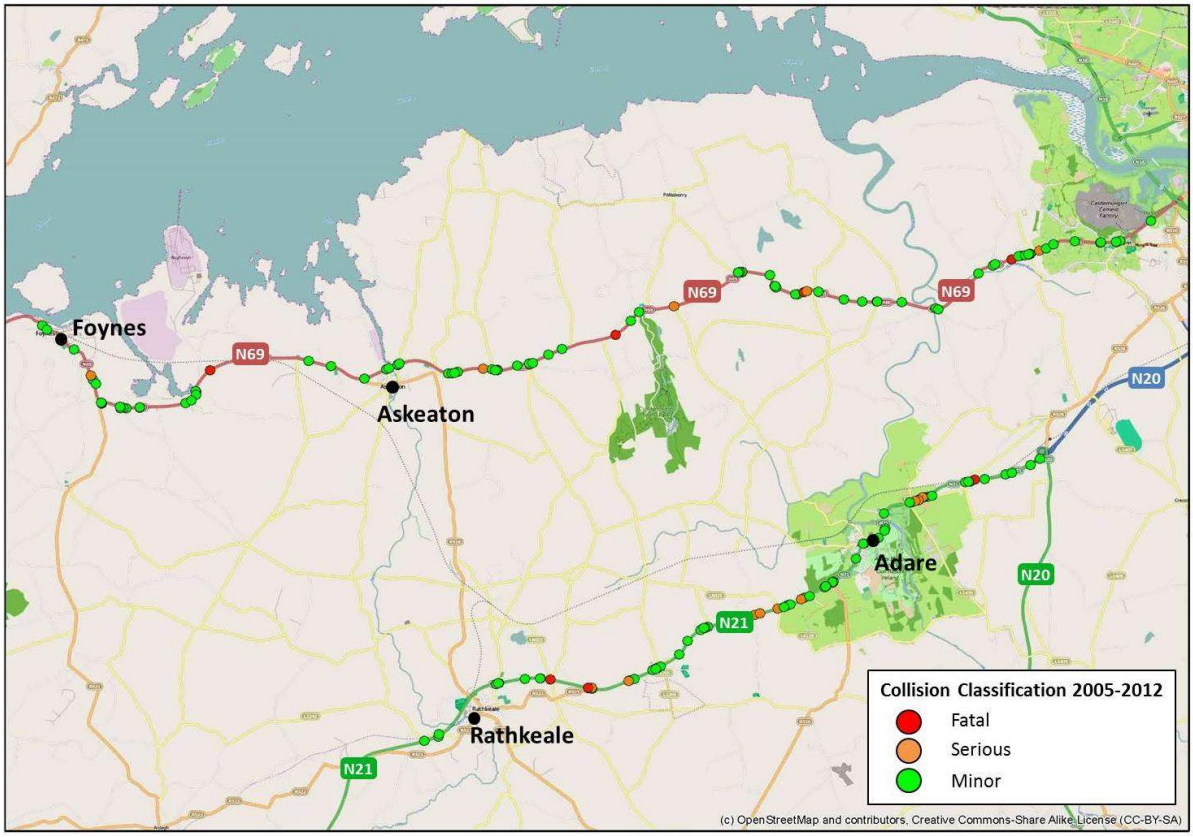
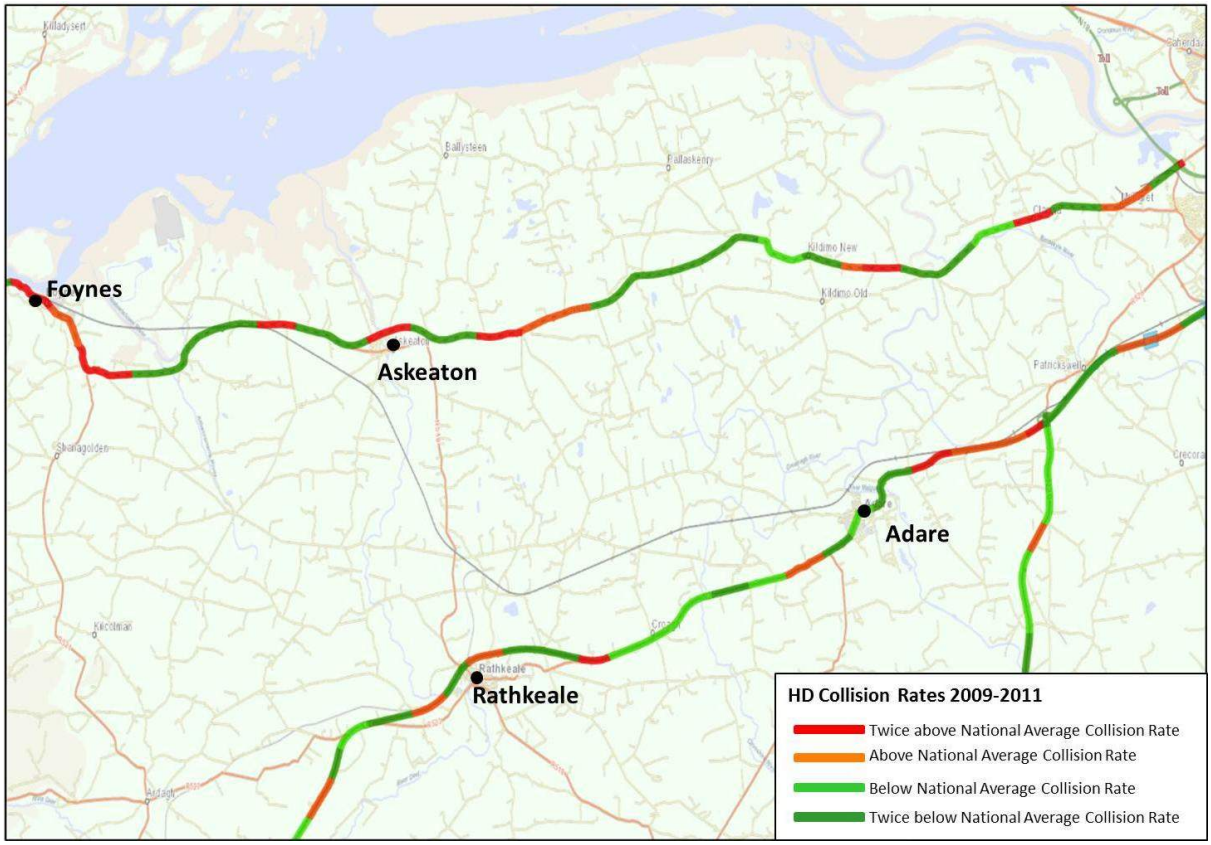


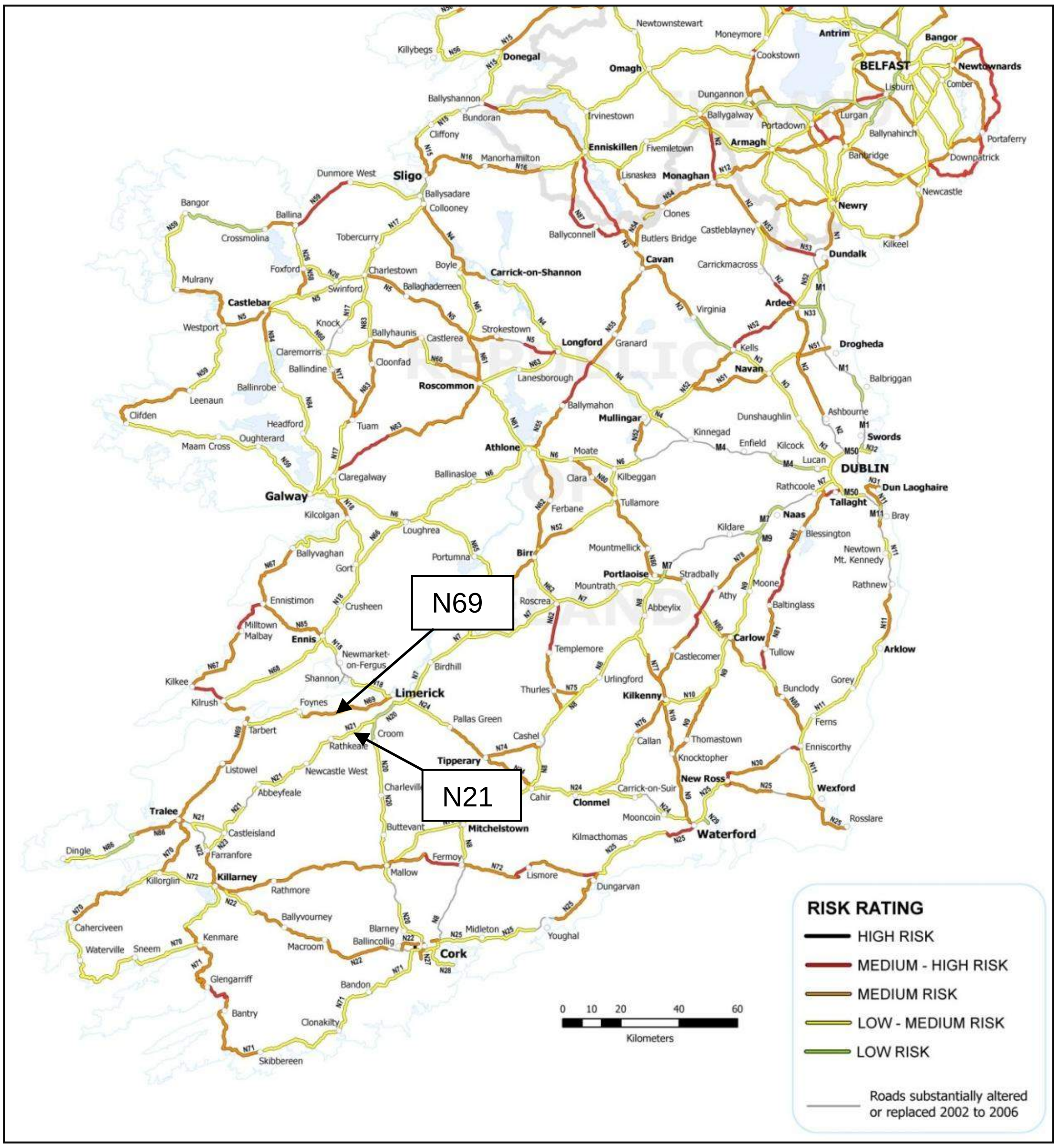
Figure 2.13 – HD15 Collision Rates 2009-2011



2.5.3 EuroRAP

EuroRAP, "The European Road Assessment Programme" is a programme which identifies the current safety standing of major roads within the EU. It calculates this based on collision statistics and vehicular traffic flows on the roads in question. The N69 between Limerick and Foynes has been identified as a "Medium Risk" road with the N21 between Rathkeale and Attyflin identified as a "Low - Medium Risk". Figure 2.14 shows the EuroRAP Risk Rating map for Ireland.

Figure 2.14 EuroRAP Risk Rating Map



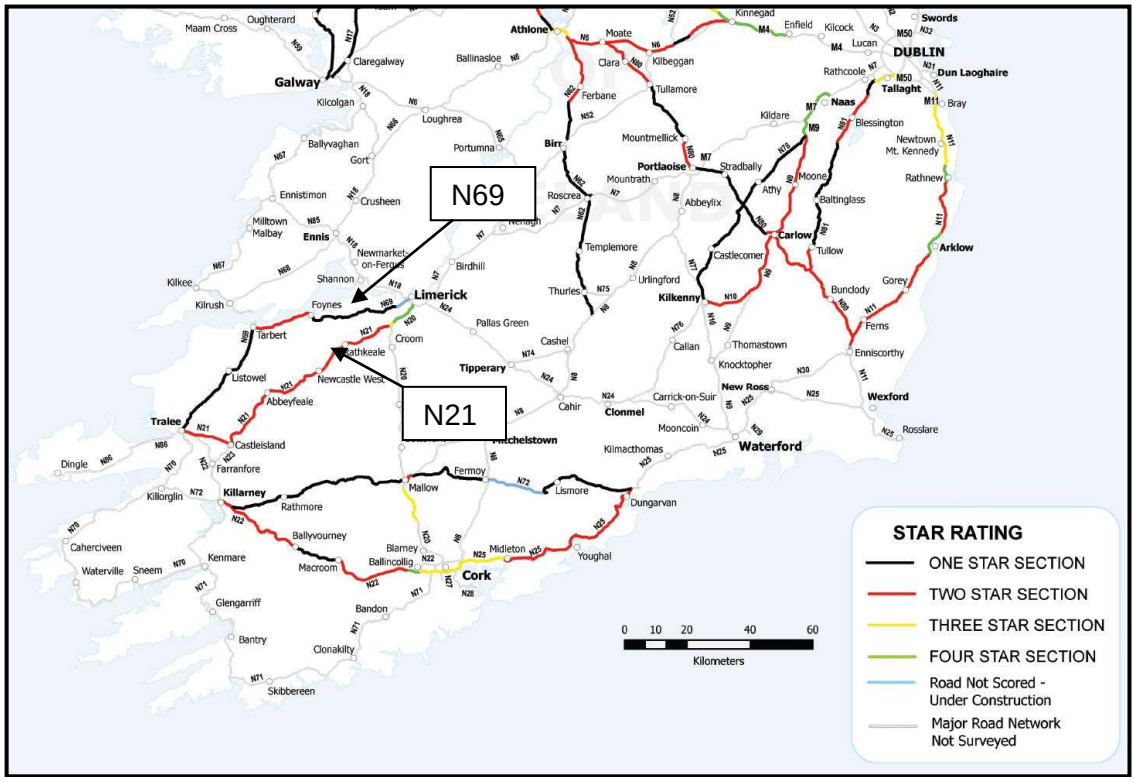
Source: EuroRAP 2008: Ireland Results

In addition to the EuroRAP Risk rating a EuroRAP Road Protection Score 'RPS' has been developed to assess the protection that the road environment will provide to the occupants of a car in a collision. For this score a star rating has been assigned to sections of road based on the features of the road which either increase or decrease the risk to the occupant of the vehicle ranging from 1 Star (worst) to 5 Star (best).

Based on this rating system the N69 between Foynes and Limerick was awarded a 1 Star rating indicating the highest level of risk to vehicle occupants.

The N21 has a 2 Star rating over its entire length (see Figure 2.15).

Figure 2.15 EuroRAP Star Rating Map



Source: EuroRAP 2008: Ireland Results

2.6 Scheme Objectives

2.6.1 Scheme Objectives

The primary objective of the Foynes to Limerick Road Improvement Scheme is to provide road connectivity between Foynes and the core road network at Limerick to a standard that fulfils the requirements of the EU TEN-T regulations.

The framing of scheme objectives has been undertaken in accordance with the guidance provided in the TII's Project Appraisal Guidelines - *PAG Unit 3.0: Project Brief* under the criteria included in the Common Appraisal Framework, inter alia:

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

2.6.2 Economy

The proposed corridor will form part of the Core EU TEN-T network which aims to promote growth and competitiveness, remove bottlenecks, upgrade infrastructure and streamline cross border transport operations for passengers and businesses throughout the EU. Obtaining best value for money in terms of the investment envisaged, taking all other relevant considerations into account is also an important economic driver for the scheme.

Key economic objectives which have been identified therefore include:

- To contribute to enhancing the internal market and strengthening economic, social and territorial cohesion;
- To improve journey times between Foynes and the core road network;
- To obtain a reasonable rate of return for the scheme
- To reduce bottlenecks, journey and traffic delays on the overall network;
- To improve journey time reliability and to reduce stop/start conditions particularly for heavy goods vehicles on the overall network.

2.6.3 Safety

The key safety objectives are:

- To reduce the frequency and severity of collisions on the network by providing a safer route for all traffic;
- To improve safety for pedestrians and cyclists; and
- To support the Government's Road Safety Strategy.

2.6.4 Environment

Air quality and noise pollution are significant issues, particularly in urban areas. Vehicles travelling at low speeds or queuing through towns and villages along the existing N21 and N69 generate high levels of emissions as a result of continuous braking and accelerating. Key environmental objectives of the scheme include:

- To reduce greenhouse gas emissions and in so doing reduce the impact on climate;
- To improve air quality in urban areas through a reduction in traffic congestion; and
- To reduce traffic noise to acceptable levels.

2.6.5 Accessibility & Social Inclusion

The scheme will provide a high quality road that will improve accessibility between Foynes and the core road network at Limerick. The scheme will also improve conditions for road based public transport.

The scheme will support the achievement of the objectives of the EU TEN-T plan, Mid-West Regional Planning Guidelines and the Limerick County Development Plan together with Regional and Local Area Plans to generally improve quality of life and improve accessibility to work and other activities. Key relevant objectives include:

- To achieve the goals of the TEN-T Core network by providing a high quality road which will contribute to enhancing social cohesion within Ireland and across the EU;
- To improve road based public transport by improving journey times and journey time reliability; and
- To improve access for vulnerable groups and also to disadvantaged geographic areas.

2.6.6 Integration

The proposed scheme is required to integrate with general policies and plans under the headings of Transport, Land Use, Geographical and Government Policy. The following objectives are outlined for integration:

- To improve connectivity to the national road network (Transport);
- To improve access between the port of Foynes and the core road network, including the national motorway network (Transport)
- To facilitate effective planning of the future national road network in the area (Transport)
- To be compatible with adopted land use objectives (Land Use)
- To improve transport links with Europe and the rest of the world(Geographical) and
- To complement wider government policy.(Government Policy)

2.7 Summary of the Need for the Scheme

The reasons for provision of the Foynes to Limerick Road Improvement scheme are as follows:

a) Policies at European Union level, as expressed in the TEN-T Regulations, supplemented by policies at National, Regional and County levels, have identified an objective for a high quality road to connect Foynes to the core road network and to thus underpin the economic development of the Mid-West region through improved road transport infrastructure for the port of Shannon-Foynes.

b) The existing N69 between Foynes and the Limerick Southern Ring Road is a low quality road that poorly serves its purpose for access by HGV's to the port of Foynes due to deficient and inconsistent width, low speed and poor alignment with tight bends and restricted visibility.

c) There is a requirement to address the existing infrastructural deficit on the N21 corridor as evidenced by severe traffic delays in Adare.

Chapter 3 Constraints Study

3.1 Introduction

The initial step in the Route Selection Process is to identify the nature and extent of significant constraints within a defined study area. This chapter outlines the process by which the study area was defined and documents significant constraints identified. The constraints identified were mapped to facilitate the design of a number of feasible route options to avoid the constraints, where possible.

The constraints gathering exercise comprised of a desktop study, with the extent and the nature of certain constraints verified by means of windshield or walkover surveys. Further constraints which were identified during the subsequent Public Consultation, through submissions received from members of the public and statutory bodies, have also been included.

3.2 Defining the Constraints Study Area

3.2.1 Introduction

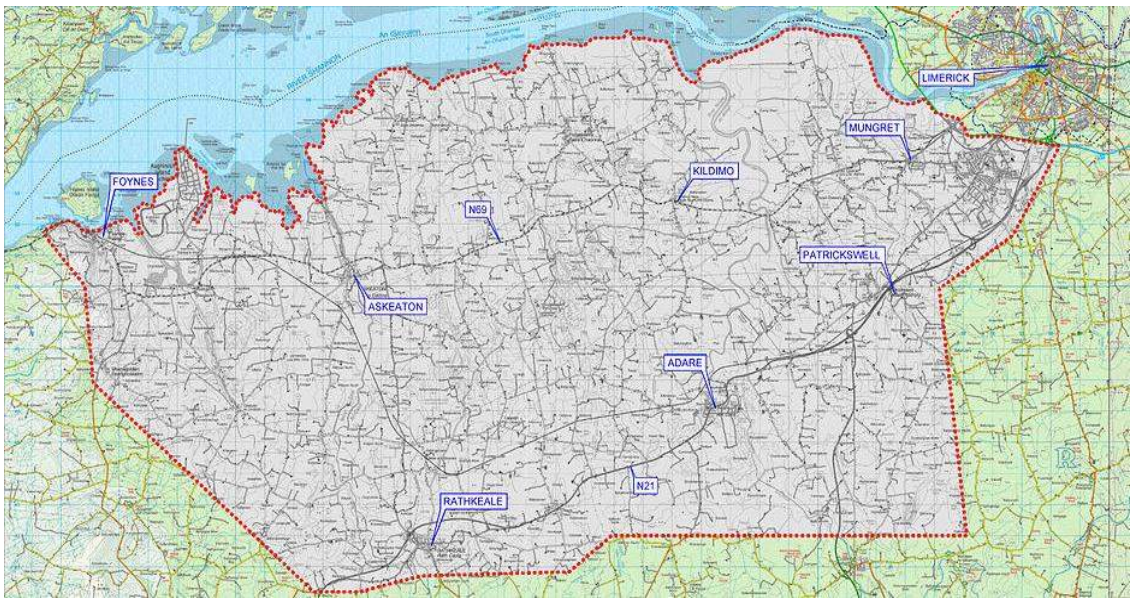
The aim of the initial investigation was to identify a constraints study area large enough for all potentially feasible route options.

The constraints study area was developed based on the initially identified constraints, including those outlined from previously identified study areas for the following schemes:

- N21 Adare Bypass;
- N21 Abbeyfeale to Adare Scheme; and
- M20 Cork Limerick Motorway Scheme.

Figure 3.1 below shows the extent of the study area while Drawing No. CS-002 in Volume 2 of this report details the extent of the constraints study area along with the extent of the previous study areas (refer Drawing No. CS-001 in Volume 2 of this report) which have informed the development of this study area.

Figure 3.1 Constraints Study Area



3.2.2 Initial Constraints

Significant constraints included the following:

- Areas with Ecological protection status – Special Areas of Conservation (SAC), National Heritage Areas (NHA) and Special Protection Areas (SPA); these include the Curraghchase Woods SAC, the Askeaton Fen Complex SAC, the Lower River Shannon SAC and the Barrigone SAC.
- Existing National Roads including the N69, N21, N18, N20 and M20 and significant Regional Roads;
- Towns and villages along the N69, including, Foynes, Askeaton, Kilcornan, Kildimo, Clarina and Mungret;
- Towns and villages along the N21 and M20 including Rathkeale, Croagh, Adare, Patrickswell, Raheen Business Park and Dooradoyle;
- Other villages within the hinterland including Pallaskenry, Shanagolden and Cappagh;
- The Rivers Maigue, Deel and the Shannon Estuary;
- The Foynes Limerick Rail Line; and
- Port of Foynes, RUSAL (Aughinish Alumina), Wyeth and other industrial sites.

The various constraints which have been identified are presented in Drawings CS-003 to CS-099 of Volume 2 of this report.

3.2.3 Definition of the Study Area

The northern extent of the study area is defined by the River Shannon and its estuary from Foynes through to Limerick. The north eastern boundary near Limerick runs along the existing N18 Limerick Southern Ring Road to the M7/M20 Junction at Rossbrien. The boundary then runs south-westward of the M20 to Patrickswell before heading south following the eastern extent of the study area for the M20 – Cork Limerick Motorway Scheme towards Croom. It then extends westwards to the south of the N21 corridor past Adare.

The southern boundary from east of Adare through to west of Rathkeale incorporates the southern extent of the N21 Adare Bypass Study Area and part of the northern section of the N21 Abbeyfeale to Adare Scheme Study Area. The boundary itself lies to the north of Croom and south of Rathkeale.

The western boundary runs north-westerly from west of Rathkeale to west of Foynes. This allowed for the potential to cover a range of route options between the two towns.

3.3 Public Consultation

The Constraints Study is the initial step in the route selection process and normally does not involve a formal public consultation. However, the public should be made aware of the proposal to develop a number of route options leading to the selection of a Preferred Route Corridor.

Limerick City and County Council undertook a publicity campaign during the Constraints Study phase of the Scheme to raise awareness of the project amongst members of the public.

In order to raise awareness of the proposed scheme amongst members of the public, the following measures were undertaken:

- **Direct contact with Elected Representatives -** A letter was issued to Councillors for Limerick City and County informing the representatives of the study area and process on the 14th of July 2014.
- **Press Coverage -** A press release was issued on the 15th of July 2014 and appeared in local newspapers including the Limerick Leader on the 21st of July 2014.
- **Electronic Media -** A website for the scheme www.foyneslimerick.ie was established which went live to the public on the 15th of July 2014. The website is periodically updated containing the latest information on the progress of the scheme. During the constraints gathering stage of the project the website contained the study area as outlined in Figure 3.1 above, a description of the project and contact details to allow members of the public to engage with the scheme.

3.4 Development and Infrastructure

3.4.1 Geographical Description

The study area is located within the western part of County Limerick and lies between:

- Foynes to the west and Limerick City to the east;
- The Shannon River and Estuary to the North; and
- South of the towns of Rathkeale and Adare and north of Croom.

The location of the study area is indicated on Drawing No. CS-002 in Volume 2 of this report.

3.4.2 Population Centres

The key population centres within the study area include:

- **Limerick City** *(Population 87,081 including suburbs in the 2011 census)* – The city of Limerick is located to the east of the study area with the River Shannon flowing through the middle of the city. Limerick is the third largest City in Ireland.
- **Foynes** (*Population 542 in the 2011 census*) - Lies on the western edge of the study area approximately 35 kilometres west of Limerick City. The town is dominated by the Port of Foynes located to the north of the town which is the central facility within the Shannon-Foynes Port Company complex and is the second largest port in Ireland by tonnage.
- **Adare** (*Population 1,106 in the 2011 census*) – Is located approximately 16 kilometres south west of Limerick City along the N21 with the River Maigue flowing to the east of the town. Adare is a designated heritage town with a number of abbeys and castles and is renowned as a tourist destination containing golf courses and hotels.
- **Rathkeale** (*Population 1,550 in the 2011 census*) - Is located approximately 30 kilometres south west of Limerick City along the N21, with the River Deel flowing to the west of the town.
- **Askeaton** (*Population 1,149 in the 2011 census)* - Located approximately 25 kilometres west of Limerick City along the N69 and on the River Deel. The ruins of a Desmond Castle and a Franciscan Friary are the focal points of the town. The town is also home to a number of industries.
- **Patrickswell** (*Population 841 in the 2011 census*) - Located to the southwest of Limerick city, 7 kilometres east of Adare and north of the M20.
- **Pallaskenry** (*Population 664 in the 2011 census*) - Lies north of the N69 between Askeaton and Limerick and is home to Pallaskenry Agricultural College.
- **Mungret** (*Population 286 in the 2011 census*) - Is located 5 kilometres west of Limerick City along the N69.
- **Clarina** (*Population 275 in the 2011 census*) - Is located 7 kilometres west of Limerick City along the N69.
- **Kildimo** (*Population 409 in the 2011 census*) - Is located approximately 14 kilometres west of the Limerick City along the N69.
- **Shanagolden** (*Population 294 in the 2011 census*) - Is located along the R521 approximately 4 kilometres south of Foynes.

- **Croagh** (*Population 222 in the 2011 census*) - Is located between Rathkeale and Adare along the N21.

3.4.3 Flooding and Drainage

The study area is located within the River Shannon Basin District and specifically the Shannon Estuary South region.

Three significant rivers and their catchments which drain northward into the River Shannon dominate the study area including:

- The River Maigue at the eastern side flowing through Adare and Kildimo;
- The River Deel flowing through Rathkeale and Askeaton; and
- The River Ahacronane flowing through Creeves into the Estuary to the east of Foynes.

There are a number of smaller rivers and streams along the northern sections of the study area which drain directly into the Shannon Estuary. These include the River Shanagolden, River Dromlohan and River Lismakeery.

The proposed road scheme will have to comply with Section 50 of the Arterial Drainage Act 1945, the purpose of which is to ensure that the existing conveyance and storage capacities of channels and floodplains are maintained. The scheme will also have to comply with the requirements of the Office of Public Works (OPW) and Inland Fisheries Ireland (IFI).

3.4.4 Existing & Future Road Network

Existing Road Network

The study area has a road network ranging from Motorways, National Primary and Secondary Roads to a network of Regional and Local Roads. The existing National Secondary N69 runs to the north of the study area. The N69 is a single carriageway road that extends from Limerick City centre at its northernmost end through to Tralee at its southernmost end. The N69 passes through or bypasses the towns and villages of Foynes, Askeaton, Kildimo, Clarina and Mungret within the study area.

Between Foynes and Limerick City the N69 intersects several regional roads, namely the R521, R518, R859 and the R510, these are connected via at-grade priority controlled junctions. The N69 also intersects with the N18 at its northern end outside Limerick City.

The existing National Primary N21 runs to the south of the study area. The N21 is a single carriageway road that extends from the M20/N20/N21 (Junction 5) at Attyflin southwest of Patrickswell to an intersection with the N69 in Tralee in Kerry. Within the study area, the N21 passes through or bypasses the towns and villages of Rathkeale, Croagh and Adare before terminating at the M20/N20/N21 junction approximately 5.5km to the east of Adare.

Between Rathkeale and Attyflin the N21 intersects several regional roads, namely the R518, R523, R519 and the R526.

The existing M20 Motorway runs to the south of the study area and is located entirely within the study area. The M20 is a dual carriageway road and travels north-easterly from the M20/N20/N21 junction at Attyflin to the M7/N18/M20 Junction at Rossbrien and bypasses Patrickswell, Raheen Business Park and Dooradoyle.

The M20 is approximately 10km long and has five grade-separated junctions, namely the M20/N20/N21 junction at Attyflin (Junction 5), the M20/R526 junction at Patrickswell (Junction 4), the M20/R510 junction at Raheen (Junction 3), the M20/R926 junction at Dooradoyle (Junction 2) and the M20/M7/N18 junction at Rossbrien (Junction 1).

Future Road Network Proposals

There are a number of major new roads that were proposed separately as follows:

- M20 Cork to Limerick Motorway Scheme;
- N21 Adare Bypass; and
- N21 Abbeyfeale to Adare Scheme.

The M20 Cork to Limerick Motorway and N21 Adare Bypass schemes progressed to the Statutory Planning Approval stage with a joint oral hearing being held. The application for the M20 scheme was withdrawn from the planning process, at the Direction of the Minister due to the economic downturn, before An Bord Pleanála made a decision.

The application for the N21 Adare Bypass was not withdrawn however but was subsequently refused permission by the Board, primarily on the basis that it was deemed premature in advance of a future decision on the M20 scheme.

While the preferred route for the N21 Adare Bypass was refused planning by the Board, the options developed at the route selection stage for that scheme, as well as the Board's decision to refuse planning for it, were considered in the constraints gathering stage for the Foynes to Limerick Road Improvement scheme.

The N21 Abbeyfeale to Adare Scheme had not yet advanced to Preferred Route Stage when it too was suspended due to the economic downturn. Thus while these three schemes are listed as objectives in various Statutory Plans, there are no formal approvals in place for the development of any of them.

Along the N69 National Secondary Road there are no specific improvement proposals currently identified beyond the general assessments included in the National Secondary Roads Needs Study, which has no statutory basis.

The existing road network is indicated on Drawing Nos. CS-003 to CS-007 in Volume 2 of this report.

3.4.5 Railways

The Foynes – Limerick railway line traverses the study area. The rail line is currently not active and has not been used for over a decade (Figure 3.2 refers). However as part of the plans for the Shannon Foynes Port and a component of the TEN-T requirements for a Tier 1 Port, it is proposed that this rail line will be reinstated to operational condition. From Foynes the rail line runs in a south easterly direction to pass south of Askeaton and north of Rathkeale.

From Ballingarrane, 2km north of Rathkeale the line turns eastwards to pass just north of Adare. The line then lies just to the north of the N21 and M20 heading towards Limerick City.

Figure 3.2 Foynes to Limerick Railway Line

3.4.6 Existing Utility Services

The major services identified within the study area are high-voltage electric power lines, gas mains, water supplies, and telecommunications. (Refer to Drawing Nos. CS-008 to CS-022 in Volume 2 of this report).

Electric Power Lines

There are a number of high voltage 110kV and 38kV lines throughout the study area along with a number of large substations. To the west of the study are two 110kV lines feeding into the Aughinish (Rusal) plant while other 110kV and 38kV lines run close to Foynes, Rathkeale and Askeaton. Approximately 2.5 kilometres northwest of Rathkeale is a large substation at Stoneville with seven high voltage lines leading to it. To the east of the study area there are three high voltage lines that run in an east - west direction between the Rathkeale substation and Limerick City. Medium and low voltage overhead and underground lines are distributed over the entire study area with higher densities of these lines in the urban areas.

Gas Mains

The Gas Pipeline to the West transmission main traverses through the study area. This line runs to the east of Rathkeale and crosses the N21 and the Foynes - Limerick rail line. North of Rathkeale this gas main heads in a north westerly direction before branching off to Askeaton, Aughinish and Foynes. To the east of the study area numerous transmission and distribution mains are located around Limerick City. Figure 3.3 below shows the location of the gas main crossing the L-1221 south west of Askeaton.

Figure 3.3 Gas Main Crossing of L-1221 near Askeaton

Water Mains

There are a number of water mains and group water schemes, both public and private within the study area. These generally run adjacent to local, regional and national roads.

Telecommunications

Telecommunication lines (overhead and underground) run along the majority of roads in the study area. Fibre optic cables are located along the existing national road network and the railway line.

3.5 Geology, Hydrology & Hydrogeology

Introduction

The identification of the geology, hydrology and hydrogeology constraints for the Foynes to Limerick Road Improvement Scheme Project was undertaken in accordance with Chapter 3 of the *TII Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2008).*

3.5.1 Soils and Geology

Introduction

This section of the constraints study identifies the general underlying geological conditions over the study area and identifies any key geological features. This includes a description of the bedrock, soil types and details of known soft or unstable ground which may affect the route of the proposed roads. The topography of the study area is generally flat-lying with elevations from 0 – 70 m ordnance datum (OD).

Methodology

An initial desktop study of the soils and bedrock conditions was undertaken with information published by Geological Survey of Ireland, and other referenced sources of information as appropriate.

Sources of information

A desk study of available published information was undertaken from the sources below:

- Geological Survey of Ireland (1999); Geology of The Shannon Estuary 1:100,000 Map Series; Sheet 17;
- National Soil Survey of Ireland (1966); Soil Map of Co. Limerick;
- Geological Survey of Ireland (2015 – website www.gsi.ie) - Quaternary geology, Karst Features, active quarries, pits and mines in Ireland and geomorphology information;
- An Foras Talúntais (1978) The Peatlands of Ireland;
- Environmental Protection Agency, (2015 – website www.epa.ie) – Waste Facilities;
- Environmental Protection Agency online mapping (http://gis.epa.ie/Envision);
- Geological Survey of Ireland – Geological Heritage Areas/Sites;
- Aerial photography of study area (GSI, OSI and online sources);
- Limerick County Development Plan 2010-2016;
- Geological Survey of Ireland (2001); Directory of Active Quarries, Pits and Mines; and
- Published reports from previous N21 & M20 road schemes.

Geomorphology

The landscape of the study area has been formed following gradual changes in bedrock geology and surface processes over a long period of time. The features described under solid geology below describe the mapped rock formations, including the intrusion of igneous rocks into sedimentary units.

The study area consists of undulating lowlands, floored by limestone of Lower Carboniferous (Dinantian) age which are generally covered by glacially deposited sediments and alluvium. Volcanic rocks erupted during the Lower Carboniferous (Dinantian) period (More than 325 million years ago) in the areas south of Limerick City. These rocks are found interbedded and / or cross cutting the limestones / sedimentary rocks.

Glacial erosion and deposition were both important in shaping the landscape. The undulating lowlands owe their appearance to deposition from ice sheets resulting in masses of boulders, pebbles, sand and mud. Evolution of the landscape is ongoing with rain and rivers gradually washing away soil and rock slopes, shaping valleys and filling lakes. Karstification of limestone also occurs, where groundwater flow results in the dissolution of the purer carbonate constituents.

Solid Geology

The bedrock of the study area is shown on Drawing Nos. CS-023 to CS-027 in Volume 2 of this report. This is based on the published available information on the 1:100,000 scale Geological Survey of Ireland map of the area. A summary of the geological sequence and main rock types is given in Table 3.1. The study area is mainly underlain by sedimentary rocks with igneous intrusions. The sedimentary rocks generally consist of limestones of the Lower Carboniferous (Dinantian) age. These formations include Ballysteen Formation, Waulsortian Limestone Formation, Rathkeale Formation, Durnish Formation and Viséan Limestone (Undifferentiated).

Ballysteen Formation generally consists of two units: an upper unit and a lower unit. The lower unit consists of dark well bedded bioclastic limestones. The limestones are mainly argillaceous wackestones with a rich invertebrae fauna of crinoids, brachiopods, bryozoa, calcareous algae and conodonts. The upper unit of the formation is more argillaceous and has a typical carbonate / shale ratio of 30 -40%.

Waulsortian Limestone Formation generally consists of three units: basal and top units with isolated clustered banks set in offbank bedded limestones, and a main unit of massive coalesced bank limestone. The dominant lithology in this formation is commonly a very fine pale-grey massive, unbedded, biomicrite wackestone, with crinoids fragments and fenestrate bryozoa, frequently with large sparry cavities floored by multi-layered carbonate muds.

Rathkeale Formation consists of dark argillaceous limestones and shaly mudstones. The formation is unfossiliferous apart from trace fossils. The limestones are well bedded, brittle and have a (clisiophyllid) fracture cleavage.

Durnish Formation consists of uniform, blue, black, bioclastic limestones which commonly contain bands of chert nodules parallel to bedding. These well-bedded cherty packstones and wakestones contain abundant in-situ coral beds and brachiopod bands, the corals being chiefly large solitary Caniniid-Clysiophyllid types.

Viséan Limestone (Undifferentiated) consist of dark grey to black thinly bedded cherty argillaceous wackestones and packstones, locally rich in foraminifera and crinoids. The limestones are bioturbated, and skeletal remains show less evidence of abrasion than the grainstones interbedded with the volcanic.

Limestone is readily dissolved by rainwater. It is often highly permeable which results in bare limestone (karst) areas.

Old Red Sandstone formation from the Devonian / Carboniferous age also underlies the study area to the south of the River Shannon west of the River Maigue.

Igneous rocks consist of volcaniclastic lithologies. Volcaniclastic rocks consist of fragmented igneous rocks with various amounts of non-igneous rocks. The volcaniclastic rocks are blue, green, red and purple coloured fine to coarse grained occasionally porphyritic or amygdaloidal, brecciated and / or conglomeratic igneous rocks. The ratio between non-volcanic and volcanic components varies widely. The non-volcanic fragment assemblage consists of limestone, grit, slate and chert with limestone clasts being most abundant.

Table 3.1 Geological Sequence within the Constraints Study Area

Period	Formation	Rock Types	Map Symbol
Carboniferous (Dinantian)	Waulsortian Limestone	Pale grey massive unbedded biocrimite Wackestone	**WA**
Carboniferous (Dinantian)	Viséan Limestone (Undifferentiated)	Dark grey to black thinly bedded cherty argillaceous Wackestone and Packstone	**VIS**
Carboniferous (Dinantian)	Ballysteen Formation	Consists of dark well bedded bioclastic limestones.	**BA**
Carboniferous (Dinantian)	Durnish Formation	Consists of uniform, blue, black, bioclastic limestones which commonly contain bands of chert nodules parallel to bedding.	**DU**
Carboniferous (Dinantian)	Rathkeale Formation	Dark argillaceous limestones and shaly mudstones. The formation is unfossiliferous apart from trace fossils.	**RC**
Carboniferous (Dinantian)	Volcaniclastic	Igneous breccias or conglomerate with ashy limestone to limestone ash, grit, slate and chert.	**V**
Devonian /Carboniferous	Old Red Sandstone	Yellow to brown coarse grained sandstone, pebbly sandstone and conglomerate.	**ORS**

Karst Surface Features

The underlying bedrock, of Carboniferous Limestone within the study area is noted to be karstified. There are also known karst features in the study area. Bedding characteristics and adjacent bedrock formations can influence development of karst features.

A search of the database identified three distinct areas at Aughinish Island and Loughmore Common where karst features exist. These features are shown on Drawing Nos. CS-033 to CS-037 in Volume 2 of this Report. A site walkover was carried out within targeted areas of the study area to verify the desktop study data and to identify possible karst surface features. Based on desk study and site reconnaissance information, it was concluded that there does not appear to be areas where karst surface features indicative of high risk areas of karsification are present other than the three areas indicated above.

Quaternary Deposits

The Quaternary Geology of the study area is shown on Drawing Nos. CS-028 to CS-032 in Volume 2 of this report, indicating Bedrock outcrops in a large number of locations throughout the study area, with rock and karstified rock present at or near ground surface level where subsoils are predominantly absent. Quaternary deposits (soils & subsoils) within the study area are represented by peats, alluvium, marine deposits, glacial tills and fluvioglacial sand and gravels. Along the River Shannon there are mixed deposits of Marine Clay and Alluvial Deposits which is typical of material located in river estuaries. There has also been extensive deposition of alluvium along the other major rivers in the study area, the River Maigue and the River Deel.

Peat deposits

A small number of peat deposits are present within the study area. Peat deposits are located to the west of Bleach Lough and south of Dromore Lough. These vary from blanket peat to cutover peat to fen peat conditions.

Road construction in areas of wet peat soils generally needs to be designed for the provision of adequate drainage of both road surfaces and adjacent watercourses in all conditions. This may result in the construction of higher embankments which increase the footprint of the roadway, in particular where excavation of the underlying organic soils and replacement with general engineering fill is required. Such operations can significantly increase project demands on both material sources and transportation. Peat materials are unsuitable for reuse in construction and typically require disposal in acceptable locations such as peat tips or material deposition areas. Selection of environmentally suitable locations should be considered at design stage.

Alluvium

Alluvial materials are deposited by river action. These deposits are found within the study area along the River Maigue, the River Ahacronane, the River Deel and the River Shannon. At the location where the River Maigue enters the River Shannon there is a large floodplain which extends along the River Shannon to the east. There are small streams dispersed throughout the study area located in low lying areas which exhibit the same type of deposits described above. Refer to Section 3.5.3 Hydrology for further details on water courses in the study area where alluvial materials are potentially deposited.

Alluvial soils are problematic for construction work as they are normally unconsolidated (i.e. they have not been previously compressed by glaciers) and thus are moderately to highly compressible though not to the same extent as peat soils.

Marine Deposits

This material consists of material deposited and transported by ocean waves and currents in on-shore and offshore areas. Marine deposits are found in the study area along the River Shannon between Ringmoylan and Foynes.

These soils are problematic for construction work as they are generally normally unconsolidated, highly compressible and contain organic and inorganic deposits of fine grained material.

Glacial Till

Glacial tills (also known as boulder clay) cover a large portion of the study area and these are described as clay matrix with clasts of varying lithology. They consist of till derived from limestone; and till with gravel.

The geotechnical properties of Irish glacial tills are well-documented. These soils are generally well graded, variable with gravel lenses, with quite an absence of clay minerals. The clay fraction (rock flour) typically amounts to about 15% and the fines fraction (clay and silt) is about 30 to 40%. The glacial tills are generally over-consolidated, and therefore are of a low compressibility. These soils are usually firm to stiff, however due to their low plasticity, they are very susceptible to softening and deterioration in wet weather, especially if heavily trafficked. When the clayey tills are kept dry, they present relatively little difficulty to road construction.

Fluvioglacial Sands and Gravels

Areas of fluvioglacial sands and gravels (limestone) are dispersed evenly throughout the study area. These were deposited through the action of glacial meltwaters and are generally well sorted, rounded and are usually loosely packed. A large portion of the study area is characterised by glacial deposits and therefore the presence of other significant deposits of sands and gravels cannot be discounted. Any such deposits will be identified when the proposed route has been selected and a detailed site investigation of the route has been completed.

These granular materials do not present problems for road construction, provided the road alignment is kept above the water table. Generally, gravels provide good formation for pavement construction and are generally suitable for reuse. Water bearing sand and silt layers, where encountered, can be problematic.

Rock at Surface

Rock is exposed at the surface in a large number of locations over the study area. The overburden cover is very thin at a number of locations also. The rock exposed generally consists of limestone of the Waulsortian Limestone and Ballysteen Formation. Existing land drainage may have caused this limestone material to be karstified. Voids and the presence of continually weathering zones in rock can be problematic for stability for road and structural support. Design and construction efforts are significantly greater and require detailed investigation in accordance with the TII Project Management Guidelines.

Geotechnical Properties of Quaternary Deposits

The Geological Survey of Ireland quaternary maps were consulted and a windscreen survey confirmed the presence of any suspected soft ground.

Table 3.2 presents a summary of the properties of the soils discussed above. The main soils occurring within the study area are as follows:

Table 3.2 Typical Subsoil Properties

Soil Type	Strength	Compressibility	Use as Earthworks
Glacial Till (Coarse Grained)	Good	Low	Good
Glacial Till (Fine Grained)	Variable	Low-medium	Variable
Alluvium / Marine Deposits	Poor	High	Poor
Peat	Very poor	Very high	Not suitable

Geohazards

Soft Ground

As outlined above, peat, marine deposits and alluvium are present at a number of places within the study area. These soft deposits are normally unconsolidated rather than over-consolidated (compressed by glacial activity) and as such can be problematic for construction purposes. Some alluvial material may contain sandy or gravelly contents and behave as loose materials.

Engineering design of road embankments through soft ground, although not desirable, is generally feasible where soil thicknesses are modest. To accommodate road embankments and suitable pavement, excavation and replacement of soft soils, ground improvement or piled load transfer platforms may be required.

Unstable Ground

(i) Rock / Karst

Limestone bedrock has been identified throughout the study area. This is important to note as it is susceptible to karst formation. While a small number of karst features have been identified throughout the study area, from the desk study and site reconnaissance information, it was concluded that there does not appear to be areas where karst surface features indicative of high risk areas of karsification are present other that the three areas identified previously. The presence of additional karst features beneath the proposed route corridor should be determined by physical site investigations at the design stage.

It is notable that karst features can result from varying aquifer conditions and frequently occurs along the margins of vulnerable formations. The identified locations are all near boundaries of Waulsortian, Ballysteen and Viséan Limestone formations with others that are less susceptible. Groundwater physical and chemical conditions influence the dissolution of the purer bedded limestone.

(ii) Slope Stability

In order to assess the stability of existing and future rock cuttings, it is important to identify the orientation and condition of discontinuities and also the extent of weathering present during the subsequent phases of assessment and design. There are no identified reports of landslides within the study area according to the GSI database. Cutting stability in limestone rocks also needs careful consideration where Karst weathering is present.

(iii) Peat deposits

Stability of these may be affected by road construction. Fen peat, which is derived from groundwater conditions, is influenced by underlying aquifers.

Contaminated Land

Certain land uses, typically waste removal, automotive servicing or dismantling, industrial fabrication and manufacturing, railways, and abstraction of minerals or soil/rock resources can cause or lead to land contamination. This may affect soils and surface water or groundwater, with significant impacts on construction methodology where these become disturbed by development.

Disused pits and quarries may also be synonymous with subsequent periods of dumping and the likelihood of this has been assessed at route selection stage where potential routes run close to such features. Any location where consistent dumping

persisted over the years would generally be well known by locals and local authority staff.

No definite areas of contaminated land are currently known. A site walkover was carried out in certain areas of the study area to identify possible areas of contamination. It was concluded that there does not appear to be high risk areas where contamination is present based on the site walkover and desktop study carried out to date.

At design stage, areas should be assessed for the presence of hazardous constituents during ground investigations in cases where the storage of industrial plant, machinery, construction and/or demolition materials are identified or suspected.

Geological Heritage Sites

There are eight identified Geological Heritage Sites within the study area. There were no other sites identified as Areas of Geological Interest in the County Development Plan within the study area. The Geological Heritage Sites are shown on Drawing Nos. CS-028 to CS-032 in Volume 2 of this report.

Table 3.3 Geological Heritage Sites within the Constraints Study Area

Site ID	Site Name	IGH Theme	Description
1.	Foynes Island	IGH 9 Upper Carboniferous and Permian IGH 8 Lower Carboniferous	Gull island, Clare Shale and Tullig sandstone formations: Exposure of Clare shales containing the type localities for two goniatite fossil species
2.	Mantlehill (Deel River Section)	IGH 8 Lower Carboniferous	River sections exposing the base of the complex and a good thickness of the underlying Basal part of Waulsortian complex on Ballysteen Formation beds, showing initiation of banks.
3.	Deel River Section, Askeaton	IGH 8 Lower Carboniferous	River sections exposing the base of the complex and a good thickness of the underlying Basal part of Waulsortian complex on Ballysteen Formation beds, showing initiation of banks.
4.	Askeaton Quarry	IGH 3 Carboniferous - Pliocene Palaeontology IGH 8 Lower Carboniferous	A quarry with good exposures of the lower part of the Carboniferous limestones, the Waulsortian. The quarry has yielded an important conodont fauna together with a macrofauna.
5.	Foynes road section and inland outcrop	IGH 8 Lower Carboniferous	East of road quarries - recent road section and in 6 no. Private gardens [rock exposures]

…Table 3.3 Continued Over/

Table 3.3 (Cont.) Geological Heritage Sites within the Constraints Study Area

Site ID	Site Name	IGH Theme	Description
6.	Carrigogunnell (Massey's Bridge to the townland of Newtown)	IGH 8 Lower Carboniferous	120m thick volcanic succession found at Carrigogunnel composed of an upper and lower volcaniclastic unit, which is separated by a central sequence of five basaltic lava flows.
7.	Mungret Quarry	IGH 8 Lower Carboniferous	Viséan Shelf Limestone Quarry
8.	Tory Hill (Lough Nagirra)	IGH 7 Quaternary	10m thick laminated Late Glacial sediments in lough to the east of the hill, which may be a bog or lake basin

Other Designated Habitats

Barrigone SAC located approximately 5 km west of Askeaton, has the exposed Limestone pavement which is listed as a priority habitat.

Man-made Features/Contaminated Land

Mining Areas

No mining areas were identified within the study area in the GSI database or OSI historic map database.

Pits/Quarries

There were four quarries identified within the study area in the GSI database or from the aerial photographs.

Table 3.4 Quarries within the Constraints Study Area

Quarry Name	Location	Operator
Castlemungret Quarry	Castlemungret	Irish Cement
Roadstone Barrigone Quarry	Glenbane East	Roadstone Provinces Ltd.
Creeves Quarry Ltd.	Craggs	Creeves Quarry Ltd.
Joseph Hogan Ltd.	Ballylin	Joseph Hogan Ltd.

These quarries are all active and their locations are shown on Drawing Nos. CS-028 to CS-032 in Volume 2 of this report.

Landfills

There are no EPA registered landfills within the study area.

Economic Geology

Economic geology includes both former and existing quarry locations in addition to the presence of known or suspected mineral deposits. OSI historic mapping can be used to identify disused quarry locations if not still visibly evident in recent maps or in the field. Mineral locations can range from simple survey records, observations by geologists of minerals in veins at the surface to detailed exploration drilling in licensed prospecting areas.

The Department of Communications, Energy and Natural Resources holds details of prospecting licences for the country. A prospecting licence is a permit issued by the state, which allows the holder (the licensee) to prospect for minerals. The study area includes the active and surrendered prospecting licence areas 3544, 3445, 3608, 3488, 2845, 2872, 2579, 3489, 1302, 2762, 2835, 1583, 1584, 2696, 786, 3923, 3369, 3368, 2927, 635, 2638 and 3908. The prospecting licences were held for certain mineral deposits including base metals, barytes, and ores of silver.

Summary of Geological Constraints

The Study Area is generally underlain by Carboniferous Limestones which are identified as being karstified. Whilst some karst features are identified in the GSI database, no high risk areas of karsification have been identified. However the presence of additional areas of karsification should be identified at design stage.

The Quaternary cover consists of glacial tills, limestone rock outcrop, soft peat, alluvium and marine deposits which have varying degrees of suitability for use in road construction.

There are eight geological heritage sites located within the study area and four quarries. There are no active landfills or mines identified within the study area.

3.5.2 Water: Hydrology / Hydrogeology

Introduction

This assessment of the hydrological and hydrogeological constraints for the Foynes to Limerick Road Improvement Scheme has been prepared in accordance with the TII's *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2008)*.

The constraints study identifies the general hydraulic conditions over the study area and identifies any key features which may constrain the development of a new road.

Methodology

This assessment was carried out as a desk based review of available information on the study area.

Sources of information

- Aerial photography of study area (GSI, OSI and online sources); and
- Environmental Protection Agency online mapping. (http://gis.epa.ie/Envision);
- Environmental Protection Agency, (website www.epa.ie) – water quality data;
- Geological Survey of Ireland (website www.gsi.ie) - Quaternary Geology, Groundwater Vulnerability, Groundwater Wells, Aquifer and Karst Features;
- Limerick County Development Plan 2010-2016.
- Office of Public Works (2015 – flood maps website www.floodmaps.ie and National Catchment-based Flood Risk Assessment and Management Study 2015);
- Shannon River Basin Management Plan (2009 – 2015);
- Water Framework directive 2000 (website www.wfdireland.ie) – river status;

3.5.3 Hydrology

This section outlines the general hydrological regime in the study area. The hydrology of the study area is dominated by the River Shannon and its associated network of tributaries. The south bank of the Shannon Estuary forms the northern boundary of the study area. There are two main river catchments within the study area, namely the River Maigue and the River Deel. Both rivers flow in a northerly direction and discharge into the Shannon Estuary.

Surface Water Features/Catchments

The study area is located within the Shannon River Basin District (RBD) (Hydrometric Area 24) and specifically the Shannon Estuary South unit of management (UoM).

River Maigue Catchment

The River Maigue rises in the Ballyhoura Mountains, in north County Cork covering an overall catchment area of approximately 1,122km^2. The river catchment covers the eastern section of the study area. The river flows through the study area in a generally northern direction, flowing through the village of Adare and discharging into the Shannon Estuary 10km north of Adare. The main tributaries of the River Maigue within the study area are the Rivers Barnakyle, Dunnaman, Greanagh and the River Mondellihy.

The River Maigue is tidally influenced as far south as the village of Adare. Large

flood defences/embankments have been constructed along the lower reaches of the River Maigue and the River Barnakyle, to protect the surrounding agricultural lands. The draft Shannon Catchment Flood Risk Assessment and Management (CFRAM) map indicates that the lands to the east of the River Maigue benefit from flood defences up to the 5% (1 in 20 year) Annual Exceedance Probability event. Although flood defences along the west bank of the River are visible in site photographs, the lands are not included in the area benefitting from defences. Two lakes, Bleach Lough and Dromore Lough, are located within the catchment to the west of the River Maigue. Large areas of paleochannels are visible on the aerial photographs within the lower reaches of the river.

River Deel Catchment

The River Deel rises in the Mullaghareirk Mountains, to the south of the study area in County Cork. The river flows in a north-westerly direction towards the town of Newcastle West and then turns in a more north-easterly direction. It flows through the town of Rathkeale and northwards through the study area where it is joined by the Kissaghatrodaun and Cloghatrida Rivers. The River Deel discharges into the Shannon Estuary just north of the town of Askeaton. The overall catchment area is approximately 597km^2. Doohyle Lough, to the north east of Rathkeale, Graigues Lough, to the south east of Askeaton, and Milltown Lake to the north east of Askeaton, are located within the catchment. A number of catchment drainage schemes have been undertaken along the River Deel catchment for agricultural purposes.

River Ahacronane Catchment

The Ahacronane catchment is located within the western region of the study area and is the smallest of the three catchments with an overall catchment area of approximately 23km^2. The river rises within the uplands located to the south of the village of Kilcolman. The river flows in an easterly direction towards Creeves where it turns in a northerly direction discharging into the Shannon Estuary at Foynes.

There are a number of smaller rivers/streams along the northern sections of the study area which drain directly into the Shannon Estuary. These include the River Shanagolden, River Dromlohan and River Lismakeery. The area around the town of Foynes has a complicated catchment with a number of streams discharging into the Shannon Estuary at this point.

Water Quality Assessments

EPA Water Quality Monitoring

Biological water quality monitoring of rivers and streams across Ireland is carried out by the EPA using the Q-rating system. This rating system is used to monitor the ecological quality of rivers and streams using the macro-invertebrate communities within the river/stream channel. The Q-rating ranges from Q5-Q1 depending on the quality of the water as detailed in the tables 3.5 and 3.6 below:

Table 3.5 Q Value Rating System

Q Value (Biotic Index)	Quality Status	Quality Class	Condition
Q5, Q4-5, Q4	Unpolluted	Class A	Satisfactory
Q3-4	Slight Pollution	Class B	Transitional
Q3, Q2-3	Moderately Polluted	Class C	Unsatisfactory
Q2, Q1-2, Q1	Seriously Polluted	Class D	Unsatisfactory

Table 3.6 Q Value Rating for Rivers in study area

River	Location	Q-Rating			
		Pre 1990	1990 – 2000	2000 - 2010	2010 +
River Maigue Catchment					
Barnakyle River	Barnakyle Bridge	4	-	-	-
	Br SE of Clarina	3-4	3, 2-3	3	3
Maigue River	Br (ford) nr Caherass Ho	3-4, 4	-	-	-
	Castleroberts Br	3-4	3, 3-4	3-4, 4	4
Greananagh River	Coolagh Bridge	3-4	3, 3-4	3, 3-4	3
Shannon Estuary Catchment					
Ahacronane River	Br N of Lissatotan	3	3	3	3
	Br N of Nutgrove Ho	3	-	-	-
	Br SW of Barrigone	3	3	3	3
Clonshire River	Milltown Br	3	3, 3-4	3	-
	Drehidnaman Br (RHS)	3	3	3	3
	Drehidnaman Br (LHS)	1,3	3	3	3
	Tuogh Br	3-4	3, 3-4	2, 3-4	3
Lismakeery Stream	Br SE of Tomdeely	-	3, 3-4	3	3
Deel River	Kilcool Bridge	3, 3-4, 4	3-4	3, 3-4,	4
	Rathkeale Bridge	3, 3-4, 4	3-4	-	-
Shanagolden River	Br S of Shanagolden	-	3-4, 4	3,4	4
	Br SE of Shanagolden	3-4	-	-	-
	1.3 km downstream	2-3	-	-	-
	Br NW of Stokesfield	3	3-4, 4	3-4,4	4

The biological surveys undertaken over the catchments illustrate an overall poor ecological status of the rivers and streams in the study area. Q values were generally given 3 and/or 3-4, which illustrate a degree of pollution occurring within the catchments. The River Deel and Maigue showed slight improvements in water quality during the most recent monitoring events, with Q ratings of 4 (unpolluted waters) reported within the study area. The Shanagolden River flowing within the western regions of the study area recorded good water quality, with Q ratings of 4 recorded along the river since 2006.

Water Framework Directive

The Water Framework Directive (WFD) 2000/60/EC established a number of water management areas which developed associated water management plans. The main objective of the WFD is to achieve and maintain "good Status" of all water bodies by 2015 and have no deterioration in water quality of any waters. Under the WFD there are 23 sub catchments within the study area. Water body classifications within the study area under the WFD are detailed in Table 3.7.

Table 3.7 WFD River Status

Name	Code	Macroinvertebrates	Ecological Status	Fish Status	Physio-chemical	Overall Status
Maigue Catchment						
Barnakyle	IE SH 24 1704					
Greananagh	IE SH 24 1680					
Adare South	IE SH 24 1688					
Nagirralough	IE SH 24 1120					
Maigue	IE SH 24 1675					
Dunnaman	IE SH 24 1595					
Croagh	IE SH 24 162					
Clonshire Finshenagh	IE SH 24 807					
Shannon Estuary South Catchment						
Carrig	IE SH 24 1712					
Pallaskenry	IE SH 24 50					
Washpool	IE SH 24 254					
Adare North	IE SH 24 812					
Roxborough	IE SH 24 382					
Askeaton	IE SH 24 1673					
Lismakeery	IE SH 24 1726					
Shanagolden	IE SH 24 87					
Shanid	IE SH 24 1392					
Shanagolden	IE SH 24 1055					
Ahacronane	IE SH 24 1170					
Milltown	IE SH 24 1075					
River Deel Catchment						
Deel	IE SH 24 1670					
Doohylelough	IE SH 24 198					
Kissaghatrodaun	IE SH 24 1070					

	High status
	Good status
	Moderate status
	Poor status

The majority of the river catchments have poor ecological status, with the exception of the River Maigue, River Nagirralough, Adare North, River Shanid, and River Shanagolden which have moderate or good ecological status.

Flooding

A desk based review of the flood risk within the study area was carried out using the draft Shannon Catchment based Flood Risk Assessment and Management (CFRAM) study maps, the OPW Preliminary Flood Risk Assessment (PFRA) mapping and the

OPW flood records (www.floodmaps.ie). Within the study area there have been records of various flooding events which resulted from both tidal and fluvial influences. Refer to Drawing Nos. CS-043 to CS-047 in Volume 2 of this report.

Table 3.8 Historical Flood Data

Catchment		Comments
River Maigue Catchment		
Adare	Seven flood events (1946, 1973, 1995, 1997, 1999, 2014)	Tidal
Clarina	Three flood events (1992); two recurring events (one at Masseys bridge west of Clarina)	Tidal
River Deel Catchment		
Askeaton	Recurring within a number of locations in the town.	Tidal & Fluvial
Rathkeale	Seven flood records (1968 & 1969); four recurring events. Flooding reported at Kilcool bridge NW of Rathkeale	Fluvial
Shannon Estuary Catchment		
Foynes	Seven flood records (1995, 2002, 2005, 2014); four recurring events	Tidal & Fluvial

There have been a number of incidences of local floods within the study area on smaller river catchments which are a result of frequent and scattered rainfall events. In addition, the historic OSI 6-inch maps were reviewed and areas "*Liable to Floods"* were identified. These include areas bordering the Shannon Estuary (reported to flood during spring tide), within the townlands of Dysert, Robertstown and Strokesfield within the vicinity of Foynes and within the vicinity of the Ballymorrisheen Marsh and Doohyle Lough. Under the CFRAM study a number of Communities at Risk (CAR) and Areas for Flood Risk Review (AFRR) were reviewed and designated as Areas of Potential Significant Risk (APSR) of flooding[1]. Within the study area there are six APSR areas identified, as detailed in Table 3.9:

Table 3.9 Areas of Potential Significant Risk

Site ID	Name	Draft Flood Risk Review
CAR 3	Adare	CAR & APSR
CAR 4	Askeaton	CAR & APSR
CAR 22	Clarina	CAR & APSR
CAR 29	Foynes	CAR & APSR
CAR 50	Rathkeale	CAR & APSR
CAR 32	Kildimo	CAR

Whilst Kildimo was identified as a CAR and Patrickswell as an AFRR, these villages were not designated as APSR within the updated management study. Hydraulic models of the areas identified as ASPRs were developed to determine the fluvial and tidal flood extents with the draft Shannon CFRAM maps dated March 2015. The draft maps indicate that significant sections of the study area, in the vicinity of the

[1] Shannon Catchment-based Flood Risk Assessment and Management (CFRAM) Study Flood Risk Review Report, Jacobs (2012).

modelled rivers, are at risk of both coastal and fluvial flooding, including the urban areas identified as ASPRs.

The PFRA mapping indicates that there are a number of areas within the study area at risk of pluvial flooding, however, no significant flood flow routes are indicated on the map. The PFRA map also indicates the area in the vicinity of Doohyle Lough, to the north east of Rathkeale, is at risk of groundwater flooding. Aughinish East, to the east of Foynes and Craggs, adjacent to the N69 to the south east of Foynes are also at risk of groundwater flooding. Refer to Drawing Nos. CS-044 to CS-047 in Volume 2 of this report.

Surface Water Amenity Value

The rivers and streams within the study area are considered to have amenity values in terms of community usage, i.e. adjoining walks, wildlife etc. Fishing on the River Maigue and River Deel is currently reported as closed (2015) for salmon and sea trout fishing under salmon conservation measures which were introduced nationally by Inland Fisheries Ireland in 2006.

3.5.4 Hydrogeology

Aquifer Classification

The GSI currently identifies seven aquifer classifications within the study area. Table 3.10 outlines the bedrock aquifer classifications that occur in the study area for the different bedrock formations. Aquifer mapping for the area is illustrated in Drawing Nos. CS-038 to CS-042 in Volume 2 of this report.

Table 3.10 Aquifer Classification

Aquifer Classification	Code	Bedrock Formations
Regionally Important Aquifer - Karstified conduit	Rkc	WA
Regionally Important Aquifer – Karstified Diffuse	Rkd	WA (East of River Maigue)
Locally Important Aquifer – Karstified	Lk	WA (Greenish Island & Courtbrown pt)
Locally Important Aquifer – Bedrock which is moderately productive only in local zones	Ll	BA, DU, ORS, BT, BV, RK, PA, SG
Locally Important Aquifer – Bedrock which is generally moderately productive	Lm	VIS
Poor Aquifer – Bedrock which is generally unproductive except for local zones	Pl	MH, RM
Poor Aquifer – Bedrock which is generally unproductive	Pu	CS

Regionally Important Bedrock Aquifers

There are two classifications of regionally important aquifers present, namely:

- Regionally Important Aquifer - Karstified conduit (Rkc); and
- Regionally Important Aquifer – Karstified Diffuse (Rkd).

Karstified conduit flow (Rkc) is classified where large conduits are present and the groundwater flow is concentrated within these flow channels. Karstified diffuse flow (Rkd) is present where the groundwater flow is considered to be more diffuse and regular. Waulsortian Limestones (WA) constitute one of the most important aquifers in County Limerick and are classified as Regionally Important with both conduit and

diffuse flow. The limestone aquifer underlying the study area is predominantly karstified with conduit flow (RKc), however the degree of karstification reduces towards the east of the study area and subsequently these rock formations are classified as having diffuse flow (Rkd). The regionally important aquifer covers over 60% of the study area from Aughinish Island in the west to Limerick City in the east, covering the central section nearly as far south as Rathkeale. This aquifer shows evidence of karstification, and dolomitisation which enhances permeability within the bedrock. Large abstraction rates have been developed within the aquifer and it is reported as being capable of supplying regional schemes.

Locally Important Aquifer

Locally important aquifers are subdivided into three categories over the study area:

- Locally Important Aquifer – Karstified (Lk);
- Locally Important Aquifer – Bedrock which is generally moderately productive (Lm); and
- Locally Important Aquifer – Bedrock which is moderately productive only in local zones (Ll).

The locally important aquifers underlying the study area are made up of the Devonian Old Red Sandstone and the argillaceous limestones, located in the northern, southern and western bounds of the study area. Karstified locally important aquifers are identified on Greenish Island and just north of Adare village within the Waulsortian Limestones. These are classified as locally important only due to the restricted extent of the rock units.

Poor Aquifers

Poor aquifers only cover a small section of the study area to the west of Foynes and just north of Pallaskenry. These aquifers generally provide small yields only, capable of supplying single houses and/or small farm holdings. The poor aquifers are sub-divided into:

- Poor Aquifer – Bedrock which is generally unproductive except for local zones (Pl); and
- Poor Aquifer – Bedrock which is generally unproductive (Pu).

There are no gravel aquifers identified over the study area.

Karstification

Karstification is a process whereby fissures and fractures in the limestone bedrock are enlarged through the action of groundwater as it passes through them and dissolves the limestone. Groundwater flows are concentrated within these conduits resulting in zones of high permeability.

There are three identified karst features in the GSI database – Refer to Drawing Nos. CS-033 to CS–037 in Volume 2. Two are located on Aughinish island, where drilling of boreholes in the area reported extensive karstification. A third feature is located at Loughmore Common in the eastern section of the site on the outskirts of Limerick City and is reported as being a turlough or seasonal lake. Whilst further karst features have not been reported by the GSI in the study area, additional karst features may be present in some areas due to the nature of the underlying bedrock and thin subsoil coverings present.

Groundwater Vulnerability

Groundwater vulnerability characterises the geological and hydrogeological conditions to determine the ease by which groundwater may become contaminated by human activities. As part of this assessment, the Groundwater Vulnerability Map for County Limerick was consulted and reviewed. This indicates that a large proportion of the study area is considered to have High to Extreme Groundwater Vulnerability. This is a consequence of the extensive areas where karst bedrock is exposed and/or where subsoils are reported as being shallow.

There are areas of moderate and low groundwater vulnerability present along the River Maigue estuary as far upstream as Adare village and beyond. This is in areas where alluvium deposits are present. Moderate/low vulnerability is also identified within the area south of Rathkeale where thickness of the glacial till is reported greater than 5 - 10 metres. Groundwater vulnerability is shown in Drawings Nos. CS-033 to CS-037 in Volume 2 of this report.

Groundwater Bodies (GWB)

There are ten groundwater bodies identified within the study area, as outlined in Table 3.11.

These are predominantly reported to have poor quality status and being at risk. The majority of the groundwater bodies are unconfined and only confined in areas where the subsoils are sufficiently thick.

Table 3.11 Groundwater Bodies (GWB)

Groundwater Body	Location	GWB Quality Status	Risk Status
Ballylongford	South-west of Foynes	Good	At Risk (1a)
Askeaton	Central area	Poor	At Risk (1a)
Ballysteen	Northern region	Good	Probably at Risk (1b)
Kildimo	Eastern region	Poor	At Risk (1a)
Limerick City Southwest	Eastern bounds	Poor	At Risk (1a)
Patrickswell	South-east region	Good	Probably at Risk (1b)
Limerick Urban	Eastern bounds	Poor	At Risk (1a)
Fedamore	Southern regions	Poor	At Risk (1a)
Newcastle West	South of Rathkeale	Poor	At Risk (1a)
Shanagolden	South-west region	Poor	At Risk (1a)

Groundwater Resources/Supply

The study area is serviced by private and public water supply schemes, which are surface water and groundwater fed. Whilst the majority of the study area is serviced by surface water, a number of smaller group schemes within the area are groundwater fed. These include the Barrigone, Cappagh and Croagh Group Water Schemes.

In addition, given the rural nature of the study area, it is known that a significant number of houses will be serviced by private groundwater supply wells. Whilst the individual private wells may be considered to have low volume abstractions, large

abstractions from private sources may occur for farms, creameries, hotels, and industrial premises.

Groundwater Flows

The generalised direction of groundwater flow across the study area is northwards to the Shannon Estuary with the exception of areas to the east and west where flow is to the Maigue or Deel Rivers and some areas along the southern boundary where the groundwater gradient is southwards. Hydraulic gradients across the study area are generally low, particularly where karst conditions exist, except in areas where confined conditions exist. Recharge occurs diffusely through the overlying subsoil and directly through bedrock outcrops which are extensive throughout the study area. Groundwater discharges to streams and springs where the subsoil is not too thick or impermeable. There are numerous records of springs in the study area which are evident in both the GSI and historic OSI maps for the area. The occurrence of springs is concentrated in the central area inside the Askeaton groundwater body.

Regionally Important Aquifer

Groundwater flow is through fissures, faults, and joints within the bedrock. There is no intergranular permeability within the underlying aquifers. The water table is expected to lie within 1-7 m of ground level. Groundwater intersects the surface where fens and marsh lands are located, such as Ballinvirick Marsh or the Askeaton Fen Complex. Given that the aquifer is karstified, an epikarstic layer of a few metres in thickness is likely to exist which accepts recharge and has large storage capabilities. Flows are concentrated in this layer with water levels variable. Deeper groundwater conduits are also reported within the regionally important karstified aquifer. Groundwater flow paths are expected to be highly variable depending on the extent of karstification present and the degree of interconnection between fissures. Due to the nature of the karst aquifers, surface water and groundwater interchanges are likely to exist in certain areas.

Locally Important Aquifers

The local important aquifers are predominantly made up of low transmissivity rocks with local zones of enhanced permeability. Groundwater flow occurs within the fissures, faults and joints within the bedrock. Recharge of the aquifers is through diffuse sources with rainwater percolating through the subsoils and recharging directly into the aquifer where bedrock is exposed. The main groundwater flow is concentrated in the upper horizons of the bedrock where the rock is weathered and the area of interconnected fractures below. Groundwater travel distances within the locally important aquifers are expected to be in the order of 100m – 300m, generally horizontal.

Groundwater Dependent Terrestrial Ecosystems (GWDTEs)

There are a number of groundwater dependent terrestrial ecosystems located within the study area. The Askeaton Fen (SAC) complex consists of a series of small fens within the area northeast of Askeaton, south west of Pallaskenry and those located north of Rathkeale which were formally designated proposed National Heritage Areas (pNHA) and are now incorporated into the overall SAC complex. These fens are considered to be GWDTEs. The Curraghchase Woods SAC includes a series of lakes and fens running the length of the site which adds to the diversity of the site and these fens may be hydraulically linked to underlying groundwater.

A number of pNHAs are present within the Askeaton Fen complex (pNHA 002279) and are assumed to have groundwater interactions, namely: Ballinvirick Marsh

(pNHA 001427), Cappagh fen (pNHA 001429), Ballymorrisheen Marsh (pNHA 001425) and Gorteenamrock Fen (pNHA 001433). Dromore and Bleach Loughs (pNHA 001030) are groundwater fed and groundwater is also locally discharging to the Shannon Estuary. These areas are further detailed in the ecological section 3.9.

3.5.5 Summary of Hydrogeological and Hydrological Constraints

The study area is located in the catchment of the River Shannon and is hydrologically dominated by the River Deel and River Maigue which drain over 80% of the study area. The water quality and ecological status of much of the river and stream catchment is considered poor. Under the Water Framework Directive these catchments need to achieve good status by 2015. Surface water abstractions are present at a number of points within the catchment, such as Askeaton and Adare and as such the quality of the water needs to be maintained. Flooding is a key constraint within the study area and a number of locations have been identified as being at risk of fluvial, tidal, pluvial and groundwater flooding in the OPW PFRA mapping and the Shannon CFRAM draft maps.

The majority of the study area is underlain by a regionally important karstified aquifer which makes up over 80% of the area. Groundwater flow is likely to be highly variable depending on the degree of karstification present. High and Extreme areas of groundwater vulnerability cover much of the study area where the bedrock is exposed and thickness of the subsoil cover is thin. There were a limited number of karst features identified within the GSI database; however given the nature of the underlying bedrock additional karst features are likely to be present in certain areas. The water quality status of the underlying groundwater bodies is predominantly reported as poor. Groundwater is used throughout the study area as a water supply, servicing both public and private group water schemes. Groundwater discharges into the surface water bodies over the study area and the various groundwater dependent terrestrial ecosystems. These GWDTEs would be considered to be key ecological constraints that would be extremely sensitive to impacts on hydrogeology.

3.6 Socio Economic

3.6.1 Introduction

An appraisal of the main socio-economic forces in operation within the study area has been carried out in order to identify all potential constraints in the area. This chapter outlines the socio-economic profile of the study area and includes a review of the existing environment, the populations, profile and key economic features.

3.6.2 The Receiving Environment

Within the study area the main population centres are as follows:

- Rathkeale;
- Askeaton;
- Adare;
- Patrickswell;
- Pallaskenry; and
- Foynes.

Rathkeale, Askeaton and Adare have the largest populations recorded with 1,550, 1,149 and 1,106 persons respectively according to the 2011 Census. Patrickswell, Pallaskenry and Foynes have lower populations of 841, 664 and 542.

Limerick City is located directly outside the eastern boundary of the study area and had a population in 2011 of 87,081 (including the suburban areas).

3.6.3 Economy, Business and Tourism

Commerce, insurance, business and finance services are predominant throughout the study area and these services are important to the economy of the local communities. Manufacturing and construction are also major activities in the area followed by agriculture and forestry. Specifically, some of the large private businesses in the study area include:

- Shannon Foynes Port Company;
- Mullock & Sons Shipbrokers, Foynes;
- Rusal Aughinish Ltd, Askeaton;
- Adare Manor Hotel and Golf Resort;
- Foynes Engineering Ltd.;
- Nestlé's Wyeth Nutrition;
- OCE Innovative Engineering, Kildimo;
- ABP Food Group, Rathkeale; and
- Greaney Concrete Products Ltd., Shanagolden.

The Shannon Estuary provides a strategic transit gateway whilst Shannon Foynes Port facilitates trade from many industrial sectors, supporting the continued sustainability and competitiveness of the region. The existing deep water facility at Foynes Port provides a transit hub for a diverse range of industries in the region including manufacturing and extractive industries. The role and function of the port and estuary are expected to increase in future years.

The villages and towns within the study area support public houses, hotels, shops, post offices, petrol stations, churches, restaurants, credit unions, community centres, playing pitches, Garda stations, guesthouses, libraries and schools. Additionally, there are a number of garden centres, racehorse breeders, car garages and horticulture businesses which provide employment for residents of the study area and beyond.

County Limerick possesses a wide range of cultural and natural tourist attractions with a high concentration of castles and ancient archaeological remains along with various recreational activities including walking, cycling, fishing and hiking routes. Some of the main tourist attractions within the study area include:

- Foynes Flying Boat and Maritime Museum;
- Curraghchase Forest Park;
- Adare Village;
- Adare Manor Hotel and Golf Resort;
- Askeaton Castle and Franciscan Friary;
- Nature Trails of Aughinish; and
- Great Southern Trail

Limerick is often referred to as "Ireland's Sporting Capital", insofar it supports a wide range of excellent quality sports facilities including an Olympic sized swimming pool, Thomond Park Rugby Stadium, Gaelic Grounds (GAA), Market Fields (Soccer), Limerick Greyhound Stadium and Limerick Racecourse.

The Foynes Flying Boat & Maritime Museum contains a range of exhibits and illustrations portraying the world of transatlantic air travel including the only Boeing 314 Clipper Flying Boat replica in the world. The Curraghchase Forest Park is a woodland estate and lake surrounding the ruins of the 18th century House of Curraghchase. The park comprises 313 hectares of mixed woodland and 8km of trails. Another key tourist attraction in the study area is Adare Village. The village, dating back to the 1200s, has been noted for its picturesque setting linked to Adare Manor. Askeaton Castle is a late 12th century ruin situated along the River Deel on a small rocky island. The castle is one of the finest medieval secular buildings in Ireland.

The Aughinish Nature Trail is a self-guided nature trail along the south bank of the Shannon Estuary. Highlights of the trails include winter migrant bird watching, a butterfly sanctuary and heath and meadowland habitats. The Great Southern Trail is a 35km walking and cycling trail following the route of the closed Limerick – Tralee railway line. The route extends from the intersection with the Foynes- Limerick rail line north of Rathkeale through to Abeyfeale. It is proposed to extend it to Tralee and Fenit in County Kerry.

Limerick has considerable potential for tourism, which remains largely untapped. In recent years there have been initiatives developed to address the shortcomings of tourism in the area. Curraghchase Forest Park has been upgraded recently with new pathways, cycleways and recreational facilities whilst the Foynes Flying Boat and Maritime Museum is another focus of tourism development in the Limerick area. The Limerick County Development Plan 2010-2016 has highlighted the Shannon Estuary as an area with potential for development as a tourist destination.

3.6.4 Transportation and Existing Infrastructure

The main road infrastructure within the study area is comprised of the N69 National Secondary Road and the N21 National Primary Road. The N69 travels along the northern extent of the study area passing through Mungret, Clarina, Kildimo and Foynes and bypassing Askeaton. The N21 travels along the southern extent of the study area and passes through Adare, Croagh and bypasses Rathkeale. The Regional Road R518 runs north to south of the study area and connects the towns of Askeaton and Rathkeale. These roads are indicated on Drawing Nos. CS-003 to CS-007 in Volume 2 of this report.

Additionally the natural harbour of the Shannon Estuary is an important national transport asset in the study area. Shannon Foynes Port is a significant deep water cargo port and contains a jetty for Rusal, the alumina factory at Aughinish and therefore is an important element of infrastructure in the area and the country. Shannon International Airport is within easy reach of the study area and is located 20km away from Mungret.

3.6.5 Community Facilities and Amenities

The study area contains many community facilities including a number of post offices, churches, cemeteries, creches and schools.

Approximately 15 primary schools and 4 secondary schools are located within the study area.

Additionally, there is a wide range of recreational facilities within the study area including:

- 10 GAA clubs;
- 10 Soccer clubs;
- 3 Rugby Clubs;
- 2 Golf Courses;
- Cricket Club;
- Adare Camping and Caravan Park;
- Curraghchase Forest Park with Caravan and Camping Park;
- Clonshire and Clarina Equestrian Centres;
- Rosemount Shooting School, Rathkeale;
- Nature Trails of Aughinish; and
- Great Southern Walking and Cycling Trail.

In the main, these facilities are an integral part of their respective communities and it is important that any potential interference with them is kept to a minimum.

The potential of Curraghchase Forest Park for further development as a recreational facility has been identified and the park has received investment for improving the walking and cycling amenity.

Rosemount Shooting School, located in Rathkeale, was the first shooting club in Limerick and provides lessons in clay pigeon shooting, archery and crossbow shooting. Clonshire, Doohyle and Clarina Equestrian Centres provide horse riding lessons, pony treks and camping facilities.

The following walking routes are located within the study area:

- The Curraghchase Forest Park;
- Aughinish Nature Trails;
- Great Southern Trail; and
- The Irish Heart Foundation has developed "Slí Na Sláinte" walking routes in Adare (River Maigue Walk) and Rathkeale, catering for a wide range of ages and walking capability.

The locations of these community facilities are presented in Drawing Nos. CS-048 to CS-052 in Volume 2 of this report.

3.7 Planning Development and Land Use

3.7.1 Introduction

The proposed Foynes to Limerick Road Improvement Scheme is not listed specifically in the Limerick County Development Plan 2010-2016 as the Plan predated the TEN-T regulations and scheme. It has been included in the more recent Adare, Askeaton, Southern Environs and Patrickswell Local Area Plans. However there are numerous objectives within the Limerick County Development Plan and other Regional and Local Plans for road improvements along the N21 and N69 which the scheme would support. It is pertinent within the context of a Constraints Study to outline any county and local planning policy issues and pending or awarded planning decisions which may have an impact on the identification of feasible route corridors.

3.7.2 Local and County Development Plan Policy

Land-Use Policies

The overall strategic aim of the Limerick County Development Plan 2010-2016 is to promote the sustainable development of the county and the settlements whilst protecting the environmental assets of same.

In order to promote economic development whilst protecting environmental assets and resources, the County Development Plan contains broad planning policies. These include policies designed to promote and develop sustainable transport, community facilities and employment opportunities. Further policies provide guidelines for rural settlement and to protect the landscape and visual amenity, the natural heritage and the built and architectural heritage.

By following the phases outlined in the Transport Infrastructure Ireland Project Management Guidelines 2010 and the TII's Environmental Assessment and Construction Guidelines all potential environmental impacts will be minimised.

Urban Development Limits and Zoning Strategies

The Strategic Integrated Framework Plan for the Shannon Estuary highlights strategic development locations within the study area. These are located in Foynes, Aughinish and north of Askeaton. Refer to Drawing No. CS-053 in Volume 2 of this report.

According to the Local Area Plan Zoning Maps for Adare, Askeaton, Southern Environs, Patrickswell and Rathkeale the study area contains areas with the following land uses:

- existing and proposed protected structures;
- amenity;
- mixed use;
- new residential;
- existing residential;
- residential serviced sites;
- education and community;
- open space,
- industry; and
- agricultural land.

In addition to these areas, the zoning maps for Adare, Patrickswell, Southern Environs and Rathkeale highlight areas zoned for enterprise and employment.

A number of zoned Architectural Conservation Areas (ACA) are located within Askeaton, Adare, Ballysteen, Foynes and Rathkeale within the study area which are identified in the County Development Plan and Local Area Plans. See Drawing No. CS-054 in Volume 2 of this report.

3.7.3 Housing and Development

The study area within County Limerick contains a number of commuter villages such as Patrickswell and Clarina. There is also a significant amount of ribbon development along the national, regional and local roads. An example of such ribbon development is the townland of Glenbane East situated along the N69 outside of Foynes. Housing at Croagh and Kildimo are further examples of ribbon development. Such strips of ribbon development are considered to be a constraint.

There are many businesses within the study area. Most of these businesses such as local shops, public houses and service stations are typical of most rural communities however the study area also contains other industries and businesses such as those listed in 3.6.3 of this report.

The study area also contains many community facilities such as churches, cemeteries, schools, a museum, sporting grounds, hotels and golf courses.

An examination of the Limerick City and County Council planning lists was undertaken in 2015 to identify any pending or awarded planning permissions within the study area. These are mapped on Drawing Nos. CS-055 to CS-059 in Volume 2 of this report.

3.7.4 Land-Use

The primary land-use in County Limerick is agricultural. The total land area is approximately 275,000 ha of which 73% is used for agriculture. The average farm size in Limerick is 34.5 ha compared with 32.7 ha for the whole country. Dairy farming is the major farming enterprise on a value basis although the number of specialist dairy farming dropped from 2,300 to 1,400 between 2000 and 2010 in Limerick. Beef farming is the predominant farm enterprise in the county with dairy still quite significant.

The study area is within the "Golden Vale" which is one of Europe's most fertile and productive grassland and dairying areas (Teagasc, 2015). Land is a particularly important natural resource within the study area and consideration will be applied to minimise the impact of the preferred route on the farming community.

3.7.5 Land Ownership

A land search will be carried out at the Design stage of the development to comprehensively identify ownership of the land in the vicinity of the preferred route. It is inevitable that land holdings will be impacted by the development. However the scheme will be designed to minimise land take and severance.

3.8 Agriculture and Agronomy

3.8.1 Introduction

This section identifies agricultural constraints within the study area as being the key farm enterprises most affected by the development of a new road scheme.

3.8.2 Methodology

Under the TII Project Management Guidelines (2010) there is a requirement to identify key agricultural farm types as part of the constraints to be considered. This is required to avoid unnecessarily impacting farms considered as sensitive or of importance in terms of type or scale. Key enterprises of a sensitive nature would include equine enterprises where the holding is involved in the breeding or training of high value bloodstock. Additional enterprises of an important nature would include dairy farms where land acquisition and land severance due to a road alignment may have a profound effect. Further enterprises such as education / training institutions, pig, poultry or horticultural units would also be regarded as key enterprises.

The methodology for the preparation of this report is based on a desktop review of the study area, local consultation and a roadside survey.

The desktop review involved a survey of available mapping for the study area and aerial photography (2013). Local consultation included a number of meetings in August 2014 with representatives of the agricultural sector in Limerick. A review of the study area identified gaps in the level of coverage. A roadside survey of these areas was conducted to identify potential constraints for consideration in this report.

3.8.3 Description of the Existing Environment

The study area (refer to Drawing No. CS–002 in Volume 2 of this report) is primarily rural in nature apart from the outskirts of Limerick city and a number of towns and villages including Foynes, Askeaton, Pallaskenry, Patrickswell, Adare and Rathkeale.

The study area is generally low-lying, of a flat to undulating topography with limestone derived agricultural soils. In the west of the study area, between Askeaton and Rathkeale, agricultural soils are predominantly well drained, somewhat shallow and are ideally suited to grassland use. Extending inland from the Shannon estuary and bordering the River Maigue as far as Adare village the agricultural soils are derived from alluvial deposits. The high silt content of these soils has resulted in poor drainage which can limit land use although good management can still ensure good productivity. In the remaining area, agricultural soils are predominantly well drained, with a deep profile and good moisture holding capacity. These soils are ideally suited to grassland production.

Land use in County Limerick is almost entirely grassland-based with farming practices in the study area predominantly beef related. There is a dairy sector comprised of dairy farms operating at or in some cases significantly above the national average dairy farm size. There is a strong equine industry in County Limerick and the study area is well represented by Limerick Racecourse, equestrian centres and several prominent stud farms and horse trainers.

3.8.4 Key Agricultural Constraints

The methodology for the identification of key agricultural constraints input has focused on those farming enterprises considered to be of a sensitive nature or of

importance in terms of type or scale. This resulted primarily in identifying those farms within the dairy sector and equine farms involved in breeding and training activities. A desktop exercise was also conducted to identify intensive farms involved in pigs, poultry and other farm enterprises. Refer to Drawing Nos. CS-060 to CS-064 Volume 2 of this report.

Dairy

The agricultural constraints in the dairy sector consist of both individual dairy farms and clusters of farms in close proximity to each other. The larger dairy farms in the study area have herd sizes of over 70 cows ranging up to approximately 300 cows. Further identification of dairy farms using aerial photography and windscreen surveys was based on comparable farm sizes and experience. The dairy constraints are generally to be found across the study area with a predominance of key dairy farms located in the west of the study area and bordering the N21. Dairy constraints included a number of large individual dairy farms together with clusters of key dairy farms:

- Cooper Hill farm, Clarina village;
- Pallaskenry Agricultural College;
- Shanagolden - Askeaton - Rathkeale area;
- Cappagh village to Adare area; and
- Patrickswell - Clarina area.

Equine

The equine sector in County Limerick comprises primarily of those involved in the breeding and training of thoroughbred racehorses for National Hunt and Flat racing in Ireland and abroad. Key equestrian enterprises include leading horse trainers and stud farm holdings as identified within the study area. Other key equestrian constraints include the following:

- Limerick Racecourse;
- Ballysteen Point to Point;
- Equestrian centres;
    - Clarina Equestrian Centre;
    - Clonshire Equestrian Centre, Adare; and
    - Dohyle House Stud, Cappagh.

Pigs / Poultry

A review of EPA licences required for key farm enterprises involved in pigs or poultry concluded there were no such farms in the study area.

Horticultural

A review of available mapping concluded there were a number of horticultural constraints in the study area with commercial horticultural activities including the following:

- Van Veens Garden Centre, Patrickswell; and
- D&M Garden Centre, Croagh.

Education / Training institutions

The agricultural college at Pallaskenry is run by the Salesian Fathers and extends to approximately 210 hectares. The college offers a number of courses in both Agriculture and Farm Machinery in conjunction with a number of educational bodies including Limerick Institute of Technology and Teagasc. The college includes a significant dairy herd, suckler beef herd, beef cattle and sheep flock.

3.9 Ecology

3.9.1 Introduction

The study area for the Foynes to Limerick Road Improvement Scheme is bounded to north by the Lower River Shannon Special Area of Conservation (site code no. 002165) and River Shannon and River Fergus Estuaries Special Protection Area (site code no. 004077). The Lower River Shannon SAC boundary extends to include the River Maigue as far as Adare, while the SPA boundary extends to just north of Ferry Bridge on the N69 route. One of the principal ecological constraints and challenges in the scheme will be the crossing of the River Maigue within the SAC in a manner which does not result in any significant impact on the site's integrity or any of the qualifying interests of the European Sites.

Refer to Drawings Nos. CS-065 to CS-079 in Volume 2 of this report.

The Lower River Shannon SAC boundary also extends to include the estuary of the River Deel to the N69 at Askeaton and the estuary of the River Ahacronane to the N69 at Rinnculia. The qualifying interests for the Lower River Shannon SAC comprise a large number of habitats and species including estuaries and mudflats, alluvial forests (a Priority habitat), salmon, lamprey and otter. Two plant species afforded protection under the Flora Protection Order (Triangular clubrush and Meadow barley) are also recorded from the River Maigue estuary.

A number of other European Sites occur within the study area including the large woodland complex at Curraghchase Woods (site code no. 000174) which supports a hibernation site of the Lesser Horseshoe Bat, a species listed on Annex II of the EU Habitats Directive. The Askeaton Fen Complex (site code no. 002279) includes a number of individual sites scattered to the north and south of the N69 between Askeaton and Kildimo. The fens occur in basins between undulating hills in an otherwise intensive agricultural landscape. The area is underlain by Lower Carboniferous Limestone and some of the fens are surrounded by large cliff-like rock outcrops.

Barrigone SAC (site code no. 000432) is situated approximately 5km west of Askeaton, and comprises an area of dry, species-rich, calcareous grassland with patches of scrub and occasional limestone outcrops. This site supports a large population of the Annex II listed Marsh fritillary butterfly and Hairy violet, a species protected under the Flora Protection Order.

Outside of the European Sites network, the principle ecological constraints include Adare Woodlands Proposed Natural Heritage Area (pNHA site code 000429), which occurs as six separate blocks of woodland to the east and west of Adare village; Dromore and Bleach Loughs pNHA (site code 001030), and Loughmore Common Turlough pNHA (site code 000438). Ballinvirick Marsh pNHA (site code 001427), Cappagh Fen pNHA (site code 001429), Ballymorrisheen Marsh pNHA (site code 001425) and Gorteennamrock Fen pNHA (site code 001433) are all part of the Askeaton Fen Complex SAC.

Non-designated areas of woodland and scrub with potential high ecological value also occur along the course of the River Ahacronane in the townlands of Deelish and Creeves (Shanagolden), and in the vicinity of the Askeaton Fen Complex to the west of Curraghchase. The River Deel and the River Ahacronane will both require crossings with due consideration given to both, the potential for direct impacts on

aquatic habitats and species, and to potential indirect impacts on the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA downstream.

Designated areas inside and within a 10km zone of the study area are listed in Table 3.12, while non-designated sites of potential ecological sensitivity are listed in Table 3.13 using the Heritage Council habitat classification codes (Fossitt, 2000).

Table 3.12 Designated Areas inside and within a 10km zone of the study area

Site Code	Site Name	Status	Qualifying Interests (* indicated priority habitat)
002165	Lower River Shannon	SAC	• Freshwater pearl mussel • Sea lamprey • Brook lamprey • River lamprey • Salmon • Sandbanks • Estuaries • Mudflats and sandflats • Coastal lagoons* • Large shallow inlets and bays • Reefs • Perennial vegetation of stony banks • Vegetated sea cliffs • Salicornia and other annuals colonizing mud and sand • Spartina swards • Atlantic salt meadows • Bottle-nosed dolphin • Otter • Mediterranean salt meadows • Water courses of plain to montane levels with the Ranunculion fluitantis • Molinia meadows • Alluvial forests*
004077	River Shannon and River Fergus Estuaries	SPA	• Cormorant • Whooper Swan • Light-bellied Brent Goose • Shelduck • Wigeon • Teal • Pintail • Shoveler • Scaup • Ringed Plover

…Table 3.12 Continued Over/

Table 3.12 (Cont.) Designated Areas inside and within a 10km zone of the study area

Site Code	Site Name	Status	Qualifying Interests (* indicated priority habitat)
004077 (Cont.)	River Shannon and River Fergus Estuaries (Cont.)	SPA	• Golden Plover • Grey Plover • Lapwing • Knot • Dunlin • Black-tailed Godwit • Bar-tailed Godwit • Curlew • Redshank • Greenshank • Black-headed Gull • Wetlands & Waterbirds
004161	Stacks to Mullagha-reirk Mts	SPA	• Hen Harrier
000174	Curragh-chase Woods	SAC	• Lesser horseshoe bat • Alluvial forests with Alnus glutinosa and Fraxinus excelsior • Taxus baccata woods of the British Isles
002279	Askeaton Fen Complex	SAC	• Calcareous fens with Cladium mariscus • Alkaline fens
000432	Barrigone	SAC	• Marsh fritillary • Juniperus communis formations on heaths or calcareous grasslands • Semi-natural dry grasslands and scrubland facies on calcareous substrates (*important orchid sites) • Limestone pavements
000439	Tory Hill	SAC	• Semi-natural dry grasslands and scrubland facies on calcareous substrates (*important orchid sites) • Calcareous fens with Cladium mariscus and species of the Caricion davallianae • Alkaline fens
000429	Adare Woodlands	pNHA	Series of woodland blocks around Adare village
001030	Dromore and Bleach Loughs	pNHA	Two freshwater lakes and surrounding wetland habitats north of Kildimo

…Table 3.12 Continued Over/

Table 3.12 (Cont.) Designated Areas inside and within a 10km zone of the study area

Site Code	Site Name	Status	Qualifying Interests (* indicated priority habitat)
000438	Loughmore Common Turlough	pNHA	Turlough and adjacent wetland habitats south of Mungret
000435	Inner Shannon Estuary - South	pNHA	The pNHA boundaries are within the Lower River Shannon SAC boundaries
001427	Ballinvirick Marsh	pNHA	Calcareous / Alkaline fens with Cladium mariscus within Askeaton Fen Complex SAC
001429	Cappagh Fen	pNHA	Calcareous / Alkaline fens with Cladium mariscus within Askeaton Fen Complex SAC
001425	Ballymorris-heen Marsh	pNHA	Calcareous / Alkaline fens with Cladium mariscus within Askeaton Fen Complex SAC
001433	Gorteenna-mrock Fen	pNHA	Calcareous / Alkaline fens with Cladium mariscus within Askeaton Fen Complex SAC

Table 3.13 Non-designated areas of potential ecological significance within the study area.

Site Number	Townland	Habitat Classification Codes	Value	Notes
1	Aughinish		A	R. Shannon & R. Fergus SPA
2	Aughinish		A	Lower R. Shannon SAC
3	Aughinish		B	Inner Shannon Estuary - South pNHA
4	Barrigone		A	Barrigone SAC
5	Foynes	WN / WD	C	
6	Ardaneer	WS	C	Potential glacial spillway and rocky ridges
7	Rincullia	WS/HH/GS/ER	C	
8	Craggs	WD/WS/ER	C	
9	Craggs	WD/WN/GS/PF	C	
10	Ballylin	WD/WN/GS/PF	C	
11	Mullagh	WS/HH/GS/ER	C	
12	Oldabbey	WL/WD/GS	D	
13	Craggard	WS	D	Separate small blocks
14	Ardgoul South	WD	D	Remnant block
15	Stoneville House	WD/WD5/FL/GS	D/C	Mosaic around estate. LHB Potential.

…Table 3.13 Continued Over/

Table 3.13 (Cont.) Non-designated areas of potential ecological significance within the study area.

Site Number	Townland	Habitat Classification Codes	Value	Notes
16	Cloghatrida	FL/WN	C	River Deel with patches of riparian woodland
17	Wolfesburgess West	FL/WN	C	River Deel with patches of riparian woodland
18	Askeaton	WD/FL	C	Woodland along west bank River Deel
19	Ballynacaheragh	WS/WD	D	Mosaic patches scrub & woodland
20	Kilbehy	WS	D	
21	Cragmore	FL/GS4	D	
22	Castlehewson	WD/WN/WS/WD5	C	Mosaic around estate. LHB Potential.
23	Ballyhomin	FL/PF	C/B	Blue Lough
24	Drominoona	WS/ER/PF	C/B	
25	Various		A	Askeaton Fen Complex SAC
26	Mornane	WS/WD/PF	C/B	Adjacent Askeaton Fen Complex SAC
27	Mornane	WS	C/B	Adjacent Askeaton Fen Complex SAC
28	Deegerty	FL	C	Stream corridor between blocks of SAC
29	Deegerty	FL/PF/WS	C/B	Patches of scrub and pockets of open water Adjacent to Askeaton Fen Complex SAC
30	Bansha	PF/GS4	C/B	Potential fen habitat Adjacent to Askeaton Fen Complex SAC
31	Shanbally	WL/WS/GS	C	Mosaic irregular small fields and patches scrub
32	Tinnacullia	GS/PF	C	
33	Tinnacullia	WD/WN	C	
34	Tinnacullia	GS/PF	C/B	
35	Ballynamona	WS	C	Block scrub adjacent to Curraghchase Woods SAC
36	Dromlohan	WS/GS/PF	C/B	Adjacent to Askeaton Fen Complex SAC
37	Graigues	WS/PF	C/B	Adjacent to Askeaton Fen Complex SAC
38	Cragreagh	WS	C	Adjacent to Askeaton Fen Complex SAC
39	Boherboy	WD/WN	C	Adjacent to Curraghchase Complex SAC
40	Curraghchase	WD/WN	A	Curraghchase Woods SAC

…Table 3.13 Continued Over/

Table 3.13 (Cont.) Non-designated areas of potential ecological significance within the study area.

Site Number	Townland	Habitat Classification Codes	Value	Notes
41	Ballycahane	WS/ER/PF	C/B	
42	Ballyshonickbane	GS4/PF/WS	C/B	
43	Tobermurry	WS/GS/PF	C/B	
44	Dromore	WD/WN/GS	C/B	Adjacent to Dromore & Bleach Lough pNHA
45	Dromore		B	Dromore & Bleach Lough pNHA
46	Tonlegee	WD/WN	C	
47	Ballynahallee	WS/WD/GS/PF	C/B	
48	Glennameade	PF/GS4	C/B	Adjacent to Askeaton Fen Complex SAC
49	Cragganacree	WD/WS/FL/PF	C/B	Large complex around Kilbready Loughs
50	Castelgrey	WS/WD	C/B	LHB potential - adjacent to Curraghchase SAC
51	Ballymacdonagh	WS/WD/WN	C/B	LHB potential - adjacent to Curraghchase SAC
52	Cloongownagh	WD/WS	D/C	Old woodland site
53	Monanooag	WS/GS	D	
54	Clorhane	WD4/WS	D	
55	Ballyrune	WD4	D	
56	Ballyvareen	WD4	D	
57	Lurraga	GS4/FL6/WD	B	Loughmore Common Turlough pNHA
58	Kilbehy	PF/GS4	C/B	Adjacent Askeaton Fen Complex SAC
59	Graigues	PF/WS	C/B	Adjacent Askeaton Fen Complex SAC
60	Loughaun	FL/GS/WN	C/B	Graigues Lough
61	Boolaglas	WS	D	
62	Bullaun	WD/WN	D	
63	Altavilla	WD	D	
64	Ballyan	WN/WD	D	Adjacent River Deel
65	Graigeen	WD/WN	D/C	
66	Ballyhomock	WL/WN network	D	
67	Ballyadam	PF/GS4	C/B	
68	Doohyle	FL/GS/WN/PF	C/B	Doohyle lake & potential fen to south
69	Blossomhill	WL/GS/PF	C	WL network with remnant potential fen to NE
70	Ballylin	PF/GS4/WN	C/B	

…Table 3.13 Continued Over/

Table 3.13 (Cont.) Non-designated areas of potential ecological significance within the study area.

Site Number	Townland	Habitat Classification Codes	Value	Notes
71	Clonshire Beg	WD	C	WD & parkland - potential LHB site
72	Adare	WN/WD	B	Adare Woodlands pNHA
73	Ballinvirick	PF/GS4	C/B	Adjacent to Askeaton Fen Complex SAC
74	Lurraga	PF/WS	C	Small patch of fen with scrub block to north
75	Lisnamuck	WD/WN	C/B	Woodland adjacent to Curraghchase Wood SAC - LHB potential
76	Rintulla	WL/WD	C	WL network with some WD - adjacent to Curraghchase Wood SAC - LHB potential
77	Kyleavarraga South	WD4	C	Plantation but potential corridor for LHB
78	Rintulla	PF/GS4	C	
79	Hollywood House	WD/WN/WD5	C/B	Wood-Parkland with high LHB value
80	Kilbreedy	WD/WL/GS	C	Some potential for LHB
81	Cloongownagh	WD	C	
82	Curraghbridge	WD	D/C	Woodland strip along Clonshire River
83	Finniterstown	WD	C	Woodland blocks adjacent to Clonshire River
84	Drehidtarsna	WS/GS	D/C	Scrub adjacent to Adare Woodland pNHA
85	Boulabally	WD	D/C	Blocks WD - some LHB potential
86	Adare / Mountwilliam	WD5/WD/FL	C/B	Adare Manor and Golf course along River Maigue
87	Ballynahown	WN/WD/FL	C	Patches WN/WD along River Maigue
88	Garranroe	WD	D	Blocks of woodland & scrub
89	Kilgobbin	WD/WD5	D	Woodlands around Kilgobbin House
90	Lurraga	HH/GS4	D	Block of heath/ wet grassland
91	Ballyanrahan	WD	D	Separate blocks of woodland
92	Patrickswell	WD/WD5	D	Woodland / parkland at Greenmount House
93	Attyflin	WD/WD5	D	Woodland / parkland at Attyflin Park
94	Ballygeale	GS4	D	Wet grassland

3.9.2 Rivers and Lakes

As the drainage within the study area is principally in a south to north direction, any route options to be considered would require crossings of many of the same

watercourses including the River Ahacronane, the Rivers Deel and the Maigue. Table 3.14 lists the main watercourses within the study area and summarises their fisheries value, the presence or suitability for protected species and the water quality rating.

Table 3.14 Main Watercourses within the Study area

River	Description	Fisheries value	Protected Species	Q Value (EPA)
Maigue	Estuarine upstream to Adare.	Runs of salmon and good population of brown trout.	Freshwater crayfish occur upstream of Adare.	Q4 (good) Castleroberts Br.
Barnakyle	Tributary of the River Maigue.			Q3 (poor) Br. SE Clarina
Kilgobbin Stream	Tributary of the River Maigue			No data
Greananagh	Tributary of the River Maigue.			Q3 (poor) Coolagh Br.
Kilbreedy Stream	Tributary of the River Greananagh (Rises Kilbreedy Lough)			No data
Clonshire	Tributary of the River Greananagh.			Q3 (poor) Drehidnaman Br.
Deel	Estuarine upstream to Askeaton.	Runs of salmon and good population of brown trout.	Freshwater crayfish occur upstream of Askeaton.	Q4 (good) Kilcool Br.
Ballyclogh Stream	Flows to sea W of Askeaton			Q3 (poor) Br. E. Tomdeely
Doohyle Stream	Tributary of River Deel (rises S of Doohyle Lough)			No data
Ahacronane	Estuarine upstream to N69.			Q3 (poor) Br. SW Barrigone

The entire section of the River Maigue upstream to the N21 at Adare is within the Lower River Shannon SAC (site code no. 002165). The River Maigue has two tributaries which join from the east the Barnakyle which joins north of the N69, and the Kilgobbin Stream which joins at Cloonaduff. The Greananagh River joins the River Maigue from the west upstream of Adare. The Greananagh River has two main tributaries, a northerly one, the Kilbreedy Stream which rises in the vicinity of Curraghchase Woods, and a southerly one, the Clonshire River which rises to the south of the N21 near Kilfinny.

The River Deel which rises near Newtownshandrum in County Cork, flows in a northerly direction to the east of Abbeyfeale and through Askeaton after which it flows into the Shannon Estuary. The River Deel is a renowned brown trout fishery and has had 200,000 salmon-fry introduced per annum in the past 10 years in an attempt to restore the salmon stocks. It has one tributary joining from the east, the Doohyle stream rising south of Doohyle Lake which joins the River Deel at Bullaun. Two tributaries join from the west, the Kissaghatrodaun Stream which joins at Ardgoulbeg and the Ballyclogh Stream which joins a short distance to north at Scart. The Ahacronane River rises near Kilcolman and flows in a northerly direction to the Shannon which it joins just east of Foynes.

A series of small lakes also occur to the north and south of the N69 many of which are part of the Askeaton Fen Complex and Curraghchase SACs. Dromore and Bleach Lough are designated as a proposed Natural Heritage Area (Site code no. 001030). There are a number of lakes not within designated conservation areas including Doohyle Loughs which are located just northeast of Rathkeale and the Kilbreedy Loughs located to the east of Curraghchase. Miltown Lake and a series of smaller lakes to the west are located near Pallaskenry in the north of the study area. The lakes are primarily alkaline and vary in their trophic status from oligotrophic to mesotrophic.

3.9.3 Rare Plants

Rare plant species recorded for the 10km squares (Ordnance Survey Ireland National Grid) within the Constraints study area obtained from the National Parks and Wildlife Service database are presented in Table 3.15 below, which lists the species, their protected status and preferred habitat. A number of these species occur within the Lower River Shannon SAC. Precise locations are not given for the species within the database.

Table 3.15. Rare plant species recorded within the Constraints Study Area.

Species	Name	Grid Square	Flora Protection Order	Preferred habitat
Viola hirta	Hairy violet	R24 R34 R35	Yes	A perennial of dry banks, rocky ground and limestone scrub. Found in the Askeaton/Foynes area.
Hordeum secalinum	Meadow barley	R35 R45 R55	Yes	Upper parts of brackish marshes, chiefly near the sea and along the River Shannon.
Papaver hybridum	Rough poppy	R35	Yes	Sandy fields.
Groenlandia densa	Opposite-leaved pondweed	R24 R45 R55	Yes	Found in the River Shannon where it passes through Limerick City.
Mentha pulegium	Pennyroyal	R55	Yes	Damp sandy places.
Colchicum autumnale	Autumn crocus	R43 R55	Yes	Found in Ballingarry, County Limerick. Occurs in old damp meadows and on river banks.
Scirpus triqueter	Triangular club rush	R44 R45 R55	Yes	A creeping perennial found in mud bordering tidal rivers. Found in the Shannon estuary bordering creeks in the inner estuary.

3.9.4 Fauna

The white-clawed crayfish (*Austropotamobius pallipes*) is recorded in the River Maigue south of Adare and in the River Deel just south of Askeaton (National Biodiversity Data Centre (NBCD) Database). The white-clawed crayfish is protected under Annex II of the EU Habitats Directive.

The otter *(Lutra lutra*) is recorded in over twenty 1km square areas within the study area (NBDC Database) and is likely to be widespread on all watercourses as well as on the various lakes and fens within the study area. The otter is also protected under Annex II of the EU Habitats Directive.

While there are no records on the NBDC Database of Sea Lamprey (*Petromyzon marinus*) within the study area, the species is likely to occur on the Maigue and the Deel Rivers. Similarly there are no records of the more common and widespread Brook Lamprey (*Lampetra planeri*) from the study area, but this species is likely to occur in many of the watercourses throughout the study area. All lamprey species are afforded protection under Annex II of the EU Habitats Directive.

Both common frog (*Rana temporaria*) and common newt (*Lissotriton vulgaris*) are expected to be widespread in the study area, while the common lizard (*Zootoca vivipara*) is likely to occur in a range of suitable habitats which would include heath, woodland and marshes.

A range of mammalian species afforded protection under the Wildlife Acts are likely to be widespread within the study area including badger (*Meles meles*), pine marten (*Martes martes*), hedgehog (*Erinaceus europaeus*), Irish stoat (*Mustela erminea*), red squirrel (*Sciurus vulgaris*), fox (*Vulpes vulpes*) and Irish hare (*Lepus timidus hibernicus*).

The study area supports a number of breeding sites of barn owl (*Tyto alba*) which is a red-listed species of conservation concern by BirdWatch Ireland. The range of habitats within the study area is however, likely to support a larger population of this species than existing records suggest. There is potential foraging by wintering whooper swan (*Cygnus cygnus*) in the northern and eastern parts of the study area where large areas of improved grassland occur in proximity to the Shannon Estuary and River Maigue. The whooper swan is listed under Annex I of the EU Birds Directive, an amber listed species of conservation concern by BirdWatch Ireland and is one of the conservation interests for the River Shannon and River Fergus Estuaries SPA.

3.9.5 Bats

Within the study area, the most important bat species is the Annex II listed Lesser Horseshoe Bat (*Rhinolophus hipposideros*) which occurs throughout the area though its numbers are concentrated in the Curraghchase and Adare areas. Lesser Horseshoe Bat are a qualifying interest for Curraghchase SAC. There are a total of 18 known roost sites for the species within the study area (National Parks and Wildlife Service National Lesser Horseshoe Bat Roost Database). A maternity roost of 160+ lesser horseshoe bats is present in Curraghchase but the highest number recorded in any roost in Rathkeale is 18 animals and only two bats have been recorded in Pallaskenry to the north of the study area. Both of the latter sites are mainly used in autumn, winter and spring and both are more important than they appear as many single animals move through these sites seasonally and, although one or two are only ever seen, these would be different individuals each time making

their way to or from summer roosts elsewhere including, possibly, Curraghchase. Successive surveys have revealed that the population of lesser horseshoe bats in the Adare area has reduced significantly since the mid-1980s. Adare Manor was a known summer and winter roosting site in the 1980s but this is no longer the case and, despite the continued existence of optimum habitat for the species in the area, only single bats have been recorded in Adare since the late 1990s (Bat Conservation Ireland data).

The lesser horseshoe bat population in the study area is isolated from other lesser horseshoe bat populations to the north (in Co. Clare) by Limerick city and the River Shannon and to the southwest (in mid-Kerry) by bog and other habitats that are unfavourable for this species. Genetic studies have been undertaken on the species to investigate this isolation as there is a fear that the gene pool of the Limerick population may be compromised as a result. The *Vincent Wildlife Trust* are currently undertaking a study of lesser horseshoe bats within the Curraghchase area to try and determine any possible links with, or barriers to the nearest known populations in the southwest, in the Castleisland and Tralee areas, of Co. Kerry.

Many of the remaining known Irish bat species have been recorded from the study area and those not recorded can be expected to occur at least occasionally. The adjudged status of these is given in Table 3.16 below. There are a total of 85 bat roosts currently recorded within the study area on the Bat Conservation Ireland Database (reviewed in September 2015), though some structures are host to more than one species so the total number of roosts are located within 70 separate structures and trees.

Table 3.16. The adjudged status of bat species within the study area

Common name	Scientific name	Status in study area
Common pipistrelle	*Pipistrellus pipistrellus*	Present – recorded
Soprano pipistrelle	*Pipistrellus pygmaeus*	Present - 2 known roosts
Nathusius's pipistrelle	*Pipistrellus nathusii*	Potential – rare
Unidentified pipistrelle	*Pipistrellus spp.*	Present - 23 known roosts
Brown long-eared bat	*Plecotus auritus*	Present - 23 known roosts
Leisler's bat	*Nyctalus leisleri*	Present - 2 known roosts
Lesser horseshoe bat	*Rhinolophus hipposideros*	Present - 18 known roosts
Whiskered bat	*Myotis mystacinus*	Present – recorded
Natterer's bat	*Myotis nattereri*	Present - 5 known roosts
Daubenton's bat	*Myotis daubentonii*	Present - 1 known roost
Brandt's bat	*Myotis brandtii*	Potential – rare
Other Unidentified species		Present - 11 known roosts

3.10 Cultural and Archaeological Heritage

3.10.1 Introduction

A Cultural Heritage Constraint Study has been undertaken in order to identify all recorded archaeological, architectural and cultural heritage sites and to highlight areas of archaeological or architectural potential within the study area. The locations of these known constraints are shown on Drawing Nos. CS080-CS094 in Volume 2 of this report and these studies have been carried out in order to inform the development of route options for the Foynes to Limerick Road Improvement Scheme.

The assessment involved a study of the archaeological, architectural, historical and cultural background of the study area. This included information from the Record of Monuments and Places (RMP) and the Sites and Monuments Records (SMR) of County Limerick including a review of all relevant county development plans and the National Inventory of Architectural Heritage (NIAH).

The study has been carried out in accordance with the TII Guidelines for the Assessment of Archaeological Heritage Impacts of National Road Schemes (2005) and the TII Guidelines for the Assessment of Architectural Heritage Impacts of National Road Schemes (2005).

Once all RMP/SMR and Built Heritage (protected structures and NIAH structures) sites had been identified during the initial research, the information was mapped onto Ordnance Survey (OS) maps of the area. In addition, further constraints which may not be subject to statutory protection, but which should nonetheless be considered as cultural heritage constraints, were also added. These include areas of designed landscapes or demesnes, which often include the site or ruins of a former country house (Designed Landscapes).

3.10.2 Archaeological Heritage

A total of 1,490 RMP/SMR sites have been identified within the study area, which covers an area measuring approximately 472km^2.

Of the 1490 recorded sites, nine are listed as National Monuments in state ownership or guardianship (Table 3.17) and one is listed as possessing a preservation order (Table 3.18). These sites should be considered as key constraints.

Table 3.17 National Monuments within the Study Area

RMP No.	Class	Townland	National Mon. Ref.:
LI011-065001	Church	Cowpark	345
LI011-092003[2]	Castle - Anglo-Norman masonry castle	Aghalacka	201
LI011-092006	Religious house - Franciscan friars	Moig South	185
LI012-025001	Church	Glennameade	341
LI021-032003	Castle - Anglo-Norman masonry castle	Adare	622

…Table 3.17 Continued Over/

[2] Located within the zone of archaeological potential for LI011-092

Table 3.17 (Cont.) National Monuments within the Study Area

RMP No.	Class	Townland	National Mon. Ref.:
LI021-032013[3]	Town defences	Adare, Blackabbey	No designated number
LI013-009001, 002, 005[4]	Mungret Churches	Baunacloka & Dromdarrig	85

Table 3.18 Sites possessing Preservation Orders within the Study Area

RMP No.	Class	Townland	Preservation Order Ref.
LI020-004001	Ringfort - cashel	Milltown North	4/1977

A national monument is described as "*a monument or the remains of a monument the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto*" (National Monuments Act, 1930, Section 2).

Sites deemed to be in danger of damage or destruction can be allocated Preservation Orders under the 1930 Act. Preservation Orders deem any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the then Minister for Arts, Heritage and the Gaeltacht.

Section 12 (1) of the National Monuments Act (1994 amendment) provides that the Minister for Arts, Heritage, Gaeltacht and the Islands (now the Minister for Arts, Heritage and the Gaeltacht) shall establish and maintain a record of monuments and places (RMP) where the Minister believes that such monuments exist. The record comprises of a list of monuments and relevant places and a map or maps showing each monument and relevant place in respect of each county in the State. Sites recorded on the Record of Monuments and Places all receive statutory protection under the National Monuments Act.

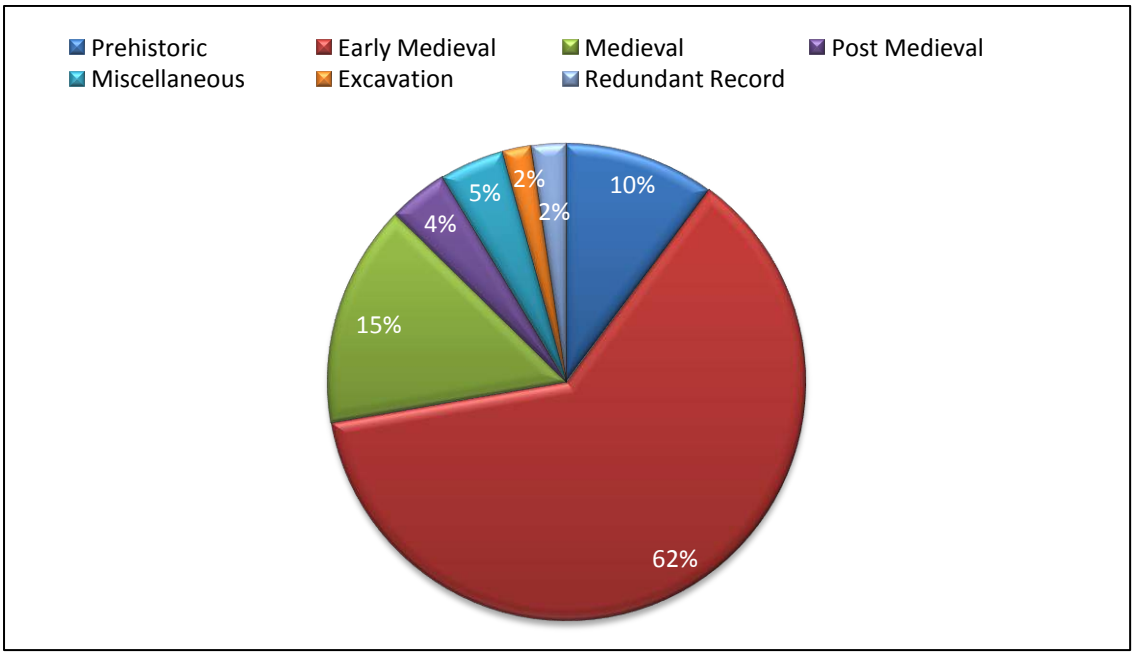
Of the 1,490 archaeological sites recorded within the constraints area, a total of 35 are classed as 'redundant records'. However, they have been included within the assessment, as in the past sites that have been made redundant have later been found to be archaeological in nature. In addition, a total of 29 of the sites are listed as 'Excavation – miscellaneous'. These too are not subject to statutory protection, having been added to the SMR for information by the Archaeological Survey of Ireland.

The recorded sites within the constraints area can be roughly divided into seven categories: Prehistoric sites, early medieval sites, medieval sites, post-medieval sites, miscellaneous sites, excavations and redundant records. Most of the sites can be allotted a time period; however, some have the potential to belong to any period and as such have been added to the miscellaneous category. In addition, certain assumptions have been made regarding churches and graveyards, which have led to

[3] Located within zone of archaeological potential for LI021-032
[4] Located within zone of archaeological potential for LI013-009

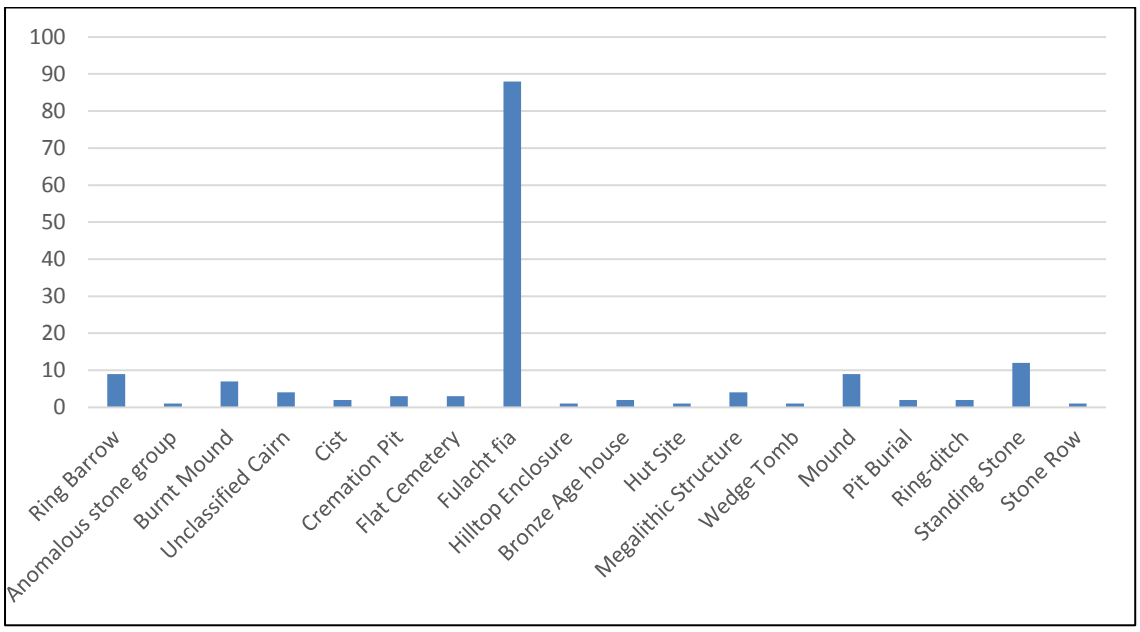
them being included within the medieval category. Figure 3.4 shows the overall percentage of sites in each category.

Figure 3.4 Percentages of Recorded Archaeological Sites within the Study Area



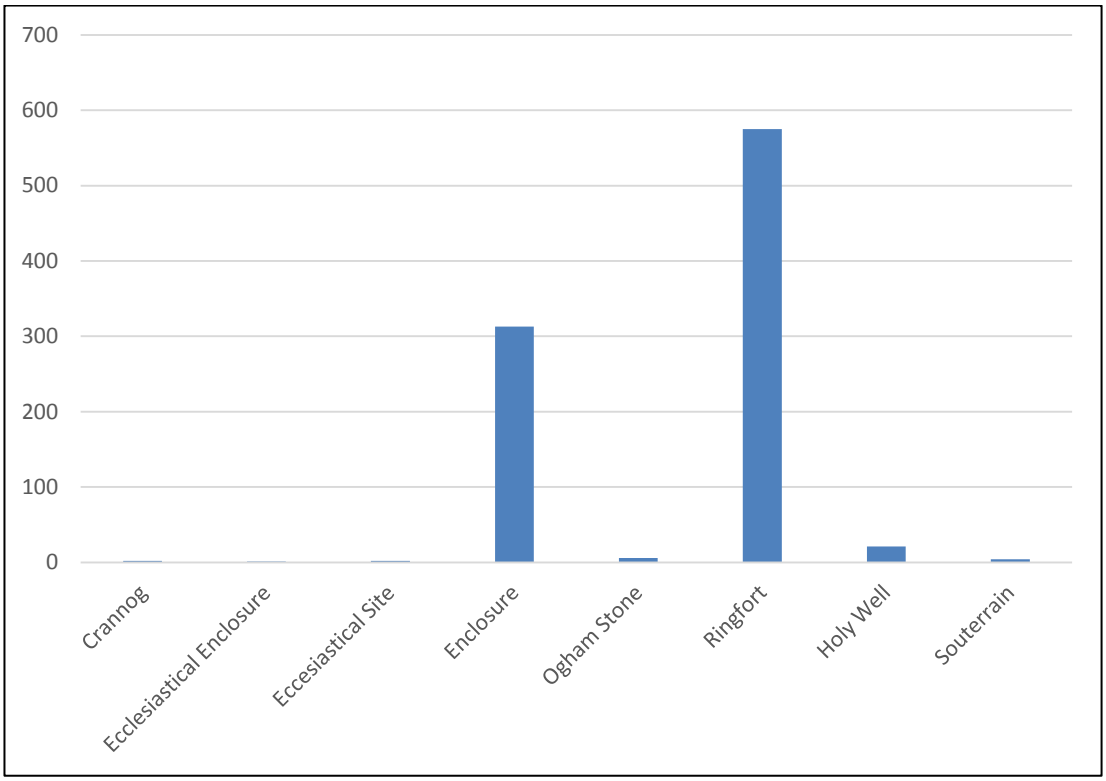
A total of 18 site classifications are included within the prehistoric category (Figure 3.5). The most numerous unsurprisingly are *fulachtaí fia*, totalling 88. This is unsurprising as this is one of the most commonly identified archaeological sites. They usually date to the Bronze Age period (c 2500-600 BC) and are found in proximity to water sources, especially streams and rivers.

Figure 3.5 Number of Prehistoric Sites Located Within the Study Area



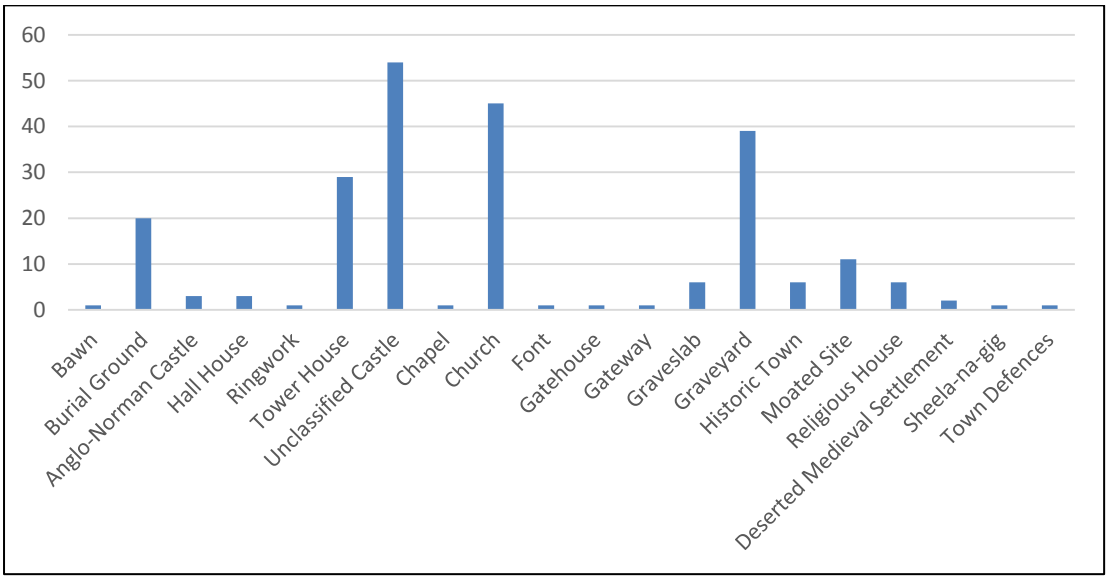
A total of eight site classifications are included within the early medieval category (Figure 3.6). By far the most numerous site types are ringforts and enclosures, totalling 575 and 313 sites respectively. Again this is unsurprising as there are almost 50,000 sites of this type located across Ireland. They represent fortified rural farmsteads and can vary in size from a simple single enclosing bank and ditch, to a large enclosure surrounded by multiple enclosing elements.

Figure 3.6 Number of Early Medieval Sites Located Within the Study Area



A total of 20 site classifications are included within the medieval category (Figure 3.7).

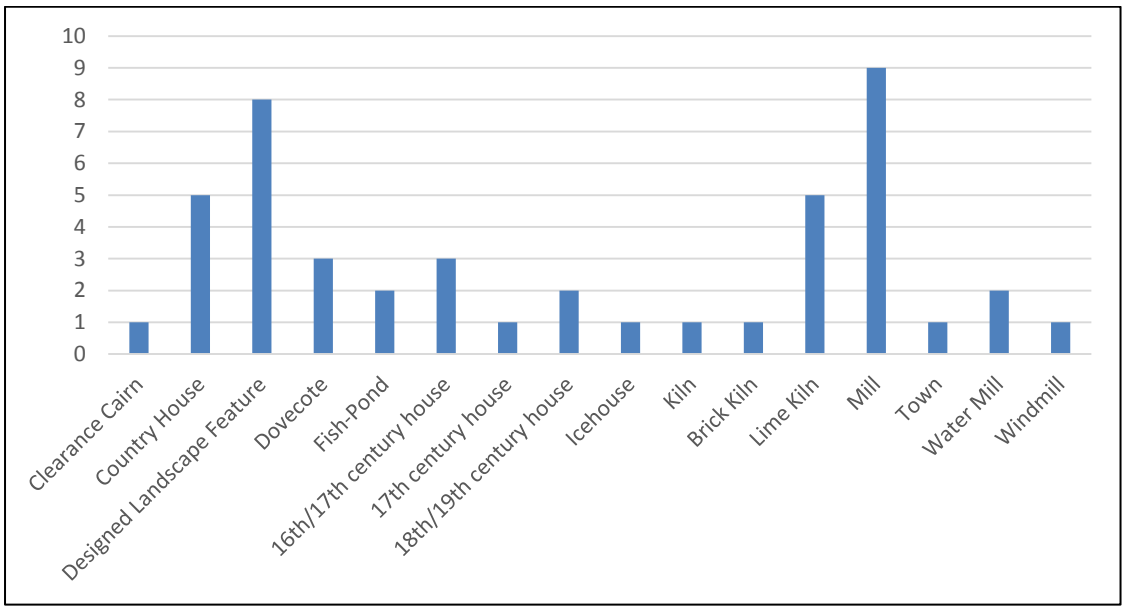
Figure 3.7 Number of Medieval Sites within the Study Area



The most numerous site type consists of castles, with 53 unclassified castles located within the study area, along with 29 tower houses. In addition a total of 44 churches are recorded along with 38 graveyards. It is possible that some of the church sites are earlier in date, although for the purpose of the constraints study a medieval date has been assumed. There are six historic towns located within the constraints area, five of which possess a zone of archaeological potential as defined within the RMP mapping. These consist of Askeaton, Shanagolden, Adare, Rathkeale and Mungret. A further town is recorded in association with the townland of Clonshire Beg, although there is no known location for the settlement.

A total of 16 site classifications are included within the post-medieval category (Figure 3.8). The most numerous site types consists of mills, with nine recorded within the study area, followed by eight designed landscape features (associated with demesne landscapes), five country houses and five limekilns. The remaining categories are not as well represented within the record as early sites and structures. This is generally due to an inconsistency as to whether post-medieval sites are recorded as 'archaeological' by the Archaeological Survey of Ireland.

Figure 3.8 Post-medieval Sites within the Study Area



3.10.3 Summary of Previous Archaeological Fieldwork

A review of the Excavations Bulletin (1970-2014) has revealed that a large amount of archaeological investigations have been carried out within the study area. These are summarised in Table 3.19 below and shown on Drawing Nos. CS080-CS094.

Table 3.19 Archaeological investigations carried out within the Study Area

Constraint Ref.	Excavations Reference	Licence Reference	Townland	Site Type
EX 1	2005:1014	A005/1011	Rossbrien River, Rossbrien &Rathurd	Riverine, No Archaeological Significance (NAS)
EX 2	1997:363	97E0286	Rossbrien	Not undertaken.
EX 3	2005:958	A005/10007	Ballynaclogh River, Ballinacurra (Weston)/Rossbrien	Riverine, NAS

…Table 3.19 Continued Over/

Table 3.19 (Cont.) Archaeological investigations carried out within the Study Area

Constraint Ref.	Excavations Reference	Licence Reference	Townland	Site Type
EX 4	1997:339	97E0289	Dooradoyle	Burnt Mound
EX 4	1996:241	96E379-AR 39	Dooradoyle	NAS
EX 4	1997:338	97E0289	Dooradoyle	Burnt Mound
EX 5	1973:0025	None	Sluggary	Ringfort LI013-038
EX 6	442	10E0368	Dooradoyle	NAS
EX 7	2005:956	A005/1009	Ballynaclogh River, Ballinacurra Hart/Ballykeeffe	Riverine, NAS
EX 8	1999:527	99E0116	Ballycummin, Raheen	NAS
EX 9	1996:240	96E380-AR16	Derryknockane	NAS
EX 10	1997:324	97E0285	Ashfort	Ringwork LI013-076
EX 11	1998:382	98E0108	Ballycummin	Pits, post-holes
EX 11	1996:234	96E379-AR 14	Ballycummin	Pits, ditch
EX 12	1992:132	None	Skehacreggaun	Monastic settlement
EX 13	2003:1158	03E0049	Dromdarrig	NAS
EX 14	2007:1136	07E0759	Dromdarrig	NAS
EX 15	2007:1151	07E0369	Skehacreggaun	Souterrain
EX 15	2008:770	03E0049 ext.	Dromdarrig	Pit
EX 16	2005:962	A005/1030	Ballykeeffe	Burnt stone spread
EX 17	2002:1143	02E1735	Castlemungret	*Fulacht fia*
EX 18	2002:1153	02E1814	Conigar	Brick kiln
EX 19	2002:1135	02E1734	Caheranardrish	Pits
EX 20	2003:1144	03E0616	Carrigogunnel	NAS
EX 21	2007:1098	07E0118	Carrigogunnel	NAS
EX 22	2002:1121	02E1697	Ballyveloge	*Fulacht fia*
EX 23	2007:1095	07E1010	Breska More	NAS
EX 24	2002:1127	02E1292	Barnakyle	NAS
EX 25	1998:394	98E0159	Cloghacloka	*Fulacht fia*
EX 26	1986:42		Cloghacloka	*Fulacht fia*
EX 27	1998:402	98E0252	Greenmount And Logavinshire	Charcoal spreads
EX 28	1986:58	None	Shanaclogh	Ring-barrow
EX 29	1986:37	None	Ballycahane Lower	Fulacht fia
EX 30	2000:0604	00E0285	Ballyanrahan East	Adjacent to holy well
EX 31	1997:328	97E0291	Attyflin	*Fulacht fia*
EX 31	1997:326	96E0379	Attyflin	*Fulacht fia*
EX 32	1997:329	None	Attyflin	Post medieval garden feature
EX 33	1997:330	97E0477	Attyflin	Medieval enclosure

…Table 3.19 Continued Over/

Table 3.19 (Cont.) Archaeological investigations carried out within the Study Area

Constraint Ref.	Excavations Reference	Licence Reference	Townland	Site Type
EX 34	1996:233	96E380-AR5	Ballybronoge South	NAS
EX 35	2008:763	08E0171	Ballybronoge South/Attyflin	Burnt mound, hearth, pits and ditches
EX 36	1991:086	None	Ballybronoge South	Trackway, Killasragh Children's Burial Ground
EX 37	1997:327	96E0380	Attyflin	Medieval (moated site)
EX 38	2008:776	08E0174	Gorteen	Moated enclosure, corn-drying kilns, ditches, pits, post-holes and structures
EX 39	1997:344	97E0230	Gorteen	Possible moated site
EX 40	2006:1254	05E1075 ext.	Coshma	NAS
EX 41	2005:991	05E0880	Kildimo	Human remains, Burials
EX 42	2009:537	09E0533	Knockroe	NAS
EX 43	1997:333	97E451	Barnakyle	Post-medieval
EX 44	1992:125	None	Glennameade	NAS
EX 45	2002:1169	02E0780 and ext.	Dromlohan	NAS
EX 46	2001:754	01E1216	Cowpark	NAS
EX 47	2003:1200	03E0620	Shannon Grove	NAS
EX 48	2007:1093	07E0936	Beagh Castle, Ballysteen	NAS
EX 49	1998:374	None	Adare	Part of historic town
	1975:26	None	Adare	Castle
	2006:1233	01E1153 ext., CO002	Adare	Castle
	1989:066		Adare	NAS
	1999:474	99E0500	Black Abbey	Medieval monastery, NAS
	1992:122		Adare	Castle, NAS
	2008:759	08E0231	Adare	NAS
	1998:375		Adare	Medieval borough
	2001:742	01E1153	Adare	Drawbridge pit of inner gatehouse
	1991:085		Adare	NAS
	1996:229	96E375	Adare	Medieval urban
	441	10E0142	Adare	NAS
	2012:378	12E030	Adare	Urban medieval
	2012:379	12E0260	Adare	Adjacent to ecclesiastical site
EX 50	1999:495	99E0638	Castleroberts	NAS
EX 51	2006:1303	06E0486	Rathbranagh	NAS
EX 52	1997:362	97E407	Rathbranagh	NAS
EX 53	2002:1136	02E1512	Caherass	Mill, NAS
EX 54	2001:752	01E0801	Clonshire Beg	NAS

…Table 3.19 Continued Over/

Table 3.19 (Cont.) Archaeological investigations carried out within the Study Area

Constraint Ref.	Excavations Reference	Licence Reference	Townland	Site Type
EX 55	2002:1197	02E0666	Kiltenan South	Kiln
	2002:1198	02E0667	Kiltenan South	Prehistoric round house
	2002:1196	02E0664	Kiltenan North	*Fulacht fia*
	2002:1068	02E0669	Adamswood	*Fulacht fia*
	2002:1069	02E0847	Adamswood	Pit or hearth
	2002:1070	02E0577	Adamswood	Fire-pit
	2002:1147	02E0657	Clogh East	Burnt spread, well, 'sweat-house'
	2002:1156	02E0877	Croagh	Cremation cemetery
	2002:1155	02E0645	Croagh	Cremation cemetery
	2002:1148	02E1436	Clogh West	Burnt spread
	2002:1157	02E0811	Curraheen South	Post-medieval pits and disarticulated skeleton
	2002:1081	02E0662	Ballingarrane	Burnt spread
	2002:1091	02E0814	Ballyadam	NAS
	2002:1166	02E0813	Doohyle More	NAS
	2002:1165	02E0634	Doohyle More	Pits and furrows
	2002:1082	02E0727	Ballingarrane	NAS
	2002:1230	02E0642	Milltown North	NAS
	2002:1229	02E0643	Milltown North	*Fulacht fia*
	2002:1231	02E0644	Milltown North	Scoop associated with Beaker pottery
	2002:1129	02E0741	Baunreagh	Burnt spread and series of pits
	2002:1130	02E0661	Baunreagh	Pit
	2002:1131	02E0750	Baunreagh	Burnt spreads
	2002:0085	02E0748	Ballycullen	Burnt spread
	2002:1092	02E0749	Ballyellinan	NAS
	2002:1093	02E0873	Ballyellinan	Fire-pit
	2002:1094	02E0874	Ballyellinan	NAS
	2002:1234	02E0875	Mulderricksfield	NAS
	2002:1252	02E0670	Robertstown	Burnt mound, roasting pits and trackway
	2002:1233	02E0872	Mulderricksfield	Probable iron furnace
	2002:1249	02E0752	Rincullia	Isolated pit with associated stakes
	2002:1251	02E0832	Robertstown	Spread of burnt-mound material
	2002:1179	02E0899	Inchagreenoge	*Fulachtai fia*, ritual deposit of a human skull, wooden artefacts, post-medieval trackway
	2002:1258	02E0876	Sroolane	NAS
	2002:1113	02E0901	Ballynacragga	NAS
	2002:1112	02E0848	Ballynacragga	Burnt mound
	2002:1209	02E0900	Leahys	Burnt mound
	2002:1210	02E0849	Leahys	Multi-phase *fulacht fiadh*
	2002:1208	02E0302	Leahys	Pit

…Table 3.19 Continued Over/

Table 3.19 (Cont.) Archaeological investigations carried out within the Study Area

Constraint Ref.	Excavations Reference	Licence Reference	Townland	Site Type
EX 56	2002:1066	02E1213	Adamswood	Burnt spread
	2002:1067	02E1214	Adamswood	Multiple burnt spreads
	2005:979	05E1076	Croagh	NAS
EX 57	2009:524	09E374	Ballycannon	NAS
EX 58	2005:967	05E0520	Ballyvocogue	NAS
EX 59	2000:0574	00E0844	Ballingarrane	Graveyard
EX 60	1996:231	96E240	Askeaton	Urban medieval
	2004:0974	04E1520	William Street, Askeaton	NAS
	1996:230	None	Askeaton	Historic town
	2003:1128	03E0933	Church Street, Askeaton	NAS
	2009:523	09E094	Church Street, Askeaton	NAS
	2009:522	09E094	Church Street, Askeaton	Urban
	2008:762	07E1126	Askeaton	NAS
	2005:955	05E0778	Church Street, Askeaton	Post-medieval
	2003:1131	03E0311	The Quay, Askeaton	NAS
	2000:0571	99E0741	Askeaton	Historic town
	2006:1235	06E0936	Askeaton	Urban, post-medieval
	1998:377	98E0585	Askeaton	Historic town, NAS
EX 61	2006:1296	06E0423	Morgans North	NAS
EX 62	2006:1297	06E0997	Morgans North	NAS
EX 63	1974:0027	None	Aughinish Island	Enclosure
	1974:0025	None	Aughinish Island	Two stone forts
	1974:0028	None	Aughinish Island	Tower House Bawn
EX 64	1996:232	96E168	Aughinish West	Enclosure
EX 65	2007:1107	07E1114	Durnish	NAS
	2002:1175	02E1767	Foynes Harbour	NAS
EX 66	2001:799	01E0003	Robertstown	Enclosure site
EX 67	2003:1199	03E1037	Main Street, Shanagolden	NAS
	2005:960	05E1340	Ballycormick	NAS
	2007:1150	07E0986	Shanagolden	NAS
	452	09E0397	Shanagolden	NAS
EX 68	2008:796	08E0873; 08R0280	St Catherine D'conyl, Old Abbey	Medieval nunnery
EX 69	2008:780	08E0214	Kilbradran	NAS
EX 70	2001:797	01E1066	Church Street, Rathkeale	NAS
	2008:798	08E0677	Rathkeale	Multi-period

…Table 3.19 Continued Over/

Table 3.19 (Cont.) Archaeological investigations carried out within the Study Area

Constraint Ref.	Excavations Reference	Licence Reference	Townland	Site Type
EX 70 (Cont.)	1992:129	None	Abbeylands, Rathkeale	Medieval abbey burial ground
	2007:1144	07E0608	Pound Lane, Rathkeale	NAS
	2009:545	07E0394	Bank Lane, Rathkeale	NAS
	2005:1012	04E1519	Main Street/Fairhill, Rathkeale	NAS
	451	10E0290	Main Street Lower, Rathkeale	Post-medieval
	2001:798	01E0924	Roche's Road, Rathkeale	NAS
EX 71	2012:387	12E228	Bolane	Burnt Mound
	2012:388	12E229	Bolane	Burnt Mound
	2012:398	12E230	Glennameade	Burnt Mound
EX 72	2012:393	12E304	Skagh	NAS
EX 73	2012:409	12E0024	Sroolane North	Early Bronze Age cremation

3.10.4 Areas of Archaeological Potential

Areas of Archaeological Potential (AAPs) can be defined as parts of the landscape that possess the potential to contain archaeological remains due to the presence of topographic features such as rivers, lakes, turloughs, high defendable ground and bog. Rivers and lakes are a focus for human habitation due to the obvious transport and food resources. They (along with bogs) also have the potential to preserve organic archaeological deposits or artefacts such as wood or leather, which do not usually survive within the alkaline conditions associated with terrestrial archaeology. Wooden trackways dating to the Bronze Age period and later have been excavated within bogland throughout Ireland. Rivers and lakes may have also played a role in prehistoric ritual, as significant artefacts from the prehistoric periods and into the early medieval period, are often found within river bed deposits. All areas of bog/peat, rivers, streams and bodies of water (both fresh and salt water), and their margins, within the scheme study area should be considered as possessing archaeological potential.

3.10.5 Architectural Heritage

Protected Structures and NIAH Structures

A total of 284 structures or groups of structures of architectural heritage significance have been identified within the Foynes to Limerick Road Improvement Scheme study area. These are either listed within the Record of Protected Structures (RPS) (County Limerick Development Plan 2010-2016) or have been identified as part of the architecture survey carried out by the National Inventory of Architectural Heritage (NIAH). These sites are referred to as Built Heritage sites (BH) within this study.

Structures of architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest are protected under the Planning and Development Act, 2000, where the conditions relating to the protection of the architectural heritage are set out in Part IV. The act defines a protected structure as:

"(a) a structure, or (b) a specified part of a structure which is included in a record of protected structures (RPS)*, and, where that record so indicates, includes any specified feature which is within the attendant grounds of the structure and which would not otherwise be included in this definition;*

"protection" in relation to a structure or part of a structure, includes conservation, preservation, and improvement compatible with maintaining the character and interest of the structure or part;"

Buildings recorded in the RPS can include recorded monuments, structures listed in the NIAH or buildings deemed to be of architectural, archaeological or artistic importance by the Minister for Arts, Heritage and the Gaeltacht. Please note that inclusion within the NIAH survey does not afford statutory protection. However, the structure may be added to the RPS by the relevant local authority in the future. As such the buildings should be considered to be constraints.

There are multiple structures/ sites that are included within the RMP and RPS, which are subject to statutory protection under both the National Monuments Act and the Planning and Development Act.

The NIAH rating values are International, National, Regional, Local and Record Only (I, N, R, L, O). Structures which are considered of International, National, and Regional significance are recommended by the Minister to the relevant planning authority for inclusion in their RPS (NIAH handbook 2011, DoAHG).

International: Structures or sites of sufficient architectural heritage importance to be considered in an international context. These are exceptional structures that can be compared to and contrasted with the finest architectural heritage in other countries.

National: Structures or sites that make a significant contribution to the architectural heritage of Ireland. These are structures and sites that are considered to be of great architectural heritage significance in an Irish context.

Regional: Structures or sites that make a significant contribution to the architectural heritage within their region or area. They also stand in comparison with similar structures or sites in other regions or areas within Ireland. Increasingly, structures that need to be protected include structures or sites that make a significant contribution to the architectural heritage within their own locality. Examples of these would include modest terraces and timber shopfronts.

Local: These are structures or sites of some vintage that make a contribution to the architectural heritage but may not merit being placed in the RPS separately. Such structures may have lost much of their original fabric.

Record Only: These are structures or sites that are not deemed to have sufficient presence or inherent architectural or other importance at the time of recording to warrant a higher rating. It is acknowledged, however, that they might be considered further at a future time.

Overall there are 688 RPS or NIAH structures located within the study area. Of these over half are located within the towns of Adare (BH 1) (146), Rathkeale (BH 2) (82), Askeaton (BH 3) (55), Foynes (BH 4) (62), Shanagolden (BH 5) (12) and Patrickswell (BH 6) (8). This produces a total of 284 individual or groups of structures. The remainder are scattered across the study area and consist for the most part of houses, country houses, churches, public houses, railway infrastructure and bridges.

Occasionally items such as water pumps and lime kilns have been included within the record.

Architectural Conservation Areas (ACAs)

An Architectural Conservation Area is defined as 'A place, area, group of structures or townscape, taking account of building lines and heights, that is of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest or that contributes to the appreciation of a protected structure, and whose character it is an objective of a development plan to preserve.' (DoAHG, 2011, 40). Chapter II of Part IV of the Planning and Development Act 2000 states that that all development plans must now include objectives for preserving the character of ACAs. As such ACAs are subject to statutory protection and are a key constraint.

There are five ACAs within the constraints study area. Three of these are located in the existing settlements of Rathkeale, Askeaton and Foynes. The fourth ACA consists of a large area that surrounds the central part of Adare and the designed landscape associated with Adare Manor. The fifth ACA consists of the core of the designed landscape that surrounds Ballystein House (Ballysteen), which is located within the north-west of the study area.

3.10.6 Designed Landscapes

The first edition six-inch OS map of County Limerick (1844) shows the extent of demesne landscapes as shaded portions of land within the scheme study area. These were established as a naturalised landscaped setting for the large houses of the landed gentry. Later OS mapping (c. 1918-24) can also indicate demesne extent, although they are not shaded. Not all demesne landscapes are subject to statutory protection. However, where a demesne exists in association with a protected structure (dependant on the preservation of the landscape), this can be considered to be attendant grounds and as such falls within the remit of the Planning and Development Act 2000. Two of the demesne landscapes within the constraints study area are protected as Architectural Conservation Areas (ACAs). These consist of Adare Manor demesne and Ballystein House.

A total of 99 designed landscapes have been identified from the desktop resource. These are listed below in Table 3.20. The NIAH have carried out a desk-based survey of identifiable demesnes within County Limerick; however, not all of the 99 are included within the survey results.

Table 3.20 Designed Landscapes

Constraints Ref.	Demesne Name	Townlands
DL 1	Cooper Hill	Cooper Hill
DL 2	Tervoe	Tervoe, Corbally
DL 3	Vermont	Glebe
DL 4	Elm Park Demesne	Elm Park Demesne
DL 5	Cragbeg	Cragbeg
DL 6	Derryknockane	Derryknockane
DL 7	Ashfort	Ashfort
DL 8	Greenmount	Greenmount
DL 9	Richmond Villa	Richmond Villa

…Table 3.20 Continued Over/

Table 3.20 (Cont.) Designed Landscapes

Constraints Ref.	Demesne Name	Townlands
DL 10	Fort Etna	Fort Etna
DL 11	Attyflin	Attyflin
DL 12	Faha Demesne	Faha Demesne, Ballyanrahan
DL 13	Bushmont	Ballycarrane
DL 14	Spring Lodge	Ballybronoge North
DL 15	Ballybronoge South	Ballybronoge South
DL 16	Ballycarrane	Ballycarrane
DL 17	Prospect Hall, Jockey Hall	Jockey Hall
DL 18	Bettyville	Killanahan
DL 19	Killonahan House & demesne	Killonahan
DL 20	Caherass House & demesne	Ballyouragan
DL 21	Part of Caherass House demesne	Ballynahown
DL 22	Caherass Court & demesne	Caherass
DL 23	Adare Manor and Deerpark	Adare Demesne, Boulabally, Mountwilliam, Copay
DL 24	Mondellihy House	Mondellihy
DL 25	Kilgobbin House	Kilgobbin
DL 26	Newborough House	Ballyloughnaan
DL 27	Curraghbridge House	Curraghbridge
DL 28	Deerpark	Cloongownagh
DL 29	Ashgrove House	Ballycasey
DL 30	Tuogh Cottage	Tuogh
DL 31	Clonshire Lodge	Clonshire Beg
DL 32	Finniterstown House	Finniterstown
DL 33	Grove House	Croagh
DL 34	Smithfield House	Croagh
DL 35	Newpark House	Newpark
DL 36	Ballinvira House	Ballinvira
DL 37	Hollywood House	Ballinvira
DL 38	Farm Lodge	Kyleavarraga Middle
DL 39	Curraghchase House & Demesne	Curraghchase, Curraghchase North
DL 40	Castle Grey	Castle Grey
DL 41	Ballynolan House	Ballynolan
DL 42	Copsewood Cottage	Chapelrussell
DL 43	Cartown House	Cartown
DL 44	Mount Pleasant	Mount Pleasant
DL 45	Rockfield House	Ballynacarriga
DL 46	Ballynacarrig House	Ballynacarriga
DL 47	Ballynacarriga House	Ballynacarriga
DL 48	Mellon House	Mellon

…Table 3.20 Continued Over/

Table 3.20 (Cont.) Designed Landscapes

Constraints Ref.	Demesne Name	Townlands
DL 49	Shannongrove House	Shannongrove
DL 50	Summerville House	Summerville
DL 51	Glebe House & Church	Moig East Glebe
DL 52	Castletown House	Castletown
DL 53	Bushypark House	Bushyisland
DL 54	Milltown House	Milltown
DL 55	Ballynacourty House	Ballynacourty
DL 56	Castle View	Beagh
DL 57	Ballysteen House (Ballystein)	Ballysteen, Ballycanauna
DL 58	Glenagauran	Ballysteen
DL 59	Ballynash Castle	Ballynash
DL 60	Shannon View	Shannonview
DL 61	Ballyengland House	Ballyengland
DL 62	Ballinvirick House	Ballinvirick
DL 63	Cappagh House	Cappagh
DL 64	Curragheen House	Curragheen South
DL 65	Ballywilliam	Ballywilliam Demesne
DL 66	Beechmount House	Beechmount Demesne
DL 67	Ballywilliam House	Ballywilliam North
DL 68	Rathkeale Abbey	Abbeylands
DL 69	Mount Southwell	Enniscoush
DL 70	Castlematrix and glebe	Castlematrix
DL 71	Court Lodge	Enniscoush
DL 72	Brownville	Castlematrix
DL 73	Riverlawn	Wolfesburgess West
DL 74	Cloghanarold House	Cloghanarold
DL 75	Tallyho Lodge	Riddlestown
DL 76	Mount William	Coolcappagh
DL 77	Waterville	Ballynisky
DL 78	Riddlestown Park	Ranahan
DL 79	Rockfield House, Rockfield Tower	Cloghatrida
DL 80	Stoneville Demesne	Stoneville, Graigeen
DL 81	Wellmount House	Ardgoul South
DL 82	Scart House	Scart
DL 83	Nantinan House & Church	Nantinan, Derry
DL 84	Alta Villa	Altavilla
DL 85	Inchirourke More	Askeaton
DL 86	Glebe	Askeaton
DL 87	Ballycullen House	Ballycullen
DL 88	Ballyclogh House	Ballyclogh

…Table 3.20 Continued Over/

Table 3.20 (Cont.) Designed Landscapes

Constraints Ref.	Demesne Name	Townlands
DL 89	Old Abbey House	Oldabbey
DL 90	Tiermore House	Dunmoylan
DL 91	Shanagolden House	Shanagolden Demesne
DL 92	Morgans House	Morgans North
DL 93	Corgrig House	Corgrig
DL 94	Vicarage	Corgrig, Ballynacragga
DL 96	Granard House	Granard
DL 97	Court	Court
DL 98	Bolane House	Bolane
DL 99	Tonlegee House	Tonlegee

3.10.7 Summary and Conclusions

The purpose of this constraints study was to provide an analysis of the archaeological, architectural and cultural heritage resources within the study area in order to inform the design of routes as part of the Foynes to Limerick Road Improvement Scheme. The scheme study area is located within County Limerick and covers an approximate area of 472km^2. The study has shown that there is a large cultural heritage resource within the area. The sites and areas listed within this section are shown on Drawing Nos. CS-080 to CS-094 in Volume 2 of this report and should be considered as constraints during the design process.

With the exception of the settlements of Adare, Rathkeale, Foynes, Pallaskenry, Patrickswell and Askeaton, the remaining landscape is rural in nature containing some scattered settlement, small to large pastoral farming enterprises with some marginal scrubby areas. A total of 1490 RMP/SMR sites of varying dates are listed within the study area indicating a continuance of activity and settlement in the region. A substantial number of these sites can be ascribed to the early medieval period, with ringforts and enclosures being most frequent. In addition, nine sites are listed as National Monuments in state care or guardianship and one site is further protected with a Preservation Order. All recorded archaeological sites should be considered as cultural heritage constraints during the design of the route options and avoided where possible. National Monuments and sites with Preservation Orders should be considered to be key constraints.

A survey of the Excavations Bulletin (1970-2014) has revealed that a number of excavations have taken place within the scheme study area. A total of 73 individual or groups of investigations have been recorded. The largest programme of fieldwork occurred prior to the construction of the Gas Networks Ireland gas pipeline to the west (2002), which resulted in 38 excavations being carried out within the study area.

There are numerous Areas of Archaeological Potential (AAPs) within the study area. These consist of the various rivers, streams, small lakes, coastal margins and areas of bog/peat land. All AAPs should be considered as archaeological constraints and avoided where possible. Where avoidance is not possible, potential impacts should be minimised through design. This includes the use of clear span structures across waterways.

An analysis of the built heritage within the study area has provided a holistic view of the built heritage resource, with the later years of the post-medieval period well-

illustrated by the presence of a substantial number of country houses, vernacular houses, bridges and churches. Structures that are architecturally and socially important are listed within the County Limerick Development Plan and NIAH survey for County Limerick. Protected structures receive statutory protection that helps to ensure their preservation for the future. A total of 284 individual or groups of protected structures and/or NIAH structures are located within the study area. Over half of these are located within the existing small towns, with the remainder scattered across the study area. All protected structures and NIAH structures should be considered as cultural heritage constraints during the design of the proposed scheme with direct impacts and impacts on settings avoided where possible.

In addition, five Architectural Conservation Areas have been identified within the constraints study area. Three are focused on the urban centres of Rathkeale, Askeaton and Foynes. The remaining two focus on Adare village (and the demesne that surrounds Adare Manor) and the core demesne associated with Ballystein (Ballysteen) House.

A total of 99 designed landscapes have been identified from the desktop resource within the study area. Some of these still retain their principal building and/or outbuildings and may be associated with a protected structure and can therefore be viewed as attendant grounds to the same, whilst others have been lost over the course of time. These landscapes should be considered as cultural heritage constraints during the development of the route options.

3.11 Landscape and Visual

3.11.1 Introduction

The investigation of the visual constraints has been undertaken in accordance with the *TII Project Management Guidelines*, the *Highways England Design Manual for Roads and Bridges (DMRB) Vol.11* and the *Guidelines for Landscape and Visual Impact Assessment* 3rd Edition, by The Landscape Institute / Institute of Environmental Assessment published by E&FN Spon (2013). The study assesses the importance of landscape features at a local and a regional/national/international level.

This section presents a baseline study of the existing landscape features within the study area. The assessment also examines any features of significance within the visual envelope of the proposed study area. Refer to Drawing Nos. CS-095 to CS-099 in Volume 2 of this report.

3.11.2 Description of Study Area

The study area can be described as an agricultural landscape, with significant mature tree and hedgerow cover and moderate to high scenic quality. In particular, the Shannon Estuary, to the north of the study area, is of high scenic value. The topography of the study area is rolling to undulating, with hills to the western edge and south, which are part of the Mullaghareirk Mountains range. The coastal edge tends to slope steeply at the coast, before giving way to the rolling farmland. There are numerous rivers, lakes and streams in the area, adding to the rural agricultural character of the landscape, as well as several wooded areas.

The study area includes the settlement centres of Mungret, Dooradoyle, Kildimo, Clarina, Pallaskenry, Askeaton, Foynes, Shanagolden, Rathkeale, Adare, and Patrickswell. The wider landscape area is also settled throughout with individual dwellings and farms, and there are also schools, recreational, religious/institutional, industry and commercial land uses. Settlement in rural areas is linear, along the roads and is constant throughout the study area, though is denser near settlement centres and to the east of the River Maigue, closer to Limerick city.

Historical landscapes are also a feature of the study area. There were many demesnes and private estates in this area, many of which have left a legacy of mature trees, woodlands, avenues, walls, gates and many architectural and designed landscape elements which are prominent features of the present landscape.

In visual terms, the hills and mountains form the visual horizon in views from elevated areas. However, due to the undulating topography and the presence of mature hedgerows and trees, there is variability in the quality and availability of views throughout the landscape. These features often block, restrict or frame views within the landscape and distant views are rare within the study area. Along the coastal zone, views are extensive along and across the estuary to the north, but views inland are often restricted by the rising topography and mature vegetation.

The most sensitive views within the study area would be from individual dwellings, public areas or monuments, cemeteries, hotels, guest houses and listed views, especially those on elevated ground or with a view of a focal element (e.g. church spire, castle, towerhouse).

Some industrial elements are highly visible in the landscape, particularly around Foynes (Aughinish Island) and to a lesser extent at Askeaton. The tall industrial

plants and chimneys are focal elements in the landscape and prominent in any views of which they form part.

3.11.3 Assessment of Constraints

Development Plan Context / Landscape Character Assessment

The Limerick County Development Plan 2010-2016 (CDP) makes a number of specific references to landscape elements within the study area. The most relevant section is Section 7.3 - Landscape and Visual Amenity. This sets out the CDP objectives as they relate to the landscape and visual amenity of the county, including Landscape Character Assessment. As part of the Core Strategy for the county, Policy CP 10 proposes:

> *"To identify, conserve, protect and enhance the unique and diverse natural and built heritage of Limerick County and to implement the provisions of the National Biodiversity Plan to secure the conservation, including where possible the enhancement, and sustainable use of biological diversity in Limerick."*

Objective EH O5: Enhancing Tree Cover sets out the Council's intention that trees should be preserved:

> *"It is the objective of the Council to preserve and enhance the general level of tree cover within the County, both in the countryside at large and also in the County's towns. The Council strongly encourages the establishment of native species, in particular broadleaf species."*

Due to the level of cover across the study area and the quality of mature trees, this should be taken into account as a landscape constraint. Almost all field boundaries are heavily populated with good quality, mature parkland trees.

Sections 7.3.3 *Landscape Assessment and Landscape Character Areas* and 7.3.4 *Landscape Character Areas* set out the more specific landscape objectives as they related to different typologies throughout the county. The study area includes three of the ten identified Landscape Character Areas.

These are as follows: Area 1 - Agricultural Lowlands; Area 6 - Shannon Integrated Coastal Management Zone and Area 8 - Tory Hill.

Area 1 Agricultural Lowlands

This is the largest of the Landscape Character Areas in the County and comprises almost the entire central plain. This landscape is a farming landscape and is defined by a series of regular field boundaries, often allowed to grow to maturity. This well-developed hedgerow system is one of its main characteristics. In terms of topography the landscape is generally rather flat with some locally prominent hills and ridges. The pastoral nature of the landscape is reinforced by the presence of farmyards.

Objective EH O7 sets out the specific objectives with regard to the Agricultural Lowlands Landscape Character Area, the most relevant of which are as follows:

(b) Encourage retention of existing landscape features such as hedgerows and trees and their incorporation into landscaping for new developments.

(c) Discourage development of locally prominent sites.

Area 6 Shannon Integrated Coastal Management Zone

This zone comprises a large area of northern County Limerick and is bounded on one side by the Shannon Estuary while its southern boundary is defined by the gradually rising ground, which leads onto the agricultural zone and the western hills to the south west. The presence of the estuary is the defining characteristic of the region. The landscape itself is generally that of an enclosed farm type, essentially that of a hedgerow dominant landscape. This differs from the other agricultural landscapes of the County in that the field patterns, particularly close to the estuary, tend to be less regular than those elsewhere in the County.

Objective EH O12 sets out the specific objectives with regard to the Shannon Integrated Coastal Zone Landscape Character Area, the most relevant of which are as follows:

(b) To protect the views and prospects along the N69…., as a priority for the Planning Authority...

Area 8 Tory Hill

Tory Hill is an isolated locally prominent hill which is within 2km of the town of Croom and is visible from the Cork/Limerick road. It is an important feature in the surrounding countryside, and is of geologic importance as it is a limestone hill with deposits of gravel, which have been left since the last ice age. The hill supports areas of scrub and woodland as well as limestone grassland. The dominant nature of the hill, which rises from the surrounding flat landscape, magnifies the effect of development.

Objective EH O15 sets out the specific objective with regard to the Tory Hill Landscape Character Area, which states that *"It is an objective of the Council that there is a presumption against development in this location."*

Section 7.3.5 *Incorporation of Views and Prospects into Landscape Character Areas* sets out views and prospects that are to be protected. Two of the listed views are within the study area:

"the views of the Shannon estuary from Foynes to Glin"
"Tory Hill."

The former area is west of Foynes and only a small part of the designated viewshed is within the study area; less than 1km of the 14km from Foynes to Glin. The latter, Tory Hill is in the south-east of the study area and is included as its own landscape character area.

Section 7.3.6 sets out the importance of the listed views and prospects with respect to tourism:

"The scenic views and prospects in the west of the County such as the coastal route from Foynes onwards... help provide the basis of a number of attractions which include Foynes, the medieval town of Askeaton and Curraghchase Forest Park. These routes are indicative of the scenic nature of the surrounding landscapes."

"The Lough Gur and Tory Hill views and prospects further complement the attractions of Lough Gur itself." [Note: Lough Gur is approximately 8km to the east of the study area.]

Section 7.3.7 elaborates on the attractions of individual views and prospects. In

relation to the N69, the following is included:

> *"Other routes such as that along the N69 from Foynes are less suitable for walking purposes due to the busy road network yet at certain points along them they provide opportunities for visitors and locals alike to stop and enjoy the view."*

The same section also sets out the value of these views in the county, stating:

> *"The views and prospects which are incorporated into the County Development Plan indicate parts of the County that are valuable amenities for locals and visitors alike and which properly conserved could help to provide the basis for further development of the tourist industry in County Limerick."*

Objective EH O17: *Scenic Views and Prospects* sets out the following objectives with regard to listed views:

(a) *It is the objective of the Council to safeguard the scenic views and prospects by integrating them into landscape character areas, which will ensure a more balanced approach towards landscape issues within the County.*

(b) *In areas where scenic views and prospects are listed …. there will be a presumption against development except that which is required in relation to farming and appropriate tourism and related activities.*

(c) *The Planning Authority will exercise a high level of control (layout design, siting, materials used, landscaping) on developments in these areas. In such areas site specific designs are required...*

Section 7.3.8 Historical Landscapes draws attention to the wealth of historic landscapes in County Limerick:

> *"Historical landscapes can be defined as the archaeological and historical elements that survive in the current landscape. Limerick is rich in such areas."*

Features of these landscapes include field boundaries and old demesnes. Areas around and including the village of Adare are specifically mentioned as being important from an archaeological and historical perspective.

Objective EH O18: *Historical Landscape Characterisation* states that

> *"It is the objective of the Council during the lifetime of the plan to develop an historical landscape appraisal process, which will identify key historical landscapes within County Limerick."*

The above areas were considered and assessed as part of the landscape constraints at Route Development Stage.

Related policies include those on green infrastructure, ecology, biodiversity and natural and cultural heritage, which add to the requirements for protection of landscapes.

Public Amenity Areas / Walking Route

The most significant public amenity area within the study area appears to be Curraghchase Forest Park, which is run by Coillte. Part of the wooded area is enclosed and used for recreation. Other public amenity areas are the car parks and

trails to the west of Foynes, and the Aughinish Nature Trail. Refer to Drawing Nos. CS-095 to CS-099 in Volume 2 of this report.

Some of the villages and towns have small parks, playgrounds or public spaces, but these whilst important locally are not significant in the context of the constraints study. There are also landscape-related facilities in the study area, such as fisheries at lakes, for example at Bleach Lough, which would have sensitivity to visual or landscape change. Golf courses would also be sensitive to landscape change, and there are two courses within the study area.

The Great Southern Trail walking route is in the south-western part of the study area and follows a disused railway line from Rathkeale for over 35km to the west and south, through Limerick. A further stretch of the route which has not been developed, described as "undeveloped greenway" follows the dismantled railway line from Rathkeale to Ballingarrane, 2.5km north of Rathkeale. As this facility is aimed at recreational walkers and tourists and its landscape setting is a considerable part of the attraction, it would have high sensitivity to change.

Existing Trees and Woodlands

A very striking feature of this landscape is the amount of mature trees. Most of the trees are part of field boundary divisions and hedgerows, but there are also some significant individual parkland specimens and pockets of woodland throughout the study area. The species include natives such as Oak *(Quercus robur)* and Ash *(Fraxinus excelsior)* with small numbers of Pine *(Pinus sylvestris)* and Yew *(Taxus baccata)* but these are outnumbered by the non-native species including Beech *(Fagus sylvatica),* Horse Chestnut *(Aesculus hippocastanum),* Sycamore *(Acer pseudoplatanus),* Lime *(Tilia* spp.), Poplar *(Populus spp.)* and others. The large number of non-native trees indicates that many of the trees were deliberately planted, rather than self-seeded, and there are several tree-lined roads and avenues that form significant features in the landscape. It is likely that much of the tree cover was planted in the 19th and early 20th centuries and is a legacy of the private estates and demesnes.

The tree cover is very consistent throughout the site, with a slight change in some coastal areas, where the trees are smaller and they are fewer in number and species. However, even in many coastal areas, there are mature wooded areas, indicating a relatively benign climate.

Hedgerows are primarily Hawthorn *(Crataegus monogyna),* Blackthorn *(Prunus spinosa),* Hazel *(Corylus avellana)* with emergent trees including Elder *(Sambucus nigra),* Ash, Sycamore, Rowan *(Sorbus* spp.), Birch *(Betula pendula),* Aspen *(Populus tremula)* and parkland trees as listed above. Many ditches, river-/stream-banks and scrub areas contain Willow *(Salix* spp.), Alder *(Alnus glutinosa)* and other riparian species.

More recent planting includes evergreen shelterbelts (Monterey Cypress *[Cupressus macrocarpa]* and Leyland Cypress [X *Cupressocyparis leylandii]* are most frequent) and garden trees. Along the recently constructed roads and by-passes are plantations of Norway Maple *(Acer platanoides),* Field Maple *(Acer campestre),* Poplar *(Populus spp.),* Birch and Ash, among others.

Commercial forests are also present in the study area, with coniferous trees dominating. Coillte manage several forests, including some with recreational elements at Curraghchase and Foynes.

Almost all field boundaries and road boundaries contain significant trees, and there are mature standalone parkland trees in a significant proportion of fields throughout the study area.

Historical Landscapes

The 19th Century Ordnance Survey mapping for the area shows that there was a high concentration of private estates and demesnes in the study area. In some instances the word "demesne" has survived on current OS maps (even, in some cases, where the designed landscape associated with the demesne itself has not), and is appended to the house name as the current townland name. The legacy of these demesnes is the large number of mature parkland trees, woodlands, avenues and driveways, high stone walls and (often ornate) gates/piers/entrances, manor houses and other associated features in the landscape of the study area such as water bodies, canalised streams, limekilns, dovecotes, windmills, etc. The Limerick County Development Plan has made particular mention of the potential value of this landscape asset.

Approximately 99 such demesnes were identified on the historic mapping within, or adjacent to, the study area. The NIAH Survey of Gardens and Designed Landscapes for Limerick enables identification of the individual estates and their current value in the landscape. Most of the estates are described as having either only "peripheral features visible" or "virtually no recognisable features remaining". 30 properties were described as having "Main features substantially present – some loss of integrity". Further cross-referencing of these properties with the Record of Protected Structures (where the house or some other feature of the demesne is listed for protection) results in a shortlist of the properties most sensitive to landscape impacts, 23 in total, as follows:

(1) Adare Manor House
(2) Shannongrove House
(3) Mellon House
(4) Cooperhill House
(5) Dooneen House
(6) Green Mount
(7) Fort Etna
(8) Attyflin House
(9) Kilgobbin House
(10) Mondellihy House
(11) Curraghbridge House
(12) Clonshire Castle / Lodge
(13) Hollywood House, Ballinvira
(14) Castle Matrix
(15) Mount Southwell
(16) Rathkeale Abbey
(17) Curraghchase House / Demesne
(18) Ballinvirick House
(19) Inchirourke More

(20) Nantinan House
(21) Alta Villa
(22) Stoneville Demesne; and
(23) Dromore Castle demesne

The following three properties are those with *"Main features substantially present - some loss of integrity"* according to the NIAH Survey, but not listed on the RPS:

(24) Tervoe House;
(25) Ballyengland House; and
(26) Cloghanarold House.

The above properties are shown on Drawing Nos. CS-095 to CS-099 in Volume 2. The remaining properties are not mapped as they would not be considered a significant constraint for the purposes of this study, although groups of trees or woodlands or other landscape features associated with the demesnes may be considered worthy of protection, under another category within this report.

Whilst Ballysteen House is not considered by the NIAH Survey to have substantial value, the field research and its designation as an Architectural Conservation Area suggest that this should also be treated as a historic landscape at this stage of the process, due to the presence of some landscape features, such as mature parkland trees. Ballycullen House, near Askeaton (proposed for inclusion on the record of protected structures), is similarly considered to have limited value in the NIAH survey but there are also large mature trees present and could therefore be considered to be a historic landscape.

Other historical landscapes include archaeological monuments such as: Ringforts, Barrows, Fulachtaí Fia, Cists, from the Bronze and Iron Ages; ecclesiastical sites, churches, abbeys, medieval settlements, castles, towerhouses; and other monuments. Such monuments confer a "profound sense of the real presence of the past" ('Atlas of the Irish Rural Landscape', Aalen, Whelan and Stout, Second Edition, 2011). Their landscape setting is a part of this and is therefore vulnerable to change.

Existing Water Bodies

There are significant numbers of lakes, pools, rivers and streams across the study area, which add to the landscape and visual character of the area. They are also a key part of the green infrastructure of the area, which link all parts of the landscape. The Shannon Estuary is the largest water body in the study area. The main rivers are River Maigue, Barnakyle River, River Deel and Ahacronane River and there are numerous streams, creeks and ditches. Water elements are vulnerable to change, both in visual terms due to the structures required to cross them, and in landscape terms, as a change to the water table or drainage pattern can alter a landscape.

Visual Amenity

In general, the scenic quality of the study area is considered to be high, with lower values around settlements including the suburban environs of Limerick. The Architectural Conservation Areas of Foynes, Askeaton, Rathkeale, Ballysteen House and Adare would also have moderate to high visual value.

Where distant views occur in the study area, the hills and mountains of the Mullaghareirk Mountains form the visual horizon in views from elevated areas to the

south and west of the study area. To the north and west, the horizon is potentially much longer, and from elevated or coastal positions, the Shannon Estuary is a key feature. However, due to the undulating topography and the presence of mature hedgerows and trees, there is variability in the quality and availability of views throughout the landscape. These features often block, restrict or frame views within the landscape and distant views are rare within the majority of the study area. Along the coastal zone, views are extensive across the estuary and to the north, but views inland are often restricted by the rising topography and mature vegetation. As a result, the landscape could be said to have high visual absorption capacity in general, with local areas of sensitivity.

The most sensitive views within the study area would be from the listed viewpoints, coastal viewpoints, individual dwellings, public areas or monuments, cemeteries, hotels, guest houses and listed views, especially those on elevated ground or with a view of the coast or a focal element (e.g. church spire, castle, towerhouse). Important views within the study area are listed in Table 3.21.

Table 3.21 Significant views

Ref	Viewpoint	Description	Significance
V1	N69 - West of Foynes	Views of the coastal landscape and Shannon Estuary	Regional / National (Listed)
V2	N69 West of Ferrybridge, Kildimo	Views of the coastal landscape zone: Parkland and Castle at Dromore Lough; Open view from bridge over landscape	Local
V3	Tory Hill	Panoramic views west and north across the landscape of the study area - farmland, parkland, mature trees	Regional / National (Listed)
V4	Knockpatrick Cemetery	Elevated position (highest point near study area, 172m OD) - panoramic views across the study area to the east and across Shannon Estuary to Clare	Regional
V5	Askeaton Bypass Bridge	View of Askeaton - Friary and quays	Local
V6	Shanagolden – bridge in village	Framed view through valley to Shanid Castle in distance	Local
V7	Approaches to Adare on N21	Parkland setting and mature trees, key buildings	Local/ Regional
V8	Approaches to Rathkeale on R518 and R523	Parkland setting and mature trees, views of church steeple from surrounding areas	Local
V9	Beagh Castle	Publicly accessible castle ruin, with pier and panoramic views across the estuary, but limited views inland due to rising topography and mature trees	Regional
V10	Ringmoylan	Publicly accessible quay, with pier and panoramic views across the estuary, but limited views inland due to rising topography and mature trees	Regional

These views are indicated on Drawing Nos. CS-095 to CS-099 in Volume 2 of this

Report. There are many other views of local significance from local roads, of upstanding cultural heritage features, water bodies, farmland, trees and woodlands, etc. Views from individual dwellings vary from distant to enclosed. These views are not considered to be significant constraints in the context of this study, despite their potential sensitivity, as they cannot be quantified or assessed at this stage.

The visual setting of cemeteries is also considered to be sensitive to change, although many of the cemeteries in the study area are currently located adjacent to busy roads.

Designated Landscapes

Designated Landscapes can include Special Areas of Conservation, Natural Heritage Areas and Proposed Natural Heritage Areas, and Special Protection Areas. These areas are listed and mapped in the County Development Plan and on the Landscape Constraints Drawing Nos. CS-095 to CS-099. Whilst these are primarily ecological designations, they are also considered to be part of the green infrastructure within the landscape and can have landscape and visual significance as features within views.

Low Quality Landscapes in the Study Area

It should be noted that the landscape around Aughinish Island is of poor quality in visual terms due to the industrial buildings and the stockpiling of bauxite residue. There are also some other prominent industrial facilities in the Study Area, including concrete works on the western edge of Limerick, and Wyeth and Kingspan in Askeaton. These landscapes have low sensitivity to change.

Conclusions

The landscape of the study area is considered to have a low to moderate degree of sensitivity to change in general terms, with locally high sensitivity. Therefore, there is a likelihood of significant landscape and visual impacts arising from the proposed development to the following elements of the study area:

- Mature trees, hedgerows and woodlands (spread throughout the study area);
- Regionally significant views from elevated viewpoints, coastal zone and listed views;
- Views from dwellings throughout the study area;
- Historical landscapes - demesnes and monuments;
- Curraghchase Forest Park & other public amenity areas;
- Great Southern Trail walking route;
- Existing water bodies - rivers and lakes in particular; and
- Designated landscapes.

3.12 Noise and Vibration

3.12.1 Introduction

The purpose of this element of the constraints study was to identify any noise-sensitive locations which would have the potential to constrain the location of any proposed routes for the new road scheme. Examples of receptors include schools, houses, hospitals, places of worship, heritage buildings, special habitats, amenity areas in common use and designated quiet areas.

The following items are the principle focus of the study:

- identification of receptors;
- identification of any significant noise sources in the area;
- a description of the existing noise climate, and
- discussion of opportunities for mitigation.

The assessment was carried out in accordance with the TII documents *Guidelines for the Treatment of Noise and Vibration in National Road Schemes (Revision 1, 25 October 2004)* and the *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (March 2014).*

3.12.2 The Receiving Environment

The study area under consideration extends from the west of Limerick to Foynes Port along the River Shannon estuary in the north and to the south of the towns and villages of Rathkeale, Adare and Patrickswell in the south of the study area.

The receiving environment within the study area is predominately rural in nature with a number of villages and towns located throughout. In terms of the existing noise environment, the existing national roads which pass through the study area are considered to be the main sources which contribute to the existing noise environment, namely the N69 Road in the north and the N21, N20 and M20 Roads in the south. There are a number of residential dwellings located in ribbon style development along the road side and within villages and towns where these roads pass through, i.e. Foynes, Askeaton, Kildimo and Clarina along the N69 and Dooradoyle, Patrickswell, Adare, Croagh and Rathkeale along the N21/M20. Noise levels at noise sensitive locations along these roads are dominated by road traffic in addition to other urban sources in the larger towns.

Between the N69 and N21/M20 roads the study area under consideration is more rural in nature with a network predominantly consisting of small local roads, agricultural lands and woodland. Residential dwellings are distributed along the local road network typically in ribbon style development.

The scheme study area was examined to identify the distribution of noise and/or vibration sensitive receptors and to determine the presence, if any, of significant constraints relating to noise and/or vibration. On review of the study area, the majority of noise sensitive locations identified are located within the larger towns and villages, namely residences, schools, churches and health centres. In this instance, these locations, whilst considered to be noise sensitive in nature, are for the majority exposed to a range of existing noise sources, predominately road traffic noise.

Noise sensitive locations set back from existing high levels of noise are considered more sensitive given the lower noise environment which they are currently exposed to. In terms of the study area under consideration, these include equine areas which are set in more rural locations, residential dwellings set in quiet rural areas and amenity areas in quiet rural settings.

Section 3.8 of this report titled Agriculture and Agronomy discusses the distribution of equine enterprises within the study area. It notes that a number of enterprises involved in breeding and training of thoroughbred racehorses in addition to those involved in show jumping and riding centres are located within the study area. These locations were considered to be noise sensitive and potential constraints for the development of route options.

For residential dwellings, schools and churches set back from existing national primary routes, the alignment of route options should avoid, where possible, passing in close proximity to these areas.

It is important to note that the presence of the noise sensitive receptors listed above is not necessarily considered to be a strict constraint which would prevent the development of a route in close proximity to them. The purpose of this initial exercise is to highlight those areas which should be considered, where possible when developing options in conjunction with the other identified constraints. In this instance, where it is not possible to develop horizontal route options away from identified noise sensitive locations, consideration can be given to the vertical alignment, the use of natural screening or false cuttings to act as noise buffers and mitigation measures as part of the base design.

Given the suburban nature of parts of the study area, it will not be possible to avoid every noise sensitive location within the scheme Study Area. It is also important to note that a large proportion of noise sensitive locations are currently located in proximity to existing busy roads or within areas exposed to noise from other urban and sub-urban sources.

3.13 Air Quality

3.13.1 Introduction

The constraints study for air quality was carried out in accordance with the TII's Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes (2011) and guidance from the UK Design Manual for Roads and Bridges (DMRB) Vol 11 Section 3. The prevailing ambient air quality, the main sources of air pollution and the most sensitive receptor locations within the study area are described in this section.

3.13.2 Air Pollution Sources

The major source of air pollution within the study area is road traffic, predominantly that from the national roads M20, N20, N69, N21 and to a lesser extent the regional roads R521, R518 and R526. Air quality is variable and subject to significant spatial variation, with concentrations generally falling significantly with distance from major road sources. The highest levels of air pollution, whilst well within limits, are experienced along the M20, N20, N69 and N21 with the remainder of the study area generally experiencing rural background concentrations of pollutants.

A review of Integrated Pollution Prevention and Control (IPPC) licences issued by the Environmental Protection Agency (EPA) for the region show that there are 9 IPPC licenced facilities with emissions to the atmosphere within the study area for this project. All of these facilities must comply with emission limit values as stipulated in their IPPC licences.

3.13.3 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) according to the World Health Organization (WHO) Air Quality Guidelines - Global Update 2005. 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} (particulate matter less than 10 microns), the situation is more complex due to the range of sources of this pollutant, and thus measured levels of PM_{10} can be a non-linear function of wind speed.

The nearest weather station collating detailed weather records is Shannon Airport meteorological station. This station is located approximately 8 km north of the N69 and approximately 3 km north of the northern boundary of the study area. For data collated from the station between 1981 - 2010, the annual average wind speed is approximately 4.7 m/s. For data collected between 2000-2002 and 2004-2005, the predominant wind ranges from south-westerly to westerly in direction.

3.13.4 Air Quality Zones in Ireland

As part of the implementation of the Framework Directive on Air Quality (1996/62/EC), four air quality zones have been defined in Ireland for air quality management and assessment purposes. Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 15 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000 is defined as Zone D. In terms of air

monitoring, the study area is predominantly categorised as Zone D whereas the eastern part of the study area is defined as Zone C as it incorporates the suburbs of Limerick City.

3.13.5 EPA / Local Authority Monitoring Programmes

Air quality monitoring programmes have been undertaken throughout Ireland in recent years by the EPA and Local Authorities. The most recent EPA annual report on air quality monitoring undertaken throughout Ireland at the time of preparing the Constraints Study Report is entitled *"Air Quality Monitoring Annual Report 2013".*

Continuous EPA monitoring is carried out for NO_2 (nitrogen dioxide) and PM_{10} at rural Zone D locations at Kilkitt (Monaghan) and Glashaboy (Cork). In addition, the EPA carried out continuous monitoring at Castlebar (Mayo) and Shannon Town (Clare) which are urban Zone D locations. Furthermore, long-term monitoring was carried out at the Zone C locations of Ennis (Clare) and Limerick in 2011. Although no EPA or Local Authority monitoring has been carried out within the study area, data from Zone C and D locations in Ireland can be used to provide an indication of the prevailing air quality conditions.

3.13.6 Review of EPA Monitoring Data

The TII Guidelines state that the local air quality assessment should focus on NO_2 and PM_{10}, as these are the pollutants of greatest concern with respect to road traffic conditions.

Long-term NO_2 monitoring was carried out at the two rural Zone D locations, Emo (Laois) and Kilkitt in 2013. The NO_2 annual averages in 2013 for Emo and Kilitt were 4 and 4 $\mu g/m^3$, respectively. These concentrations are significantly lower than the limit value and would be broadly representative of the prevailing NO_2 concentrations at distances of 250m or greater from the national roads within the study area. A conservative estimate of the current rural background NO_2 concentration in the study area is 10 $\mu g/m^3$.

The results of NO_2 monitoring carried out at urban Zone D location in Castlebar in 2013 indicated average NO_2 concentrations of 11 $\mu g/m^3$, with no exceedances of the 1-hour limit value. Furthermore, the NO_2 annual average in 2013 for the Zone C locations of Kilkenny Seville Lodge and Mullingar (Westmeath) ranged from 4-6 $\mu g/m^3$. Hence long-term average concentrations measured at these locations were significantly lower than the annual average limit value for NO_2 of 40 $\mu g/m^3$. Based on the above information, a conservative estimate of the current background NO_2 concentration close to the national roads within the study area and at small towns and villages in the study area is 12 $\mu g/m^3$.

Long-term PM_{10} monitoring is carried out at the rural Zone D location of Kilkitt. The average concentration measured at Kilkitt in 2013 was 11 $\mu g/m^3$. This concentration would be broadly representative of the prevailing PM_{10} concentration at distances of 250m or greater from the national roads within the study area. A conservative estimate of the current rural background PM_{10} concentration in the study area is 12 $\mu g/m^3$.

Long-term PM_{10} measurements carried out at urban Zone D locations in Castlebar and Claremorris (Mayo) in 2013 gave average levels of 13 - 15 $\mu g/m^3$. Data from the Phoenix Park in Dublin also provides a good indication of urban background levels, with an annual average in 2013 of 14 $\mu g/m^3$. Hence long-term average

concentrations measured at these locations were significantly lower than the annual average limit value for PM_{10} of 40 $\mu g/m^3$. Based on the above information, a conservative estimate of the background PM_{10} concentration close to the national roads within the study area and at small towns and villages in the study area is 15 $\mu g/m^3$.

3.13.7 Sensitive Receptors

The largest number of sensitive receptors within the study area is located along the N69 and N21, in particular at Rathkeale, Askeaton, Adare and on the outskirts of Limerick City. There are also villages at Foynes and Pallaskenry and smaller population centres at Mungret, Clarina, Kildimo, Shanagolden and Croagh. A number of schools are located within the aforementioned towns and villages. The village of Adare on the N21 and many of the villages along the N69 experience elevated pollution levels from traffic queuing and congestion, especially with regard to HGVs. The project will provide a high quality road connection between Shannon Foynes Port and Limerick which will lead to reduced journey times and improved safety. As there will be less congestion on the proposed high quality road connection, sensitive locations in the region which are affected by port traffic between Foynes and Limerick, will experience an improvement in air quality.

The most sensitive receptor with respect to air quality impacts on ecology is the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA, which are located to the northern parts of the study area. Other SACs in the study area include Barrigone, the Askeaton Fen Complex, Curraghchase Woods and Tory Hill. There are also a number of pNHAs in the study area to be considered in this regard.

3.13.8 Opportunity for Mitigation

Assessment of air quality (particularly focusing on PM_{10} and NO_2), at the most sensitive receptors in the study area will be carried out at the various stages of the design phase of the scheme, in order to ensure that required ambient limit values for the protection of human health are not exceeded.

3.14 Summary and Conclusion

The study area for the Foynes to Limerick Road Improvement Scheme has been determined largely by reference to the project objectives, the range of possible route options envisaged and the extent of the previous studies that were undertaken for the following projects:

- N21 Adare Bypass;
- N21 Abbeyfeale to Adare Scheme; and
- M20 Cork Limerick Motorway Scheme

The study area extends from south of the existing N21 through to the Shannon estuary at its northern extent. To the west, the study area extends from Foynes through to the Limerick Southern Ring road at the east (see Drawing No. CS-002 in Volume 2 of this report). The topography is dominated by undulating lowlands, floored by limestone of Lower Carboniferous (Dinantian) age which are generally covered by glacially deposited sediments and alluvium. The study area has a road network ranging from Motorways, National Primary and Secondary Roads to a network of Regional and Local Roads.

The geological and hydrogeological study has shown up potential constraints, in particular areas of fen which can be a constraint to the route of the road.

There are a significant number of designated European Sites within the study area including the Lower River Shannon SAC (site code no. 002165) and River Shannon and River Fergus Estuaries SPA (site code no. 004077), a large woodland complex at Curraghchase Woods SAC (site code no. 000174) which supports a hibernation site of the Lesser Horseshoe Bat, a species listed on Annex II of the EU Habitats Directive. The Askeaton Fen Complex SAC (site code no. 002279) includes a number of individual sites scattered to the north and south of the N69. The fens occur in basins between undulating hills in an otherwise intensive agricultural landscape. While the fens are designated the supporting streams and ground surrounding them also need to be considered for potential impacts. Barrigone SAC and a number of pNHA's also require consideration.

Non-designated areas of woodland, turlough, scrub with potential high ecological value also occur along the course of the River Ahacronane in the townlands of Deelish and Creeves (Shanagolden), and in the vicinity of the Askeaton Fen Complex to the west of Curraghchase. The River Deel and the River Ahacronane will both require crossings with due consideration given to both the potential for direct impacts on aquatic habitats and species and for indirect impacts on the Lower River Shannon SAC/ River Shannon and River Fergus Estuaries SPA.

One of the principal ecological constraints is the crossing of the River Maigue. This crossing will need to be delivered in a manner which does not result in any significant impact on the site's integrity or any of the qualifying interests of the European Sites.

The study has shown that there is a large cultural heritage resource within the area, with numerous sites of architectural, archaeological and industrial archaeological significance identified. This has had an important bearing on the route options considered for the scheme.

Within the study area, the majority of noise sensitive locations identified are located within the larger towns and villages within the study area, namely residences,

schools, churches and health centres. In this instance, these locations, whilst considered to be noise sensitive in nature, are for the majority exposed to a range of existing noise sources, predominately road traffic noise. Furthermore noise sensitive locations set back from existing high levels of noise are considered more sensitive given the lower noise environment which they are currently exposed to. In terms of the study area under consideration, these include equine holdings which are set in more rural locations, residential dwellings set in quiet rural areas and amenity areas in quiet rural settings.

With regard to air quality the largest number of sensitive receptors, within the study area are located along the N69 and N21, in particular at Rathkeale, Askeaton, Adare and on the outskirts of Limerick City. There are also villages at Patrickswell, Foynes and Pallaskenry and smaller population centres at Mungret, Clarina, Kildimo, Shanagolden and Croagh. With respect to air quality impacts on ecology, the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA, are located to the northern parts of the study area. Other designated areas within the study area include the Askeaton Fen Complex, Curraghchase Woods, Barrigone, Tory Hill SACs and a number of pNHAs including Adare Woodlands.

In terms of agriculture the land use is almost entirely grassland-based with farming practices in the study area predominantly beef related. There is a dairy sector comprised of dairy farms operating at or in some cases significantly above the national average dairy farm size. There is a strong equine industry in Limerick and the study area is well represented by Limerick Racecourse, equestrian centres and several prominent stud farms and horse trainers.

The landscape within the study area is rolling to undulating, with hills to the western edge and south of the study area, which are part of the Mullaghareirk Mountains. The coastal edge tends to slope steeply before giving way to the rolling farmland. There are numerous rivers, lakes and streams in the area, adding to the rural agricultural character of the landscape, as well as several wooded areas.

The information collected was both wide ranging and comprehensive and provided a sound basis for the development of route options. Collection of data continued through the Route Selection Stage, and beyond, concentrating on the route corridors and on the Preferred Route corridor in turn when it was identified.

A list of the key consultees for the constraints stage is presented in Table 3.22 overleaf.

Table 3.22 Constraints Study – Key Consultees

Consultee
Transport Infrastructure Ireland (TII)
Office of Public Works (OPW)
Eir (Formerly Eircom)
Irish Rail (IR)
Electricity Supply Board (ESB)
ESB networks
Gas Networks Ireland (Formerly Bord Gáis)
National Parks and Wildlife Service (NPWS)
Environmental Protection Agency (EPA)
Department of Arts, Heritage and Local Government
Inland Fisheries Ireland
Limerick City and County Council
Road Safety Authority
Teagasc
Coillte
An Taisce

Chapter 4 Traffic Assessment

4.1 Introduction

This chapter outlines details of the following traffic modelling related information;

- Summary of Traffic Modelling
- Assessment of Route Options
- Initial Selection of Road Type
- Consideration of Preliminary Junction Strategy

4.2 Summary of Traffic Modelling

This section outlines the development of the Local Area Model (LAM) that was developed to assess the traffic impacts of the route options for the Foynes to Limerick Road Improvement Scheme. The key model development processes are discussed under the following headings:

- Traffic Model Study Area;
- Traffic Modelling Software;
- Traffic Data Collection;
- Network Development;
- Matrix Development;
- Model Calibration/Validation; and
- Future Year Forecasts.

4.2.1 Traffic Model Study Area

The Foynes to Limerick Road Improvement Scheme study required a traffic model which could assess the potential scheme impacts along the corridor from Foynes to Limerick encompassing the existing N69, N21, M20 and N20 national roads. In addition, the model was also required to understand how a proposed scheme might attract traffic from regional and local roads to a new route alignment in the event of a corridor upgrade. As such, the model boundary was defined to enable these impacts to be assessed. The resultant traffic model study area is illustrated in Figure 4.1 below.

Figure 4.1 Traffic Model Study Area

4.2.2 Traffic Modelling Software

The National Traffic Model (NTM) has been developed by Transport Infrastructure Ireland (TII) using the transportation planning software platform VISUM[1]. VISUM is a strategic modelling tool that can be used to assess the following:

- The effects of land use change and development;
- Traffic management and network changes as well as junction revisions; and
- Effects of overall economic growth and increased pressure on the network;

The NTM covers the entire national and regional road network and is used by TII as a tool in the appraisal of potential road schemes, land-use and policy changes. The NTM provides demand data for Light Vehicles (Cars & Light Goods Vehicles) and Heavy Vehicles (Other Goods Vehicle 1, Other Goods Vehicle 2 and Buses/Coaches) for the following time periods:

- Average AM Peak Hour (average hour between 07:00 – 09:00); and
- Average Inter Peak Hour (average hour between 12:00 – 14:00).

The NTM is high level strategic traffic model and though it is suitably refined to test impacts on a national scale it is not detailed enough to assess local impacts on the road network. The model was therefore used as a starting point to provide both the initial road network and demand matrices for the development of a Local Area Model (LAM). The Foynes to Limerick LAM is an enhancement of the relevant section of the NTM and as such was also developed using VISUM.

[1] VISUM - **V**erkehr **I**n **S**tadten **UM**legung (Urban Transport Assignment)

4.2.3 Traffic Data Collection

In order to develop the LAM, a significant volume of traffic data was required to ensure that the model could replicate existing traffic patterns and volumes. A series of detailed traffic surveys were therefore undertaken in order to inform the development of the Base Year (2014) LAM. The surveys undertaken included:

- Junction Turning Counts (JTC);
- Origin-Destination Surveys (OD);
- Automatic Traffic Counts (ATC); and
- Journey Time Surveys (JTS).

The following sections describe the collation of traffic data for the construction of the Base Year (2014) LAM.

Junction Turning Counts (JTC)

A Junction Turning Count (JTC) captures the number of vehicles turning at a junction and observes the direction that the vehicles turn. Additionally JTCs classify the traffic into different vehicle categories. JTC surveys were undertaken at 27 junctions on Tuesday 20th May 2014 between 07:00-19:00. Traffic flow was classified by vehicle type and recorded in 15 minute time intervals. The JTC survey locations are indicated in Figure 4.2 below.

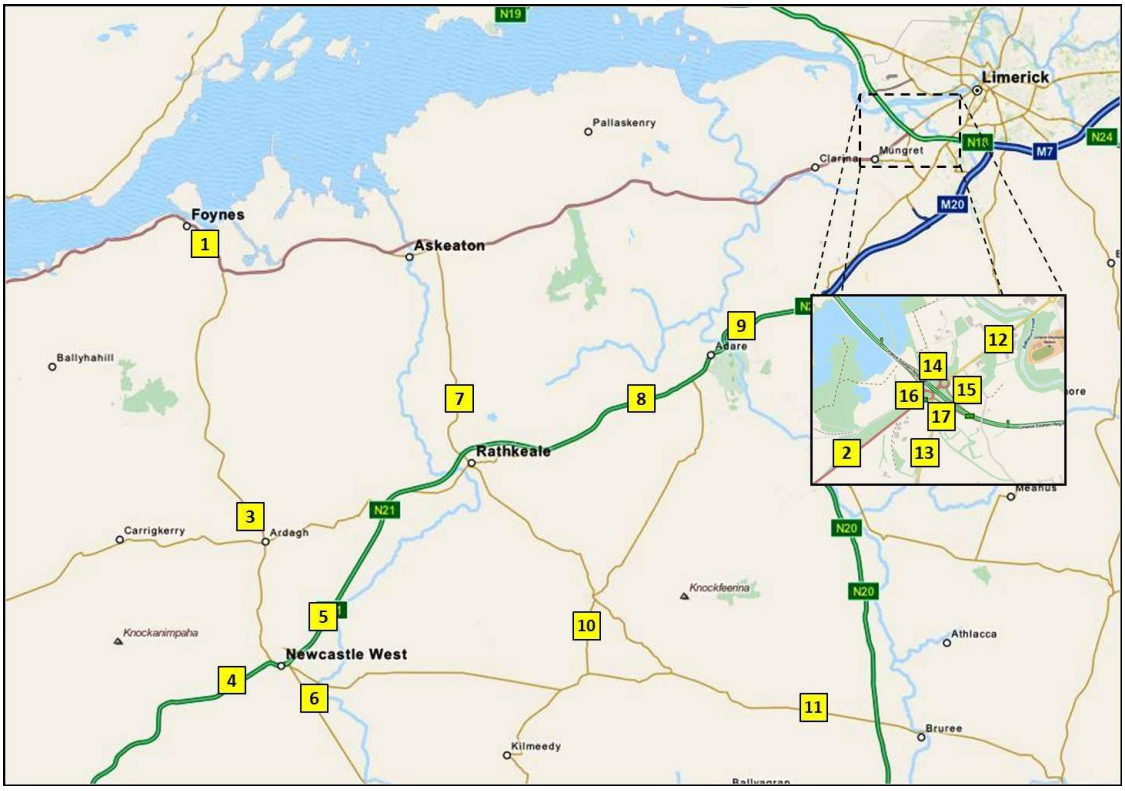
Figure 4.2 Overview of JTC Survey Locations

Origin Destination (OD) Surveys

Origin Destination (OD) surveys were conducted using Automatic Number Plate Recognition (ANPR) technology for all traffic passing through the 17 sites as identified in Figure 4.3 below. The surveys were carried out on Tuesday 20th May 2014 at 17 sites between 07:00-19:00. Additional ANPR surveys were also carried out at these same sites on Wednesday 4th June 2014 between 06:00 – 08:00 & 15:30 – 20:00.

The OD data collected was used to produce 17 x 17 matrices for the sites indicated in Figure 4.3. Matrices were developed for every hour for the duration of the survey. The matrices were developed based on a "First Seen, Last Seen" format where each vehicle was input as an OD pair based on the first and last site it was seen in the survey area i.e. a trip from 4-5-8-9 is shown as a trip from 4-9 only.

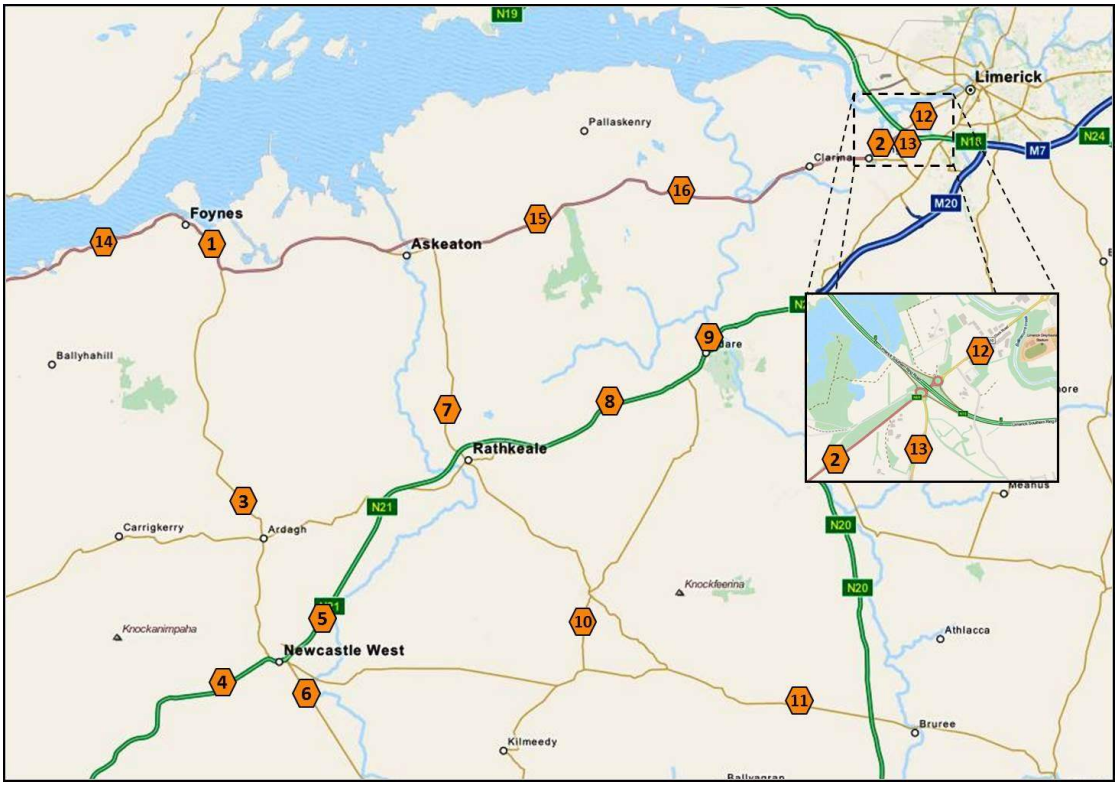
Figure 4.3 Overview of ANPR Survey Locations



Automatic Traffic Counts (ATC)

An Automatic Traffic Count (ATC) captures the traffic flow passing a given point on a road and classifies the flow into different vehicle classifications, for example cars, Light Goods Vehicles (LGV) and Heavy Goods Vehicles (HGV). ATC surveys were carried out at 13 of the ANPR sites along with an additional 3 sites along the existing N69 between the 19th May and the 1st June 2014. Figure 4.4 below details the location of the ATC sites throughout the study area.

Figure 4.4 Overview of ATC Survey Locations



In addition to the ATC counts traffic data from all permanent TII Traffic Monitoring Units (TMU) in the study area was assessed. Figure 4.5 below outlines the location of the permanent TMUs within the traffic model study area.

Figure 4.5 TII Traffic Monitoring Units within the Study Area

2014 Traffic Volumes

The traffic flow data extracted from the 16 ATC surveys undertaken over a 14 day period in May & June 2014 is presented in Table 4.1 below for the following time periods:

- AM Peak Hour (08:00 – 09:00);
- Average Inter Peak Hour (average hour between 12:00 – 14:00); and
- PM Peak Hour (17:00 – 18:00).

Table 4.1 also provides annual average estimates of both weekday (Mon – Fri) and 7 day traffic flow. In order to estimate the annual data, seasonality factors were developed from the TII TMUs within the study area and applied to the survey data. The following estimates are provided:

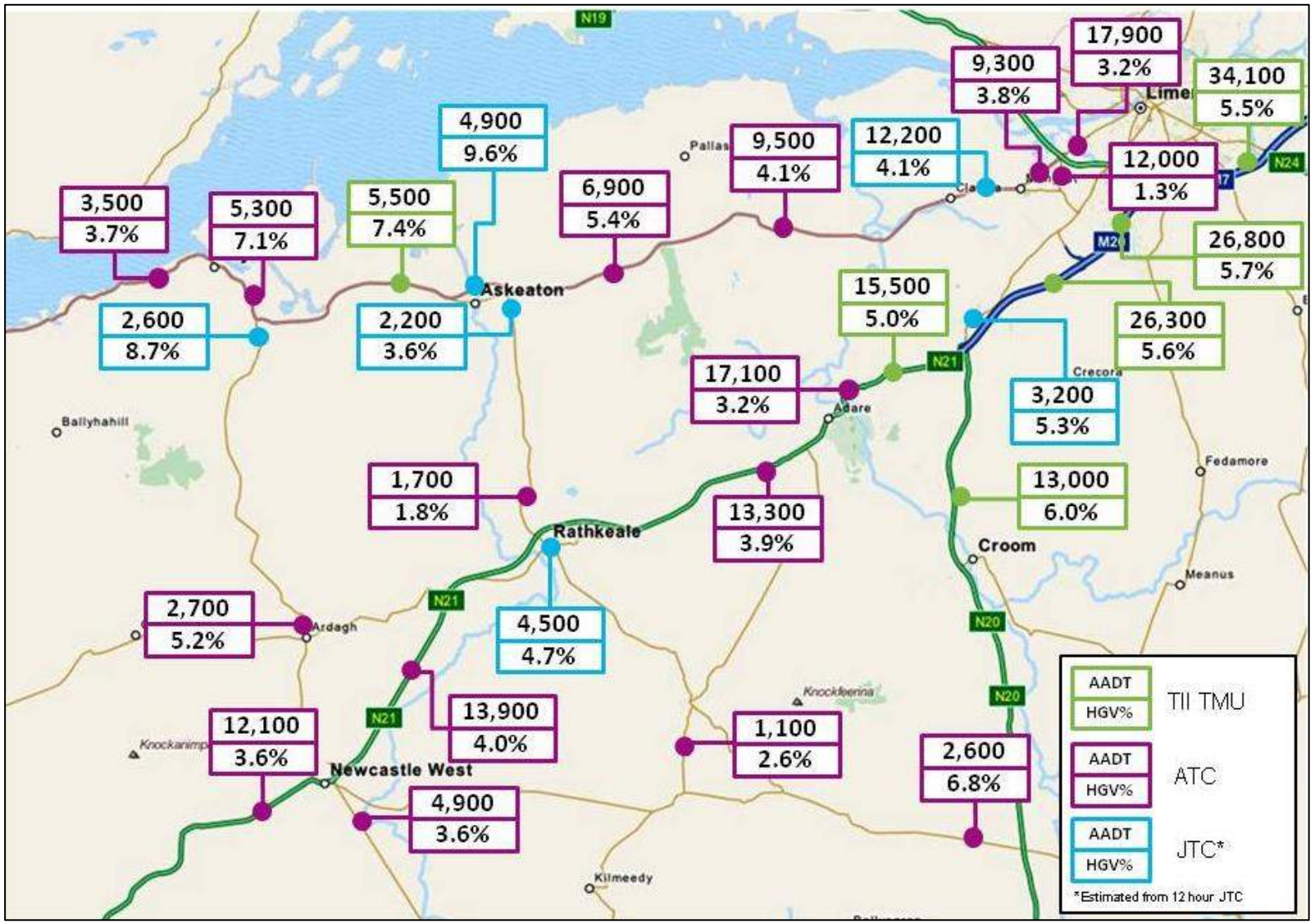
- 2014 Annual Average Weekday Traffic (AAWT); and
- 2014 Annual Average Daily Traffic (AADT).

The AADT estimates including their percentage HGV content are also presented graphically in Figure 4.6.

Table 4.1 Automatic Traffic Counter Data 2 Way Flow (2014)

Site No.	Location	Vehicles Per Hour			Vehicles Per Day	
		AM	IP	PM	AAWT	AADT
1	N69 - 900m west of N69/R521 Jct.	291	314	444	5512	5287
2	N69 - 400m southwest of N18 Jct.	725	552	853	9699	9303
3	R521 - 900m north of Ardagh	163	164	202	2819	2704
4	N21 - 450m west of N21/R521 Jct.	763	800	973	12619	12104
5	N21 - 1km northeast of N21/R522 Jct.	899	858	1099	14482	13890
6	R522 - 1km south of N21	325	290	395	5116	4907
7	R518 - 500m north of N21	119	97	147	1823	1749
8	N21 - 1km West of N21/R519 Jct.	985	821	1071	13899	13331
9	N21 - 500m east of River Maigue Bridge	1310	1077	1224	17821	17094
10	R519 - 600m south of R519/R518 Jct.	85	65	81	1119	1074
11	R518 - 1km West of N20/R518 Jct.	206	146	218	2665	2556
12	Dock Rd - 200m northeast of N18 Jct.	1481	1163	1498	18690	17927
13	R510 - 300m south of N18 Jct.	1048	771	1067	12560	12048
14	N69 - 2.5km west of Foynes	145	227	305	3623	3460
15	N69 at Ballyvogue 4 km east of R518 Jct.	453	389	608	7201	6907
16	N69 - 2.2 km west of Ferry Bridge	729	512	895	9876	9473

Figure 4.6 2014 Estimated AADT & Percentage HGV Summary



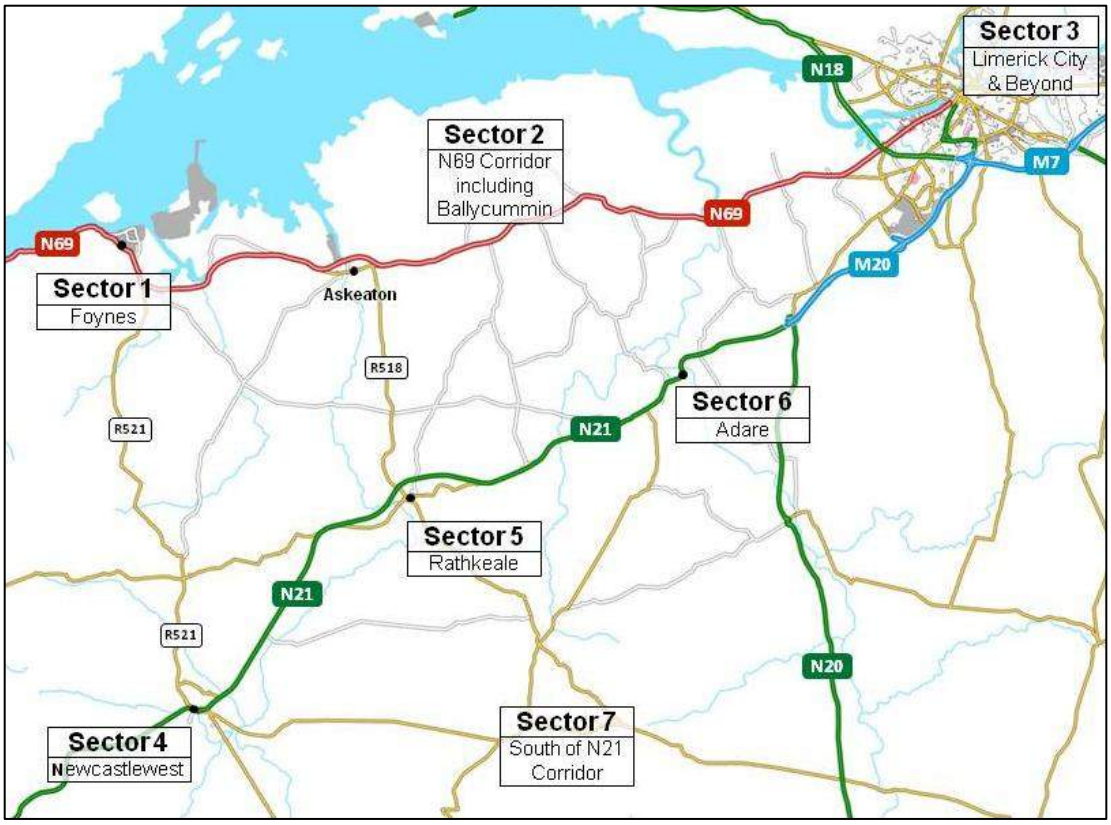
From the above table and graph we can see that M20/N21 corridor carries the greatest volume of traffic in the study area with a volume of 26,800 AADT observed on the M20 in the vicinity of Limerick City. On the N21 a volume of 17,100 AADT is observed east of Adare, this reduces to 13,300 AADT west of Adare after which the volume remains reasonably consistent through Newcastle West where figures of 13,900 AADT and 12,100 AADT are observed to the east and west of the town respectively.

On the N69 corridor the highest traffic volume recorded is 17,900 AADT to the east of the N18 / Dock Road interchange in the vicinity of Limerick City. The volume reduces to 12,200 AADT west of the N18 / Dock Road interchange and 9,500 AADT at Kildimo. After Kildimo the traffic reduces substantially with volumes of 6,900 AADT being recorded to the east of Askeaton reducing further to 5,300 AADT east of Foynes.

Results of Origin Destination Surveys

For the purpose of presenting a high level summary of the data, the Origin-Destination dataset has been divided into seven sectors as shown in Figure 4.7 below. A more detailed analysis was used in the calibration and validation of the model.

Figure 4.7 ANPR Sectors



Traffic travelling to/from the N18/M7 has been included in Sector 3 and traffic travelling further southwest along the N21 and R522 past Newcastle West has been included in Sector 4. Sector 2 covers the length of the N69 from Foynes to Mungret and includes Ballycummin.

The analysis of the Origin/Destination patterns of traffic as revealed from the ANPR surveys are summarised in the following sections. The vehicular movements were analysed for both Light Vehicle travel patterns and Heavy Vehicle travel Patterns.

Light Vehicle Travel Patterns AM Peak

During the AM peak hour (08:00 to 09:00) a strong desire line between Sector 1 (Foynes) and Sector 2 (the N69 corridor) was noted. Indeed 63% of traffic originating at Sector 1 has a destination along the N69 corridor. A strong desire line was also noted from Sector 1 (Foynes) to Sector 3 (Limerick City & beyond) with 29% of traffic originating at Sector 1 being last seen in Sector 3 (Limerick City and beyond). The balance of traffic from Sector 1 (Foynes) was dispersed across the remaining sectors in the study area.

From Sector 2 (N69 corridor) the strongest desire line was to Sector 3 (Limerick City & beyond), with 48% of traffic originating in Sector 2 (N69 corridor) having a destination in Sector 3 (Limerick City & beyond). After Sector 3 the second highest level of demand was seen for destinations within Sector 2 itself, with 29% of traffic originating in Sector 2 also having a destination in Sector 2 (N69 corridor).

From Sector 3 (Limerick City & beyond) there was a reasonable connection with Sector 2 (N69 corridor), with 14% of traffic originating in Sector 3 having its destination in Sector 2. From Sector 3 there is also a strong connection with the N21 corridor (Sectors 4, 5 and 6), and indeed 26% of traffic originating in Sector 3 had a destination along the N21 corridor. However the bulk of traffic (60%) originating in Sector 3 remained within the Sector 3 cordon.

From the N21 corridor (Sectors 4, 5 and 6) a strong desire line was noted with Sector 3 (Limerick City & beyond), particularly from Sector 6 (Adare) which showed 71% of traffic having a destination within Sector 3. A reasonable level of interconnectivity was also noted between Sectors 4 (Newcastle West) and 5 (Rathkeale), with 29% of traffic originating in Sector 5 having a destination in Sector 4.

Heavy Vehicle Travel Patterns AM Peak

For HGV traffic during the AM peak hour (08:00 to 09:00) a strong desire line between Sector 1 (Foynes) and Sector 3 (Limerick City & beyond) was noted with 63% of traffic originating at Sector 1 having a destination in Sector 3.

Sector 1 also has a strong connection with Sector 2 and Sector 4, with 13% and 15% respectively of traffic originating in Sector 1 having a destination in these Sectors. Sector 4 has a strong connection with Sector 3, with 64% of traffic originating in Sector 4 having a destination in Sector 3.

A strong desire line between Sector 6 (Adare) and Sector 3 (36%) (Limerick City & beyond) and Sector 4 (55%) (Newcastle West) was also revealed in the OD patterns emphasising the strategic importance of the N21 corridor.

A strong desire line was also noted from Sector 3 to Sectors 2 and 4 (the N69 corridor and Newcastle West) with 18% and 14% respectively of HGV traffic

originating in Sector 3 having a destination in these sectors during the AM peak hours.

Light Vehicle Travel Patterns PM Peak

During the PM peak hour (17:00 to 18:00) a strong desire line between Sector 1 (Foynes) and Sector 2 (N69 corridor) was again noted. Of the traffic originating in Sector 1, 68% had a destination along the N69 Corridor (Sector 2) with 20% having a destination in Sector 3 (Limerick City & beyond). The remaining traffic from Sector 1 was dispersed across the remaining sectors in the study area.

From Sector 2 (the N69 corridor) the strongest desire lines during the PM peak hours were to Sectors 1 (26%) and 3 (26%).

From Sector 3 (Limerick City & beyond) there was a reasonable connection with Sector 2 (N69 corridor), 15% of traffic, and Sector 4, 12% of traffic. Again however the bulk of traffic (57%) originating in Sector 3 remained within the Sector 3 cordon.

From the N21 corridor (Sectors 4, 5 and 6) a strong desire line was noted with Sector 4 and Sector 3. Indeed the strongest desire line noted in the PM peak hours is between Sector 6 and Sector 3, with 69% of traffic first seen at Sector 6 (Adare) having a destination in Sector 3 (Limerick City & beyond).

Heavy Vehicle Travel Patterns PM Peak

For HGV traffic during the PM peak hour (17:00 to 18:00) a strong desire line between Sector 1 (Foynes) and Sector 3 (Limerick City & beyond) was noted with 58% of traffic originating at Sector 1 having a destination in Sector 3.

Sector 1 also has a strong connection with Sector 2 and Sector 4, with 20% and 15% respectively of traffic originating in Sector 1 having a destination in these sectors.

The connection between Sector 4 and Sector 3 is less notable in the PM peak hours, with 26% of HGV traffic originating in Sector 4 having a destination in Sector 3. Substantial HGV traffic from Sector 4 was noted having a destination within Sector 4 itself (19% of HGV traffic from Sector 4), and in Sector 5 (22% of HGV traffic from Sector 4) during the PM peak hours.

A strong desire line for HGV Traffic between Sector 6 (Adare) and Sector 3 (Limerick City & beyond 43%) and Sector 4 (Newcastle West 29%) was again also revealed in the PM peak OD patterns emphasising the strategic importance of the N21 corridor.

A strong desire line was also noted from Sector 3 to Sector 2 (N69 corridor) with 13% of HGV traffic originating in Sector 3 having a destination in Sector 2 during the PM peak hours. Less HGV traffic is attracted to the N21 corridor destinations during the PM peak hour.

Journey Time Survey Results

Journey time information was also collated from the ANPR 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. A cap was placed on the recorded journey times from the ANPR data in order to ensure trips with short stops were excluded. Analysis was also undertaken to remove statistical outliers from the data.

The journey times represent an average of journey time surveys captured on Tuesday 20th of May 2014.

Traffic delays and congestion through the village are regularly reported Adare. In order to capture traffic delay through Adare across an extended period (2 weeks) additional journey time surveys were undertaken in October 2015. These surveys were undertaken using Bluetooth tracking devices which capture the Bluetooth signal emanating from mobile phones and car kits in vehicles travelling along a selected route.

The ANPR and Bluetooth data was used to validate the base year models against a total of 12 journey time sections which are illustrated below in Figures 4.8 and 4.9. The selected route along the N21 through Adare was from the N21/L1424 roundabout (Lantern Lodge) east of Adare to the N21/R519 junction (Murphy's Cross) west of Adare.

Details of the resultant journey times and average speeds for the AM, Inter and PM Peak periods are presented in Table 4.2 below.

Figure 4.8 Journey Time Sections

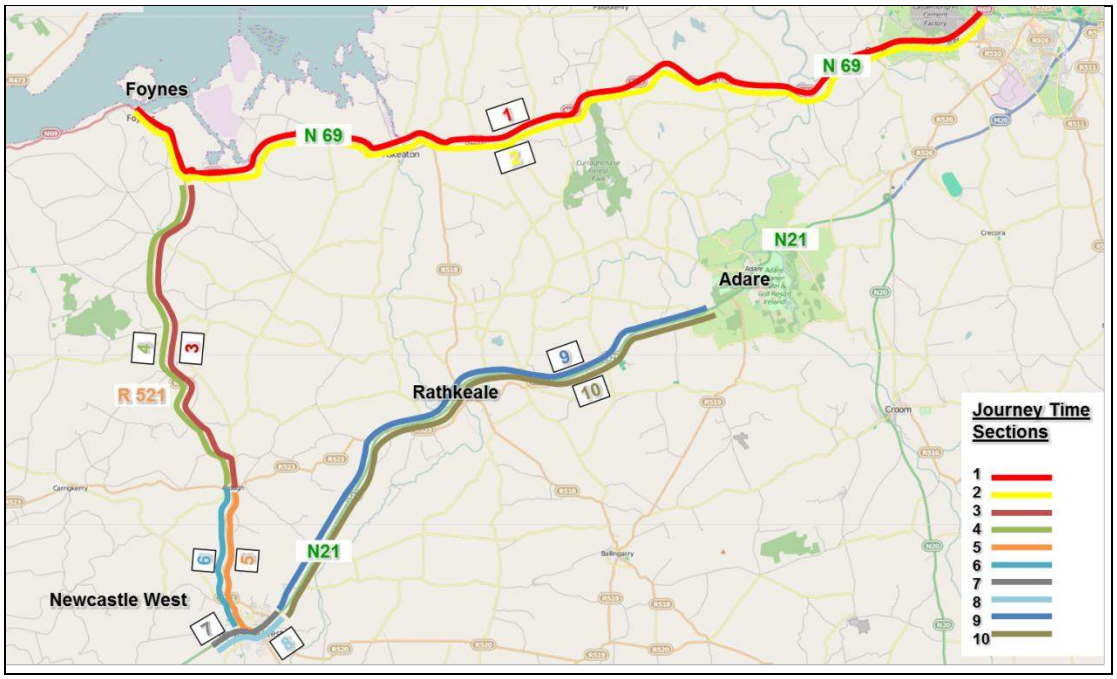


Figure 4.9 Adare Journey Time Sections

Table 4.2 Average Journey Times & Speeds during Peak Hours

Route No.	Section	Direction	Distance (km)	Average Journey Times (min:sec)			Average Speeds (kph)		
				AM	IP	PM	AM	IP	PM
1	N69 Foynes to Limerick	EB	32.3	28	28	26	70	69	74
2		WB	32.3	27	28	27	72	68	71
3	R521 Foynes to Ardagh	SB	13.5	12	11	12	70	74	66
4		NB	13.5	11	12	12	71	69	67
5	R521 Ardagh to Newcastle West	SB	7.4	11	11	12	42	40	37
6		NB	7.4	11	12	10	42	37	42
7	N21 through Newcastle West Town	EB	2.1	03	04	03	42	35	38
8		WB	2.1	03	04	03	38	31	38
9	N21 Newcastle West to West of Adare	EB	20.0	14	13	14	84	90	86
10		WB	20.0	14	14	14	88	85	85
11	N21 Through Adare Village	EB	2.5	06	05	04	24	32	35
12		WB	2.5	04	05	09	36	30	16

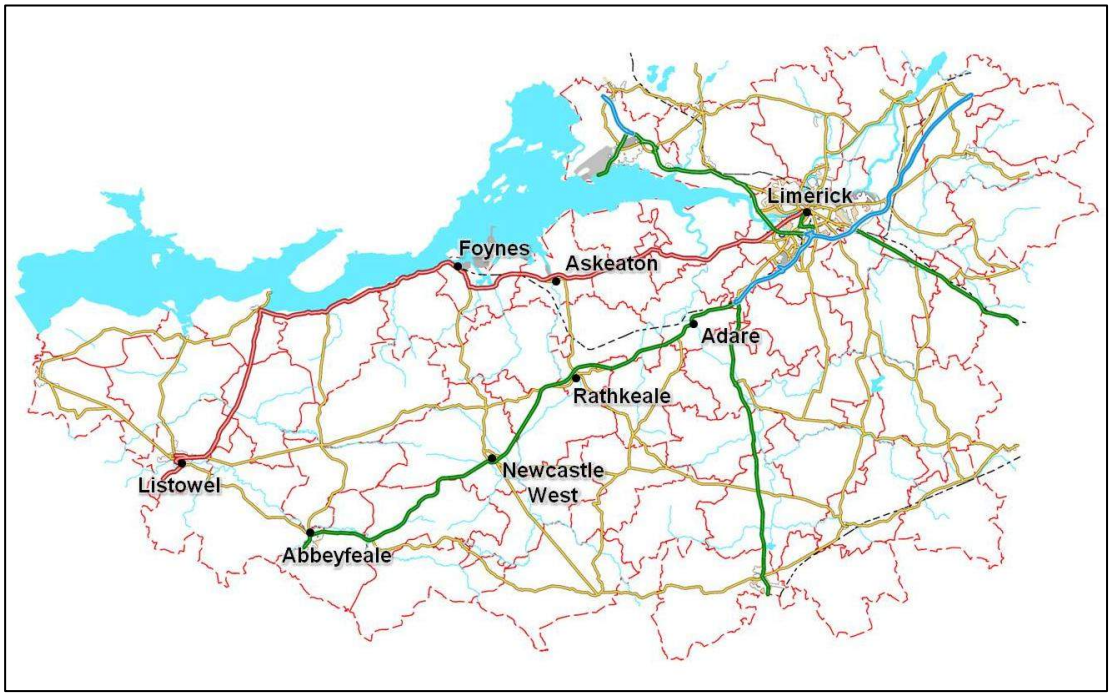
From the above table we note that average speeds on the existing N69 are reasonably consistent throughout the AM, Inter and PM Peak periods with an average speed of 71 kph experienced along the N69 corridor between Foynes and N18 Dock Road. Moving south from Foynes the average speed of 70 kph is recorded until Ardagh after which average speeds reduce significantly to 40 kph.

Average speeds through Newcastle West are slow at 37kph, reflecting the urban nature of the N21 corridor at this location. On the N21 corridor east of Newcastle West the average vehicular speed increases significantly to 86 kph. However, average speeds reduced significantly through Adare, with average speeds of 16kph observed westbound in the evening peak.

4.2.4 Network Development

As mentioned above, the NTM was used as a starting point for developing the 2014 LAM. Having identified the extent of the study area, the subsequent traffic model area of influence was 'cordoned' out of the 2013 NTM Base model and is shown in Figure 4.10 below.

Figure 4.10 LAM Study Area Cordoned from NTM



Refinement of LAM Road Network

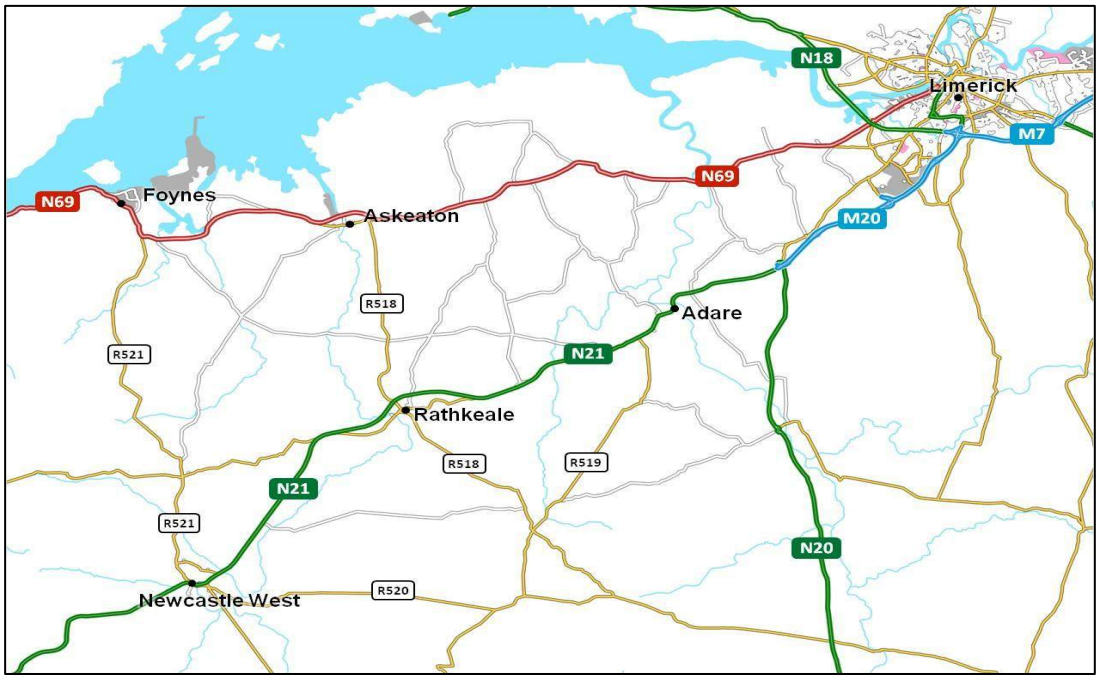
Once the study area had been cordoned from the NTM, the road network was further refined to reflect the 2014 road network conditions (i.e. inclusion of further detail such as refined road capacity, banned turns, junction types etc.). This information was collected through site observations and aerial mapping.

There were a significant number of local roads which are not included in the 2013 NTM modelled network. These local roads were coded into the 2014 LAM as they could be potentially impacted upon by a proposed scheme. The refined LAM road network after network refinement is shown in Figure 4.11.

The road network was developed to a level of detail that includes all national primary, secondary and regional roads and significant local roads through the study area, in addition to all significant urban roads in Limerick, Askeaton, Foynes, Newcastle West, Rathkeale and Adare. Each road link in the LAM contains the following characteristics;

- Length;
- Link type, for example, Type 1 Single Carriageway and Type 2 Dual Carriageway;
- Link capacity;
- Speed limit and free flow speed; and
- Reference to an appropriate speed flow curve

Figure 4.11 - Refined LAM Road Network



Refinement of LAM Zoning System

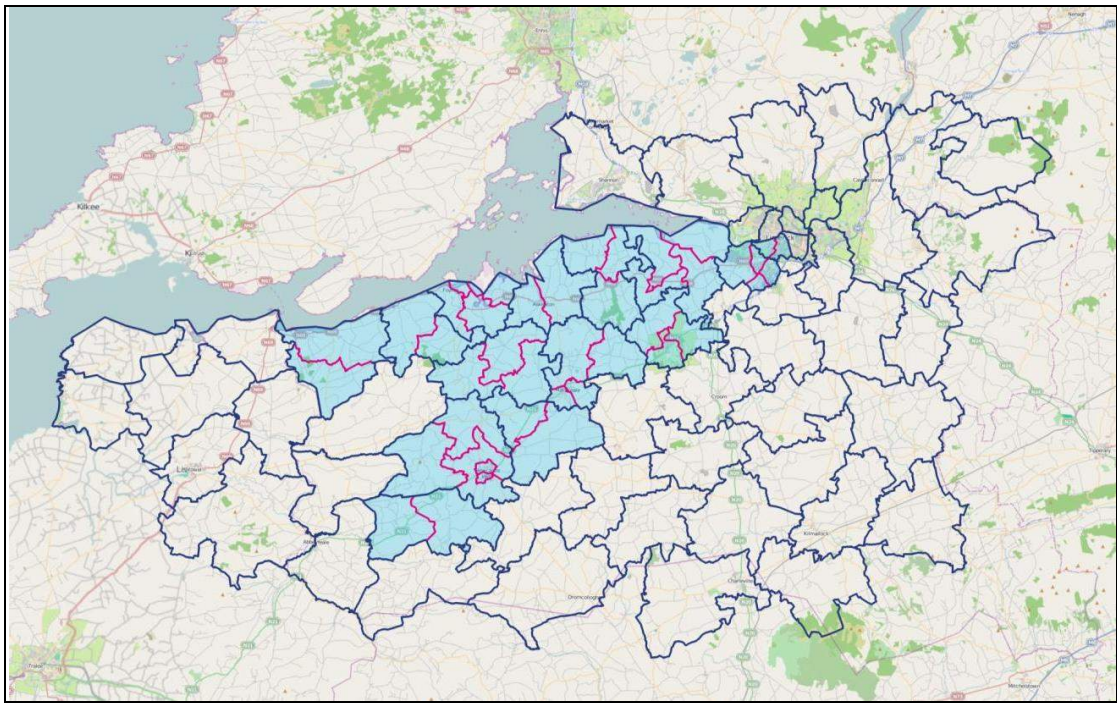
In order to obtain suitable detail within the LAM, a more detailed zoning system than used in the NTM was required. The zoning system in the NTM is based on the aggregation of Electoral Divisions (ED's), which is suitable for most zones in the LAM apart from urban areas and excessively large zones. Examples of the urban areas that needed further refinement were Foynes, Askeaton, Raheen, Rathkeale, Newcastle West, Adare & Limerick.

The towns & villages mentioned above were each represented by a single zone, with the exception of Limerick, in the original NTM zoning system. In order to obtain greater detail and to reflect existing traffic flows and traffic patterns in these key areas, these zones were disaggregated into several sub-zones. The majority of zones were split based on ED boundaries where possible.

The trips from the split zones were allocated to the new sub zones based on the proportion of residential and commercial addresses located within the sub zone. Figure 4.12 below highlights in blue the zones which were split in these processes.

The original model cordoned from the NTM contained 82 zones, which included 22 external zones (these zones feed traffic into and out of the LAM). The disaggregation of the various zones noted above produced a model containing a total of 110 zones, including 22 external zones.

Figure 4.12 - Refined Foynes to Limerick LAM Zoning Structure



4.2.5 Matrix Development

The following time periods were required for the LAM:

- Morning peak from 08:00 – 09:00 (AM Peak Period);
- Average hour in the inter peak period from 12:00 - 14:00 (Inter Peak Period); and
- Evening Peak from 17:00 – 18:00 (PM Peak Hour)

'Prior' AM, Inter and PM Peak hour Light and Heavy vehicle matrices were extracted from the 2013 NTM. The matrices were disaggregated (split) to provide a more refined LAM matrix in line with the zoning system as discussed in Section 4.2.4. The process of zone splitting was undertaken using VISUM, whereby origin and destination trip ends were allocated to the sub-zones based on the An Post GeoDirectory information whilst maintaining the equivalent distribution of the larger zones.

Assignment Model

The assignment model applies the demand for travel, represented by the trip matrices, to the supply, in the form of the road network. The 'generalised cost' of a journey, represented by a combination of time and distance is compared in a route choice algorithm, and a stable output produced, where ideally, all possible routes

between an origin and destination have the same 'cost'. Generalised cost is computed as follows:

Generalised Cost = Value of Time * Time + Vehicle Operating Cost * Distance + Toll

The economic parameters used in the LAM are outlined in Table 4.3. These are fully compliant with parameters set out in the Project Appraisal Guidelines.

Table 4.3 Generalised Cost Economic Parameters (2014)

Peak Hour	User Class	Value of Time (VoT)*		Vehicle Operating Cost (VOC)	
		Cents/sec	*€/hr*	*Cents/metre*	*€/km*
AM and PM	Light	0.5393	19.41	0.0101	0.101
	Heavy	0.9243	33.27	0.0382	0.382
Inter	Light	0.5272	18.98	0.0101	0.101
	Heavy	0.9538	34.33	0.0370	0.370

**Average 2014 VoT for Working, Commuting & Other Trip Purposes*

4.2.6 Model Calibration/Validation

The TII Project Appraisal Guidelines Unit 5.2 Construction of Traffic Models sets out the criteria that must be satisfied in order to calibrate and validate strategic traffic models. Tables 4.4 to 4.7 outline the model calibration results.

Table 4.4 Link Calibration Results: Individual Flows

% of Calibration Sites Meeting Individual Flow Criteria				
Time Period	**Link Flows**			**Required**
	Total Traffic	**Lights**	**Heavies**	
AM Peak	95%	93%	100%	>85%
Inter Peak	100%	98%	100%	>85%
PM Peak	98%	98%	100%	>85%

Table 4.5 Link Calibration Results: GEH[2] Values

% of Calibration Sites with GEH < 5				
Time Period	**Link Flows**			**Required**
	Total Traffic	**Lights**	**Heavies**	
AM Peak	93%	93%	100%	>85%
Inter Peak	97%	97%	100%	>85%
PM Peak	100%	100%	100%	>85%

Table 4.6 Turn Calibration Results: Individual Flows

[2] 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.

% of Calibration Sites Meeting Individual Flow Criteria				
Time Period	Link Flows			Required
	Total Traffic	Lights	Heavies	
AM Peak	99%	99%	100%	>85%
Inter Peak	99%	99%	100%	>85%
PM Peak	98%	98%	100%	>85%

Table 4.7 Turn Calibration Results: GEH Values

% of Calibration Sites with GEH < 5				
Time Period	Link Flows			Required
	Total Traffic	Lights	Heavies	
AM Peak	92%	94%	100%	>85%
Inter Peak	94%	93%	100%	>85%
PM Peak	89%	90%	100%	>85%

The comparison of modelled and observed flows demonstrated that the AM, Inter-Peak and PM Peak period models matched very closely and exceeded the requirements for all user classes. Likewise, the GEH results showed that the AM Peak, Inter-Peak and PM Peak periods models also matched very closely and exceeded the requirements for all user classes. The results therefore confirmed that the models were calibrated to a standard compliant with the PAG criteria for all user classes and all time periods.

Model Validation

Following calibration, a validation process (again in line with guidance from the NRA Project Appraisal Guidelines Unit 5.2) was conducted which compared the model outputs to observed data. The results of the validation process are outlined below.

Validation of Flows

The validation process compared the modelled flow outputs after the calibration process against a set of observed data that was not previously used in the calibration process. Validation results are summarised in Tables 4.8 to 4.11 below.

Table 4.8 Link Validation Results: Individual Flows

% of Validation Sites Meeting Individual Flow Criteria				
Time Period	Link Flows			Required
	Total Traffic	Lights	Heavies	
AM Peak	93%	93%	100%	>85%
Inter Peak	96%	96%	100%	>85%
PM Peak	100%	100%	100%	>85%

Table 4.9 Link Validation Results: GEH Values

% of Calibration Sites with GEH < 5				
Time Period	Link Flows			Required
	Total Traffic	Lights	Heavies	
AM Peak	93%	93%	100%	>85%
Inter Peak	96%	96%	100%	>85%
PM Peak	100%	100%	100%	>85%

The comparison against the validation counts for individual link flows showed that the AM, Inter and PM peak period models all exceeded the PAG requirements for the validation of traffic flow on links. Likewise, all models exceeded the GEH criteria of 85%. The results therefore demonstrated that the validation criteria as set out by the NRA were successfully achieved by all models for all time periods.

Table 4.10 Turn Validation Results: Individual Flows

% of Validation Sites Meeting Individual Flow Criteria				
Time Period	Link Flows			Required
	Total Traffic	Lights	Heavies	
AM Peak	100%	100%	100%	>85%
Inter Peak	98%	98%	100%	>85%
PM Peak	98%	98%	100%	>85%

Table 4.11 Turn Validation Results: GEH Values

% of Calibration Sites with GEH < 5				
Time Period	Link Flows			Required
	Total Traffic	Lights	Heavies	
AM Peak	96%	93%	100%	>85%
Inter Peak	89%	89%	100%	>85%
PM Peak	91%	91%	100%	>85%

Again the comparison against the validation turning counts showed that all the models exceeded the PAG requirements for the validation of traffic flow. Likewise, all models exceeded the GEH criteria of 85%. The results therefore demonstrated that the validation criteria as set out by TII were successfully achieved in all models for all time periods.

Validation of Journey Times

As part of the validation process, the modelled journey times were also compared against the surveyed journey times to ensure the model gave a reasonable representation of existing conditions. The results of the journey time validation are presented in Tables 4.12 to 4.14 for the AM, Inter and PM peak hours, respectively, for the sections shown previously in Figures 4.8 and 4.9.

Table 4.12 - AM Peak Modelled/Observed Journey Times

Route	Observed *(min:sec)*	Modelled *(min:sec)*	Absolute Difference *(min:sec)*	% Difference	Validated (<15% difference or 1 minute)
1	27:37	27:50	00:13	1%	✓
2	26:50	26:12	-00:38	-2%	✓
3	11:35	10:31	-01:04	-9%	✓
4	11:25	10:31	-00:54	-8%	✓
5	10:34	10:25	-00:09	-1%	✓
6	10:31	10:14	-00:17	-3%	✓
7	2:57	3:11	00:14	8%	✓
8	3:17	3:07	-00:10	-5%	✓
9	14:14	14:13	-00:01	0%	✓
10	13:37	13:28	-00:09	-1%	✓
11	6:10	5.28	-00:44	-11%	✓
12	4:10	5:02	00:52	21%	✓
Percentage Validated					**100%**

Table 4.13 Inter Peak Modelled/Observed Journey Times

Route	Observed *(min:sec)*	Modelled *(min:sec)*	Absolute Difference *(min:sec)*	% Difference	Validated (<15% difference or 1 minute)
1	27:58	26:28	-01:30	-5%	✓
2	28:27	26:31	-01:56	-7%	✓
3	11:00	11:30	00:30	5%	✓
4	11:47	11:30	-00:17	-2%	✓
5	10:54	10:14	-00:40	-6%	✓
6	11:55	10:16	-01:39	-14%	✓
7	3:34	3:38	00:04	2%	✓
8	4:03	3:36	-00:27	-11%	✓
9	13:20	13:44	00:24	3%	✓
10	14:04	13:35	-00:29	-4%	✓
11	4:43	5:11	00:28	10%	✓
12	5:04	5:14	00:10	3%	✓
Percentage Validated					**100%**

Table 4.14 PM Peak Modelled/Observed Journey Times

Route	Observed *(min:sec)*	Modelled *(min:sec)*	Absolute Difference *(min:sec)*	% Difference	Validated (<15% difference or 1 minute)
1	26:19	28:11	01:52	7%	✓
2	27:23	28:52	01:29	5%	✓
3	12:13	11:32	-00:41	-6%	✓
4	11:59	11:32	-00:27	-4%	✓
5	11:52	10:15	-01:37	-14%	✓
6	10:27	10:17	-00:10	-2%	✓
7	3:17	3:11	-00:06	-3%	✓
8	3:17	3:16	-00:01	0%	✓
9	13:55	13:45	-00:10	-1%	✓
10	14:04	14:09	00:05	1%	✓
11	4:20	4:37	00:17	7%	✓
12	9:10	1. 8:29	00:41	-7%	✓
Percentage Validated					**100%**

All models satisfy 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 are considered validated to the requirements of PAG Unit 5.2: Construction of Transport Models in terms of journey times.

4.2.7 Future Traffic Forecasts

The future year forecast traffic growth in the LAM for the schemes Opening Year (2024) and Design Year (2039) was based on growth rates developed from the NTM. The growth rates per NTM zone were disaggregated to the LAM zonal level based on the existing and future land uses forecast in each of the LAM zones.

The growth rates for light and heavy vehicles are based on different economic and demographic projections. The growth in light vehicles is forecast based on demographic data such as employment, population, jobs and car ownership. The forecast increase in heavy vehicles is based on the projected increase in the size of the national goods vehicle fleet which in turn is related to Gross Domestic Product (GDP). Full details on the process for both light and heavy vehicle forecasting can be found in the National Transport Model Demographic and Economic Forecasting Report (NTpM Volume 3, 2014).
The development of traffic growth forecasts for the proposed scheme Opening Year and Design Year LAMs was based on the methodology set out in NRA PAG Unit 5.4 – Zone Based Traffic Growth Forecasting. The PAG sets out the criteria for using the Zonal Growth Rate forecasting methodology which is used for forecasting traffic growth when using traffic assignment models. The growth forecasts for the Opening year (2024) and Design year (2039) growth scenarios are presented in Table 4.15.

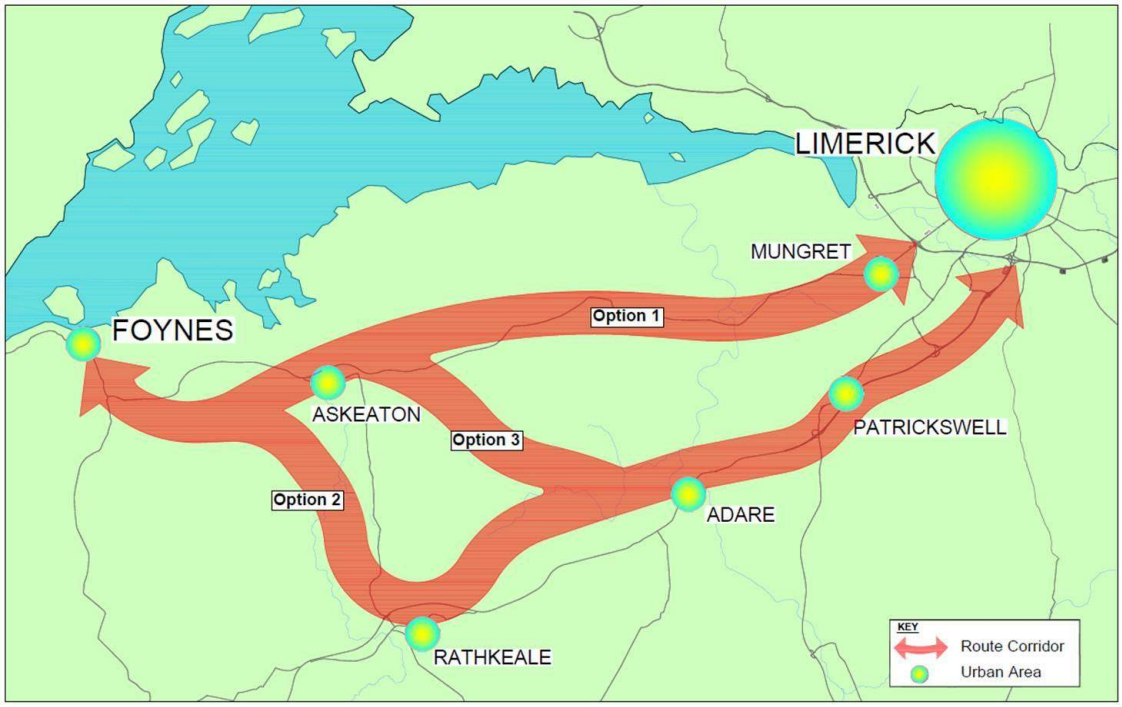
Table 4.15 Total Growth in LAM

Matrix	2024	2039
	Central Growth	Central Growth
AM Peak Car	12%	20%
AM Peak HGV	27%	69%
Inter Peak Car	7%	12%
Inter Peak HGV	26%	68%
PM Peak Car	12%	20%
PM Peak HGV	27%	69%

4.3 Assessment of Route Options

For the purpose of route selection an assessment was made of a number of corridor options in two stages. Stage 1, the Preliminary Appraisal Process examined three broad route corridors as shown in Figure 4.13 below.

Figure 4.13 Stage 1 Route Selection Broad Route Corridor Options (1, 2 & 3)



The outcome of the Stage 1 Preliminary Appraisal process fed into the Stage 2 corridor assessment which identified refined route options that could be added to the LAMs in order to assess the relative benefits of each option against the 'Do-Minimum' scenario.

There are no significant road improvements committed to currently, within the study area. As such the 'Do-Minimum' future network consisted of the existing road network only.

For the purpose of the Stage 2 Route Selection process four route corridor options were identified and assessed, these are referred to as Options 1, 2, 3 & 4. These options were modelled and assessed through the LAMs.

The Do-Nothing and Do-Minimum alternatives are described in Chapter 5. The Stage 1 Preliminary Appraisal Process and the selection of corridor options under Stage 2 are described in more detail in Chapter 6.

In assessing the relative benefits of each option network statistics were extracted from the traffic models for each scenario and a comparison was made between the Do-Minimum and the Do-Something Route Options under consideration. The key network statistics comprised of the following:

- Total Network Travel Time (hrs) for all vehicles;
- Total Network Vehicle Kilometres (vkms) for all vehicles; and
- Average Vehicle Speed (km/hr).

4.3.1 Route Corridor Option Assessment Results

The four route corridor options were added to the LAMs with network statistics subsequently being extracted for the scheme opening and design years in order to assess the benefits of each route corridor option. As detailed above, the key network statistics extracted were:

- Total Network Travel Time (hrs) for all vehicles;
- Total Network Vehicle Kilometres (vkms) for all vehicles; and
- Average Vehicle Speed (km/hr).

These network statistics were then compared to those from the Do Minimum scenario. The results of this comparison exercise are discussed in detail below.

Network Statistics

Network statistics were extracted from the traffic models for each of the four proposed Do Something (DS) route options and a comparison was made against the Do Minimum scenario.

The key network statistics are presented for the Do Minimum and each of the four route options for AM, IP and PM peak periods for the 2039 design year central growth scenario.

Table 4.16 Network Statistics – AM – Central Growth

Scenario	Total Network Trips	Total Vehicle km	Total Network Travel Time (hrs)	Average Vehicle Speed (km/hr)
2039 Do Minimum	33,755	550,133	9,673	56.88
2039 DS Option 1	33,755	550,935	9,603	57.37
2039 DS Option 2	33,755	550,526	9,529	57.77
2039 DS Option 3	33,755	550,499	9,532	57.75
2039 DS Option 4	33,755	551,561	9,536	57.84

Table 4.17 Network Statistics – IP– Central Growth

Scenario	Total Network Trips	Total Vehicle km	Total Network Travel Time (hrs)	Average Vehicle Speed (km/hr)
2039 Do Minimum	29,124	454,469	7,726	58.83
2039 DS Option 1	29,124	454,881	7,677	59.25
2039 DS Option 2	29,124	454,545	7,616	59.68
2039 DS Option 3	29,124	454,398	7,617	59.65
2039 DS Option 4	29,124	455,393	7,618	59.78

Table 4.18 Network Statistics – PM – Central Growth

Scenario	Total Network Trips	Total Vehicle km	Total Network Travel Time (hrs)	Average Vehicle Speed (km/hr)
2039 Do Minimum	40,429	663,056	11,814	56.12
2039 DS Option 1	40,429	663,825	11,689	56.79
2039 DS Option 2	40,429	663,852	11,632	57.07
2039 DS Option 3	40,429	663,925	11,644	57.02
2039 DS Option 4	40,429	664,987	11,625	57.20

The statistics show that there is a decrease in total network travel time and total network delay and a subsequent increase in average speeds between the Do Minimum and Do Something scenarios. As such, the tables above demonstrate that each of the Do-Something scenario will provide benefits for the entire network.

4.3.2 Estimation of Annual Average Daily Traffic

To estimate the Annual Average Daily Traffic (AADT), conversion rates were developed which allowed the extrapolation of AM, Inter and PM peak hour traffic flows to AADT. The AM, Inter and PM Peak Hour flows were converted to AADT flows using the following formula:

(3.1275 * u) + (7.9746 * v) + (3.1275 * w) = LV AADT

(5.6175 * x) + (4.1197 * y) + (5.6175 * z) = HV AADT

LV AADT + HV AADT= Total AADT

Where,

u = AM Peak Period LV Demand, x = AM Peak Period HV Demand

v= Inter Peak Period LV Demand, y= Inter Peak Period HV Demand

w = PM Peak Period LV Demand, z = PM Peak Period HV Demand

Regression analysis, based on data from the TII Traffic Monitoring Units located within the study area (refer Figure 4.5), was used to generate the equation outlined above. As such seasonality has been taken into account within the formula above. In order to assess the accuracy of the AM, Inter and PM Peak hour expansion factors to AADT a comparison of observed and modelled 2014 base year AADT has been undertaken in Table 4.19.

Table 4.19 Accuracy of AM, Inter & PM Expansion Factors to AADT

Location	TII TMU Reference*	2014 AADT		Accuracy
		Observed	Modelled	
N69 West of Askeaton	1692	5,581	5,285	-5%
N18 East of Shannon	20183	26,592	26,293	-1%
N18 East of Cratloe	20184	33,921	32,560	-4%
M20 Jn 2 – Jn 3	20205	26,999	26,034	-4%
M20 Jn 3 – Jn 4	20203	26,457	24,967	-6%
N20 North of Croom	20202	13,102	13,924	6%
N21 East of Adare	20212	15,612	16,571	6%
N21 East of Abbeyfeale	20211	9,684	9,280	-4%
N24 East of Ballysimon	20243	15,338	15,569	2%
R445 West of Annacotty	200714	16,553	15,619	-6%
M7 Jn 28 – Jn 29	200722	23,346	24,279	4%
M7 Jn 29 – Jn 30	200713	34,428	33,796	-2%

** Note: See TII website for locations and details of TMU data at https://www.nratrafficdata.ie/*

The table above shows that the expansion factors used to estimate AADT from AM, Inter and PM peak hour models leads to accurately modelled AADT forecasts.

Forecast AADT

The 2039 Modelled AADT and percentage HGV for the following scenarios is presented in Figures 4.14 – 4.18:

- Do- Minimum;
- Do-Something Option 1;
- Do-Something Option 2;
- Do-Something Option 3; and
- Do-Something Option 4.

Figure 4.14 2039 Modelled Future AADT & Percentage HGV– Do Minimum Network

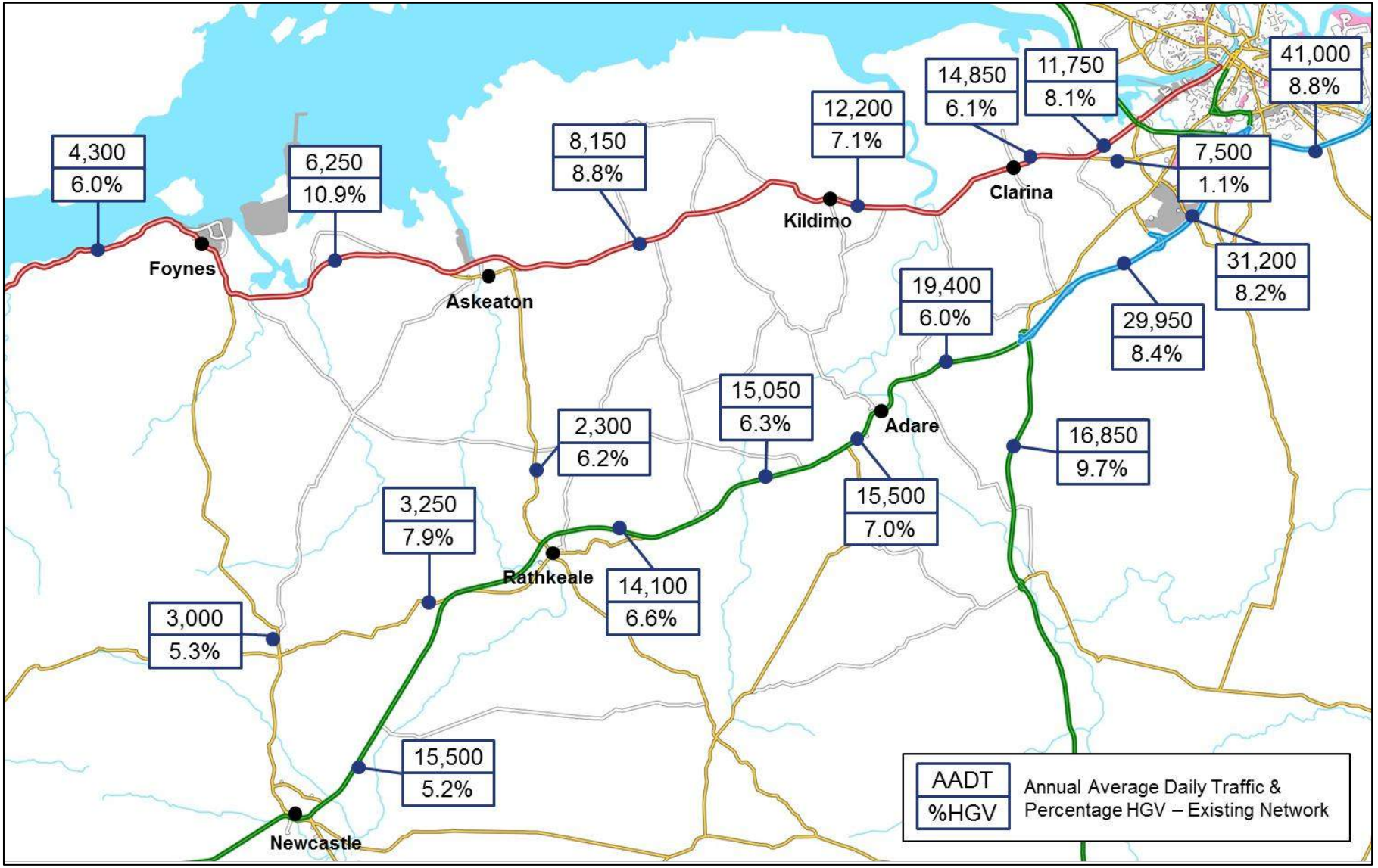


Figure 4.15 2039 Modelled Future AADT & Percentage HGV – Do Something Option 1

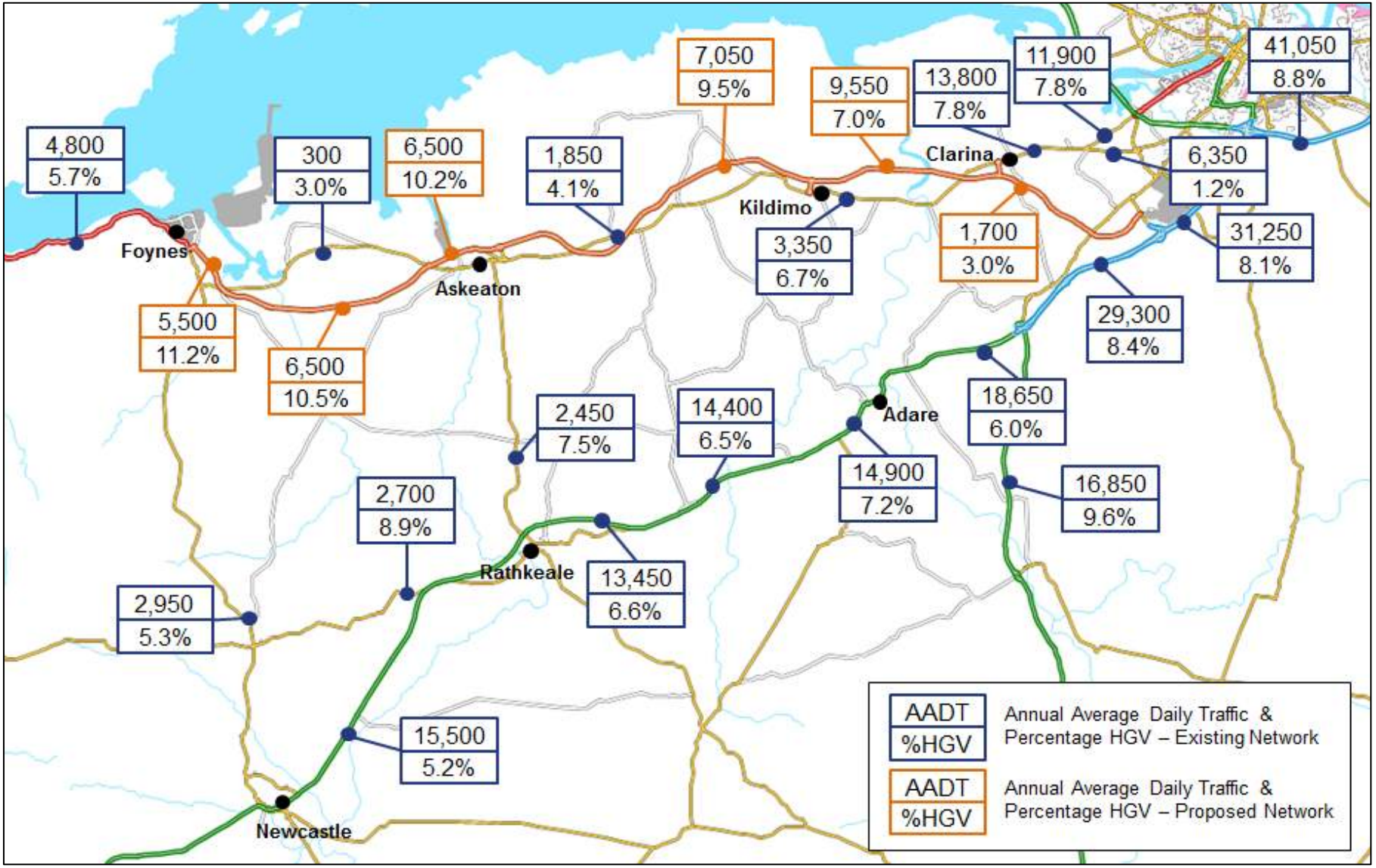


Figure 4.16 2039 Modelled Future AADT & Percentage HGV – Do Something Option 2

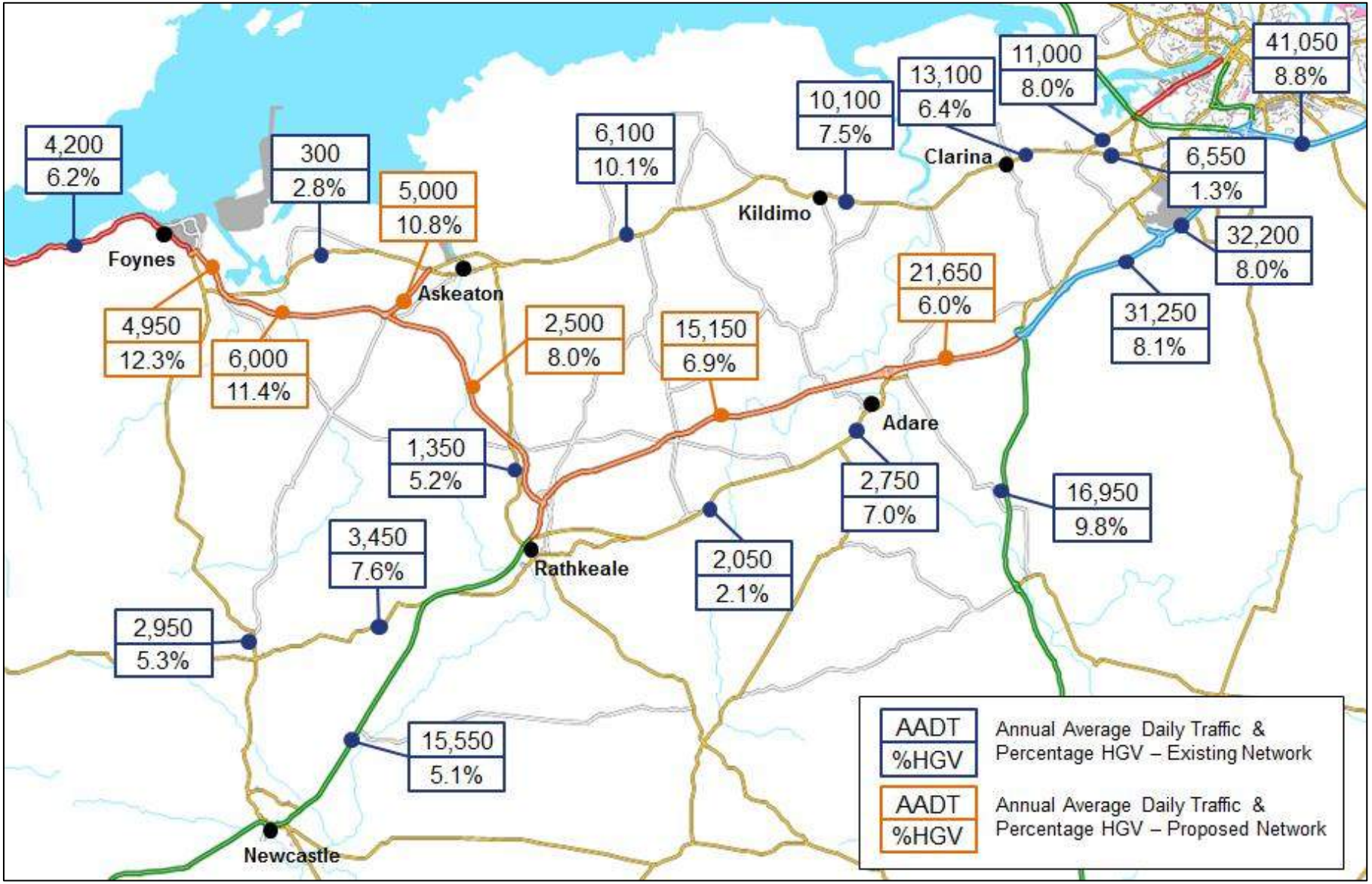


Figure 4.17 2039 Modelled Future AADT & Percentage HGV – Do Something Option 3

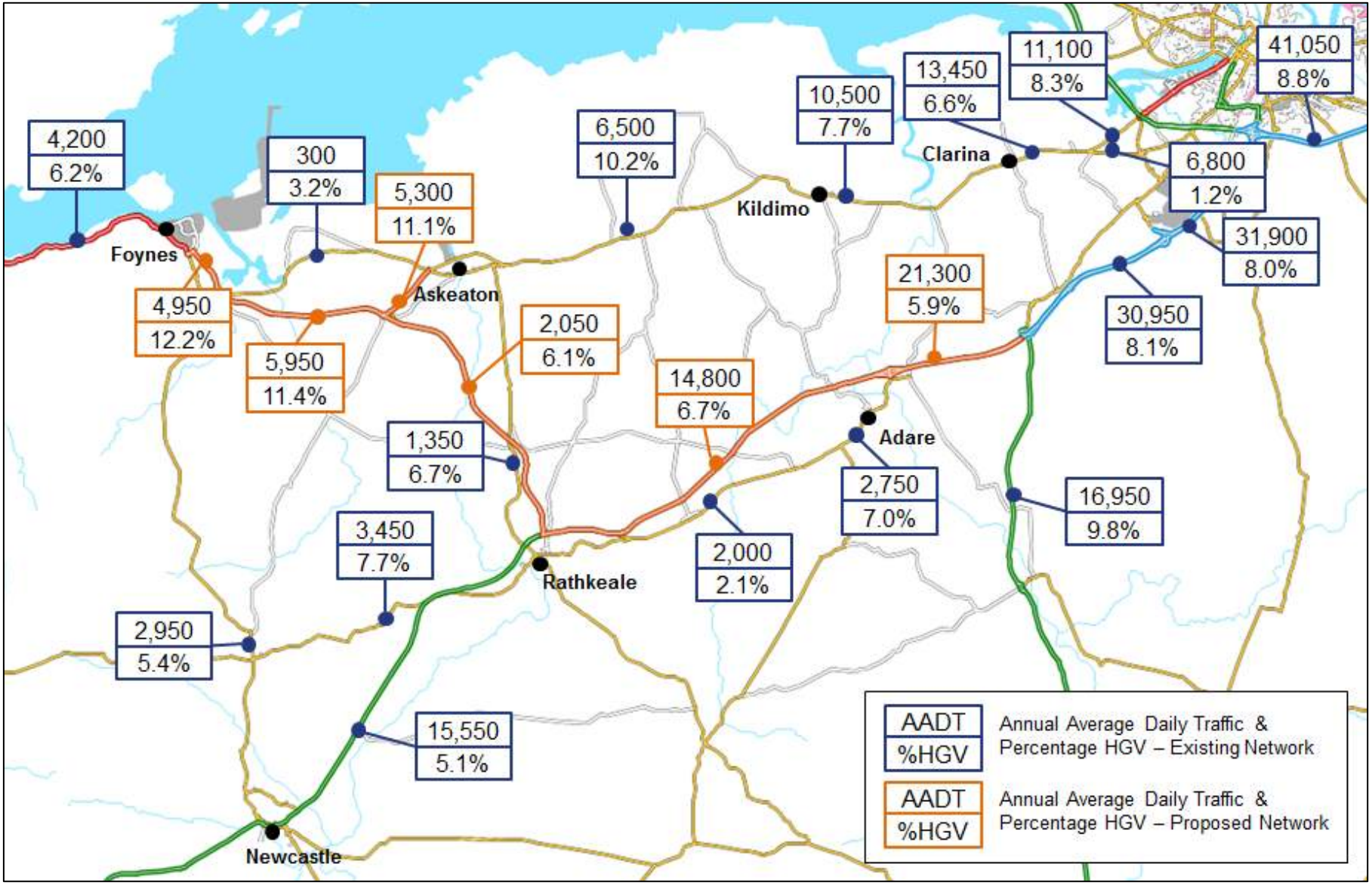
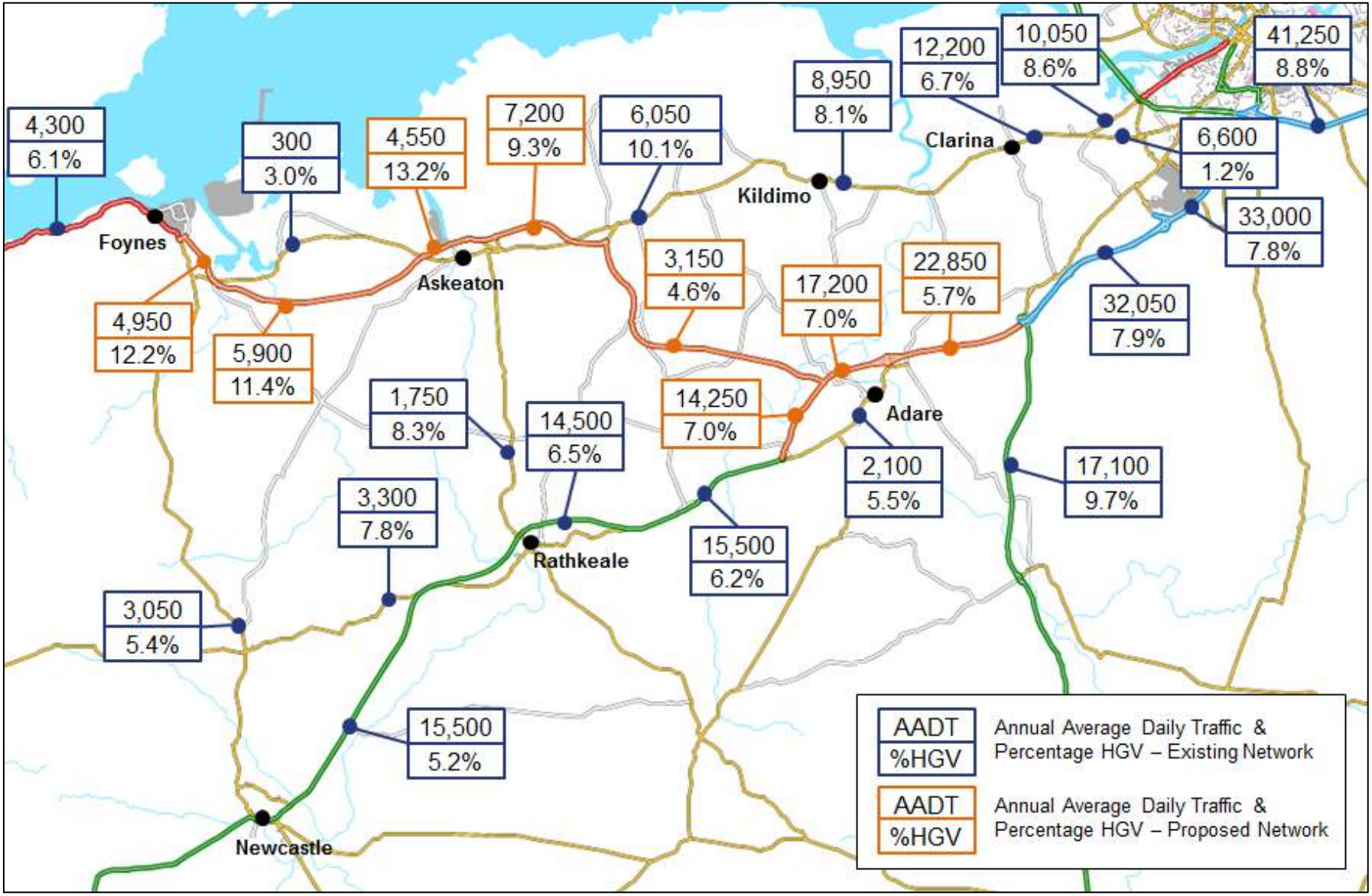


Figure 4.18 2039 Modelled Future AADT & Percentage HGV – Do Something Option 4



4.4 Initial Selection of Road Type

4.4.1 N69 Foynes to Limerick

The traffic surveys carried out in May 2014, detailed in Section 4.2.3 above, indicate that the existing N69 between Foynes Port and Limerick carries a traffic flow of 5,300 AADT at Foynes increasing to 6,900 AADT east of Askeaton and 12,200 AADT west of the N18 / Dock Road junction and a maximum of 17,900 to the east of the N18 / Dock Road interchange along the R510 Dock Road. The increase in flows along the corridor is attributable to the traffic joining the road from the local roads linking onto the N69 and settlements including Askeaton, Pallaskenry, Kildimo and Clarina. To the east of the N18 / Dock Road junction the increase in AADT is attributable to traffic joining from the N18/M7 and local roads.

The key scheme objective is to provide a high quality road from Foynes to the existing motorway network in the vicinity of Limerick City, therefore only the section of road running from Foynes to west of the N18 / Dock Road junction has been considered in this study.

The predicted traffic flow is expected to grow to a maximum of 14,850 AADT for the Do-Minimum scenario by the scheme Design Year of 2039, with the majority of the road experiencing traffic volumes lower than this in 2039 i.e. 12,200 AADT at Kildimo, 8,150 AADT east of Askeaton and 6,250 AADT west of Askeaton.

For Route Corridor Option 1, which runs parallel to the existing N69 corridor, the anticipated traffic flow is 5,500 AADT east of Foynes, increasing to a maximum of 9,550 AADT to the west of Clarina.

The average flows along the N69 corridor for Route Corridor Option 1 will therefore be within the range indicated for a Type 1 Single Carriageway (Capacity 11,600 AADT) in accordance with Table 6/1 of TII TD9.

4.4.2 N21 Rathkeale to Limerick

The May 2014 traffic surveys indicate that the existing N21 carries a flow of between 13,900 AADT east of Newcastle West to a maximum of 17,100 AADT east of Adare village.

Route Corridor Options 2, 3 and 4 utilise sections of the N21 corridor before tying into the existing M20 at the Attyflin junction (J5). The anticipated traffic flows on Route Corridor Options 2, 3 and 4 in Scheme Design Year 2039 range from a minimum of 14,250 AADT west of Adare on Route Corridor Option 4 to a maximum of 22,850 AADT east of Adare on Route Corridor Option 4. These flow volumes are within the ranges indicated for a Type 1 (Capacity 42,000 AADT) Dual Carriageway, but exceed the capacity of a Type 2 (Capacity 20,000 AADT) Dual Carriageway as indicated in Table 6/1 of TII TD9. Also given that each of Route Corridor Options 2, 3 and 4 constitute a continuation of the existing M20 (an existing Type 1 Dual Carriageway motorway) it is recommended that the options along the N21 corridor should be developed as Type 1 Dual Carriageways at this stage of the project.

4.4.3 N69 to N21 Corridor Link Road

Whilst Route Corridor Options 2, 3 and 4 utilise sections of the N21 corridor to the greatest extent possible, each of these options includes a link road which connects the existing N69 corridor to the N21 corridor. The anticipated traffic flows on these link roads range from a minimum of 2,050 AADT to a maximum of 6,000 AADT.

These flows are below the levels indicated for a Type 1 (Capacity 11,600 AADT), or Type 2 (Capacity 8,600 AADT) Single Carriageway, but exceed the capacity of a Type 3 (Capacity 5,000 AADT) Single Carriageway in Table 6/1 of TII TD9. As the key scheme objective is to provide a high quality road link from Foynes to the existing motorway network in the vicinity of Limerick City it is considered appropriate that this link road should be considered as a Type 1 Single Carriageway for the route selection stage of the project.

4.5 Consideration of Preliminary Junction Strategy

As one of the primary objectives of the Foynes to Limerick Road Improvement Scheme is to deliver a high quality road to TEN-T standards, the limiting of junctions on the new road is anticipated with no direct access to the new Foynes to Limerick road for individual houses, farms or businesses.

The following preliminary junction strategy, in conjunction with the initial selection of carriageway cross section, has been established to inform the development of the traffic models at the route selection stage of the project. This preliminary junction strategy and the traffic model will be developed further and subject to change during the Design stage for the preferred route corridor.

4.5.1 Foynes to Limerick / N21

For Route Corridor Option 1 terminal roundabouts have been modelled at either end to the corridor, near Foynes and again on the R510 near the M20. Roundabouts will connect the corridor to the existing N69 where required while, local and regional roads have been modelled to be bridged over or under the mainline of the road. For modelling purposes the section of the corridor online at Askeaton will retain its current at-grade junctions.

Route Corridor Options 2 and 3 have been modelled with a roundabout junction near Foynes with a further roundabout modelled at the Junction with the Foynes to N21 Corridor Link Road and another roundabout to the west of Askeaton connecting to the existing N69. Local and regional roads have been modelled to be bridged over or under the mainline of the road.

For Route Corridor Option 4 the junction strategy is the same as for Route Corridor Option 1 up to where the Foynes to N21 Corridor Link Road is proposed near Kilcornan. Here a roundabout has been modelled with the existing N69 to the east of this junction realigned to tie into the roundabout. Local and regional roads have been modelled to be bridged over or under the mainline of the road.

4.5.2 N21 to M20

For Route Corridor Options 2, 3 and 4 a junction to the east of Adare has been modelled with the current N21 extended through to a grade separated junction (TII TD 22 design standard) with merges and diverges in both east and westbound directions.

For Route Corridor Options 2 and 3 a roundabout has been modelled where the Foynes to Rathkeale corridor meets the N21 corridor. All of the local and regional roads between these two junctions have been modelled to be bridged over or under the mainline of the road.

For Route Corridor Option 4 a roundabout has been modelled where the Foynes to Adare corridor meets the N21 corridor and another roundabout on the existing N21 west of Adare.

Chapter 5 Do-Nothing and Do-Minimum Alternatives

5.1 Introduction

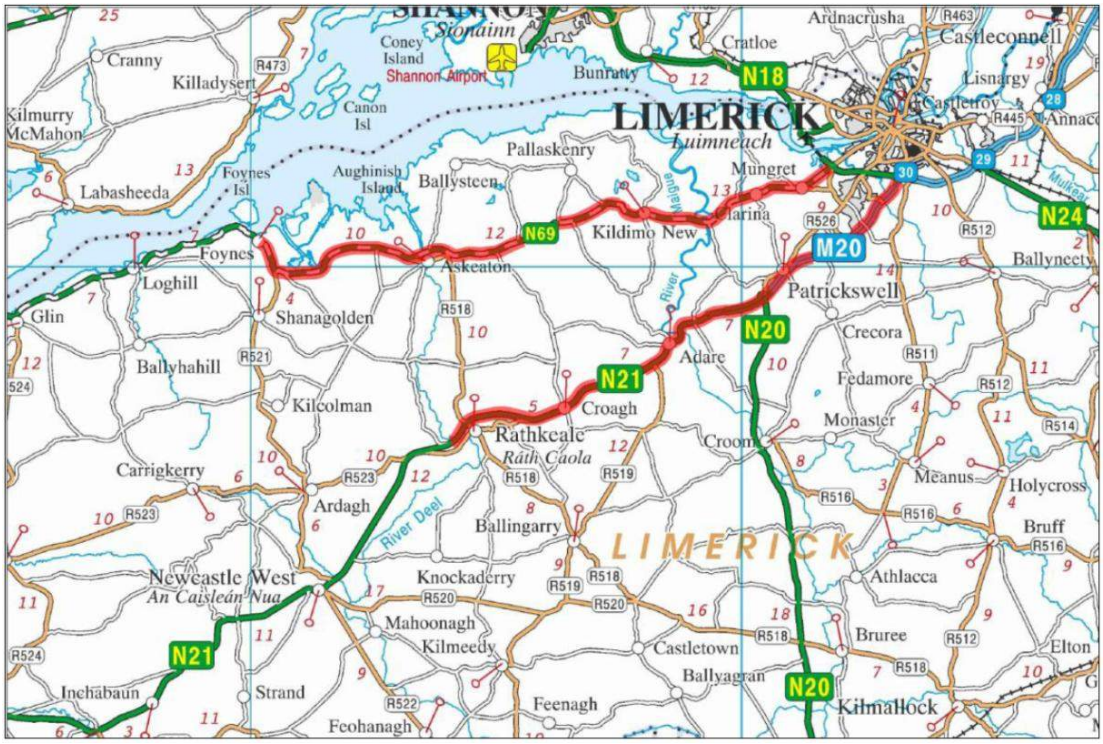
This chapter discusses the existing road characteristics of the N69, the N21, and the M20 and assesses the feasibility of the 'Do-Nothing' and 'Do-Minimum' alternatives for the Foynes to Limerick Road Improvement Scheme. It addresses the deficiencies that these roads have in terms of modern road design standards and examines the potential for a 'Do Minimum' improvement of these roads.

There are three national roads under consideration in this study. These are as follows:

- N69 National Secondary Route: Foynes to Limerick City
- N21 National Primary Route: Rathkeale to Attyflin (M20/N20/N21 junction)
- M20 National Primary Route: Attyflin to Rossbrien (M7/N18/M20 junction)

The extent of these routes is shown in Figure 5.1 below:

Figure 5.1 Extent of Routes under Consideration



5.1.1 Existing N69 National Secondary Route

The existing N69 National Secondary Route is a single carriageway road that extends from Limerick City at the eastern end through to Tralee at the western end. The N69 passes through or bypasses the towns and villages of Listowel, Tarbert, Glin, Loghill, Foynes, Askeaton, Kildimo, Clarina and Mungret before entering Limerick City.

Between Foynes and Limerick City the N69 intersects several regional roads, namely the R521, R518, R859 and the R510. These are connected via at-grade priority

controlled junctions. The N69 also intersects with the N18 Limerick Southern Ring Road at its eastern end outside Limerick City, where it terminates at the grade-separated dumbbell junction with the N18 (Junction No 2). The R510 (old N69) continues as the Dock Road on through to the centre of the city to its termination at the Shannon Bridge Roundabout. The N18 is a national primary road which connects Limerick, Shannon and Ennis in the West to the M7 National Road which in turn connects to Dublin in the East.

5.1.2 Existing N21 National Primary Route

The existing N21 National Primary route is a single carriageway road that extends from the M20/N20/N21 junction at Attyflin southwest of Patrickswell to an intersection with the N69 in Tralee in Kerry. The N21 passes through or bypasses the towns/villages of Castleisland, Abbeyfeale, Templeglantine, Newcastle West, Rathkeale, Croagh and Adare before terminating at the M20/N20/N21 junction approximately 5.5 kilometres to the east of Adare at Attyflin.

Between Rathkeale and Attyflin the N21 intersects several regional roads, namely the R518, R523 and the R519. The N21/R518 junction is a compact grade separated junction located outside Rathkeale town. The N21/R523 junction to the east of Rathkeale and N21/R519 junction to the west of Adare are at grade priority controlled junctions. East of Adare a junction is formed with the local roads L1424 (Kilgobbin Road) and L1420 (Knockanes Road) at the Lantern Lodge Roundabout.

Between Attyflin and the Lantern Lodge roundabout, east of Adare, the N21 is a wide single carriageway with generous hard shoulders and large radius curves.

5.1.3 Existing M20 National Primary Route

The M20 is a dual carriageway road and travels north-easterly from the M20/N20/N21 junction at Attyflin to the M7/N18/M20 Junction at Rossbrien and bypasses Patrickswell, Raheen Business Park and Dooradoyle. The road was redesignated as a Motorway in 2009.

The M20 is approximately 10 kilometres long and has five grade-separated junctions, namely the M20/N20/N21 junction at Attyflin (J5), the M20/R526 junction at Patrickswell (J4), the M20/R510 junction at Raheen (J3), the M20/R926 junction at Dooradoyle (J2) and the M20/M7/N18 junction at Rossbrien (J1).

5.1.4 Existing Regional Roads

Regional roads intercepted by the N69, N21 and M20 between Foynes and Limerick include the:

- R521: Foynes – Newcastle West;
- R518: Askeaton – Rathkeale – Kilmallock;
- R519: Adare – Ballingarry;
- R859: Mungret – Dooradoyle;
- R510: Dock Road – Ballycummin, Limerick;
- R523: Listowel – Rathkeale (including old N21 through Rathkeale);
- R526: Limerick City – Raheen - Attyflin; and
- R926: Dooradoyle

5.1.5 Existing Local Roads

There are numerous local roads within the study area for the scheme. These roads generally have cross-sections ranging from 3.0 metres – 7.0 metres in width with limited verges and no hard shoulders. These roads vary in function from local connector roads down to access roads serving only two or three individual properties.

5.2 Functional and Operational Requirements

5.2.1 TEN-T Requirements

As described in Chapter 2 the TEN-T Regulations require that all roads that form part of the TEN-T network must, as a minimum, be a high quality road. Regulation (EU) No 1315/2013 sets out the requirements for high quality roads that shall form part of the network, both Core and Comprehensive, and states under Article 17(3), the following:

> *"High-quality roads shall be specially designed and built for motor traffic, and shall be either motorways, express roads or conventional strategic roads.*
>
> *(a) A motorway is a road specially designed and built for motor traffic, which does not serve properties bordering on it and which:*
>
> *(i) is provided, except at special points or temporarily, with separate carriageways for the two directions of traffic, separated from each other by a dividing strip not intended for traffic or, exceptionally, by other means;*
>
> *(ii) does not cross at grade with any road, railway or tramway track, bicycle path or footpath; and*
>
> *(iii) is specially sign-posted as a motorway.*
>
> *(b) An express road is a road designed for motor traffic, which is accessible primarily from interchanges or controlled junctions and which:*
>
> *(i) prohibits stopping and parking on the running carriageway; and*
>
> *(ii) does not cross at grade with any railway or tramway track.*
>
> *(c) A conventional strategic road is a road which is not a motorway or express road but which is still a high-quality road*."

Article 39(2) of the Regulations sets out that for the Core Network only options (a), a motorway, or (b) an express road, may be considered as road option types. However Article 39 (3) states further that:

> *"At the request of a Member State, as regards road transport infrastructure, exemptions from the provisions of points (a) or (b) of Article 17(3) may be granted by the Commission in duly justified cases as long as an appropriate level of safety is ensured.*
>
> *The duly justified cases referred to in this paragraph shall include cases where investment in infrastructure cannot be justified in socio-economic cost-benefit terms."*

To meet the requirements for the Core TEN-T Network for the Foynes to Limerick Road Improvement Scheme, the new or upgraded national road will need to meet the following criteria:

- The road shall either be an Express Road or Motorway in conformance with the relevant national road design standards, in this case the *TII Design Manual for Roads and Bridges (DMRB)*;
- Accessible primarily from interchanges or controlled junctions;
- The road shall have no direct accesses and shall have minimal junctions with other roads to achieve a high quality road to a consistent standard throughout the scheme;
- For single carriageway sections, the road should offer generous opportunities for overtaking as per Table 7/3 in the TII DMRB TD9; and
- The road may provide for non-motorised users in accordance with TII TD300. For a motorway, this provision must be separate from the reservation to comply with relevant legal restrictions.

The existing condition of the N69 and N21 are reported under the following headings:

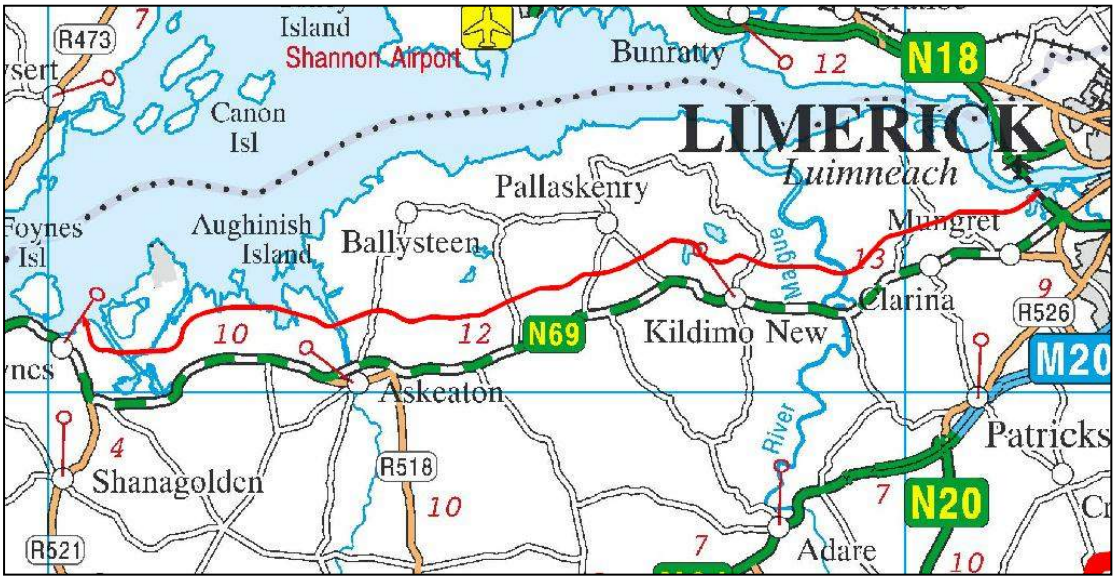
- Traffic Volumes
- Road Cross-Section
- Horizontal Alignment
- Vertical Alignment
- Junctions and Accesses
- Design Speed
- Pedestrians and Cycle Facilities
- Road Pavement
- Overtaking Opportunities
- Environmental Constraints
- Local Constraints to On-Line Improvement

5.3 N69 National Secondary Route - Existing Road Conditions

5.3.1 General

This section of the existing N69 extends from Foynes to the junction formed between the N18 and the N69, southwest of Limerick City over a length of approximately 32 kilometres. This section of the existing N69 is shown in Figure 5.2 below:

Figure 5.2 N69 Foynes to Limerick



5.3.2 Traffic Volumes

Four Automatic Traffic Count (ATC) surveys were carried out along the N69 between the 19th May and the 1st of June 2014. The existing two – way traffic volumes were recorded as follows:

- Foynes to Askeaton - 5,300 AADT;
- Askeaton to Kildimo - 6,900 AADT;
- Kildimo to Clarina - 9,500 AADT; and
- Clarina to the N18 junction - 12,200 AADT.

5.3.3 Road Cross-section

The N69 between Foynes and the N18 junction is a single carriageway road with varying cross sectional width. An analysis of the cross-section of the road is shown in Table 5.1 below.

Table 5.1 Cross section of the N69

Existing N69 Cross-section	Widths (m)
Northern Verge	0.5 - 1.5m
Northern Hard Shoulder or Hard Strip	0m - 0.5m
Carriageway	7.5m (2 x 3.75 metre lanes)
Southern Hard Shoulder or Hard Strip	0m - 0.5m
Southern Verge	0.5 - 1.5m
Paved *Width (Overall Width Incl. Verges)*	**7.5m – 8.5m *(8.5m – 11.5m)***

There is little or no hard shoulder along the majority of this route other than at sections which have been subject to improvements such as the Askeaton Bypass, and even then sections of hard strip are limited. Within the villages along the route the road cross-section is of an urban nature with raised footpaths, some parking provision and speed restricted sections.

In some areas the cross-section of the carriageway is extremely narrow. Figure 5.3 below shows the cross-section of the Ferry Bridge crossing the River Maigue and associated Lower Shannon SAC. The cross-section of the road has no hard shoulders or footpath provided over the humpback bridge, and this leads to high risk conditions due to the number of trucks using the road from Foynes port. Non motorised road users are at particular risk should they wish to cross the Ferry Bridge. Any online upgrade of the existing N69 would require significant bridge widening or the construction of a new bridge at this location.

Figure 5.3 N69 at Ferrybridge

The section of N69 to the west of Kildimo, is shown in Figure 5.4.

Figure 5.4 N69 west of Kildimo

Source: Google Street View

The section of road west of Askeaton, in the vicinity of Morgans South, is shown in Figure 5.5 overleaf.

Figure 5.5 N69 west of Askeaton

Source: Google Street View

Figure 5.6 below shows a typical cross section through the village of Clarina which is constrained by development and a signalised junction at Clarina Cross.

Figure 5.6 N69 at Clarina Cross

Source: Google Street View

5.3.4 Horizontal Alignment

The horizontal alignment of this section of the N69 is generally a mix of tight radius curves and straight sections. 8 Horizontal curves are below standard for a 100km/h design speed with radii between 125 and 255 metres. A further 20 horizontal curves would be considered as less than desirable for a 100km/h design speed. 5 of these horizontal curves have radii that are not recommended for single carriageway roads as these curves lead to dubious overtaking conditions. Figure 5.7 shows the tight radii and restricted overtaking at Ballyengland to the east of Askeaton.

Figure 5.7 N69 at Ballyengland

Source: Google Street View

5.3.5 Vertical Alignment

The vertical alignment of the N69 has a relatively flat gradient overall ranging from flat to approximately 1.5%. There are a few sections where the gradient rises to approximately 3.5% such as at the Ferrybridge crossing of the River Maigue with steeper gradients exceeding 5% over short sections. Even with the predominantly flat gradients the road is relatively undulating.

The vertical geometry is generally poor with many of the vertical curves appropriate for a lower design speed of approximately 70km/h in accordance with TII TD9 Table 1/3.

None of the crest curves on straight horizontal sections achieves the minimum design standard for overtaking. This is evident in the road marking which reflects the lack of visibility on a number of the straight sections of road.

5.3.6 Junctions and Accesses

The various types of junctions and accesses along this section of the N69 are noted below:

- Public Road Junctions – 63
- House and Farm Accesses – 236
- Field Accesses – 151
- Business / Community Accesses – 43

These figures incorporate all accesses in the various villages and towns along this section of the route. All of these accesses lead to reduced traffic safety with potential traffic hazards and decreased traffic capacity along the length of this section of the national road network. The standards of access vary considerably along the N69 with generally poor visibility from the junctions due to the general absence of hard shoulders coupled with narrow verges and the restricted alignment.

The number of accesses equates to approximately 11 junctions / accesses per kilometre (excluding single field accesses). 9 or more junctions / accesses per kilometre is considered as 'High' in accordance with the design standard TII TD 9, Section 1.4.

5.3.7 Design Speed

Between Foynes and Limerick the N69 is mainly a 100km/h posted speed limit road. There is a 100km/h speed limit on approximately 82% of the route under assessment but average speeds are approximately 73km/h. There are 50km/h and/or 60km/h speed restrictions through the villages of Foynes, Kilcornan, Kildimo, Clarina and Mungret.

In accordance with TII TD 9, Chapter 1, this section of the N69 has the following geometric characteristics:

- Alignment Constraint, A_C= 9.6
  (Measure of the degree of constraint imparted by the road alignment)
- Layout Constraint, L_C = 31
  (Measure of constraint imparted by the road cross-section, verge width, and frequency of junctions and access)

An analysis of the design speed in accordance with TII TD 9 Figure 1/1 indicates that the existing road would meet the requirements for a design speed of 85A (85km/h) and that the mean speed of light vehicles would be approximately 70km/h.

5.3.8 Pedestrians and Cycle Facilities

The pedestrian facilities along the existing N69 are limited to the villages of Foynes, Kildimo, Clarina and Mungret with no dedicated cycle facilities provided along any of the route.

Figure 5.8 shows the typical carriageway cross section through the village of Kildimo with wide pedestrian footpaths and a zebra crossing; however the footpath width reduces significantly in other areas of the village.

Figure 5.8 N69 in the village of Kildimo

Source: Google Street View

The village of Clarina is also located along the N69. Figure 5.9 shows the typical carriageway cross section through the village of Clarina with good pedestrian

facilities but no dedicated cycle facilities. Speeds through the village of Clarina are limited to 50km/h. There is also a signalised junction at this location.

Figure 5.9 N69 in the village of Clarina

Source: Google Street View

The village of Mungret is located along the N69 and the R859. Figure 5.10 shows the typical carriageway cross section along the N69 through the village of Mungret with limited pedestrian facilities. Speeds through the village of Mungret are limited to 50km/h.

Figure 5.10 N69 in the village of Mungret

Source: Google Street View

5.3.9 Road Pavement

This section of the N69 appears to be in good condition with overlays at a number of locations, however with increasing traffic the carriageway will require a structural overlay at some point to extend its life further. The towns and villages along the N69 have pavement conditions that are in slightly worse condition which are as a result of service diversions and connections within the villages.

5.3.10 Overtaking Opportunities

In terms of current road markings, overtaking is permitted over approximately 36% of the length of the road, in both the eastbound and westbound directions. However the opportunities are infrequent and the individual lengths are relatively short and most do not provide the length required in accordance with the DMRB to be counted as a proper overtaking section. If this road were to be designed as a new single carriageway road, a minimum overtaking percentage of 30% would be required, in accordance with TII TD 9, Table 7/3. For a 100km/h design speed, full overtaking sight distance of 580 metres is required. In this regard only 2 kilometres, or 6%, of the existing road meets this requirement.

In addition to the above, the general lack of hard shoulder results in a situation where there is inadequate provision for overtaking broken down vehicles which may be temporarily parked on the carriageway.

5.3.11 Environmental Constraints

The main environmental constraint along this section of the N69 is its proximity to the River Deel and the River Maigue, which are tributaries of the lower river Shannon. The N69 also borders the Lower River Shannon SAC for approximately 250m, the Barrigone SAC for approximately 900m, the Curraghchase Woods SAC for approximately 350m and the Askeaton Fen Complex SAC for approximately 100m. The N69 also runs adjacent to the Inner Shannon Estuary – South proposed Natural Heritage Area at the N18/N69 junction.

5.3.12 Local Constraints to On-Line Improvement

The N69 between Foynes and the N18 junction has a high level of frontage and local accesses along with numerous farm accesses and agricultural buildings. Other constraints limiting on-line improvements to the existing road are:

- The N69 passes through the villages of Mungret (Figure 5.10), Clarina (Figure 5.9), Kildimo (Figure 5.8), Kilcornan and Foynes;
- A large number of businesses and facilities on the approach to the N18/N69 junction;
- A rail level crossing serving a siding on the approach to the N18/N69 junction. (Figure 5.11);
- The River Deel and associated bridge structure;
- The River Maigue and associated SAC and bridge structure (Figure 5.3);
- The rail line and associated bridge structure at Morgans South, west of Askeaton;
- Askeaton and Kilcornan Cemeteries (Figure 5.12);
- Kilcornan Primary School; and
- Kildimo, Kilcornan and Robertstown Churches.

The degree of frontage coupled with a sub-standard horizontal alignment makes the potential for on-line improvements difficult without significant modification to the existing alignment.

Figure 5.11 Level crossing on N69 east of Mungret

Source: Google Street View

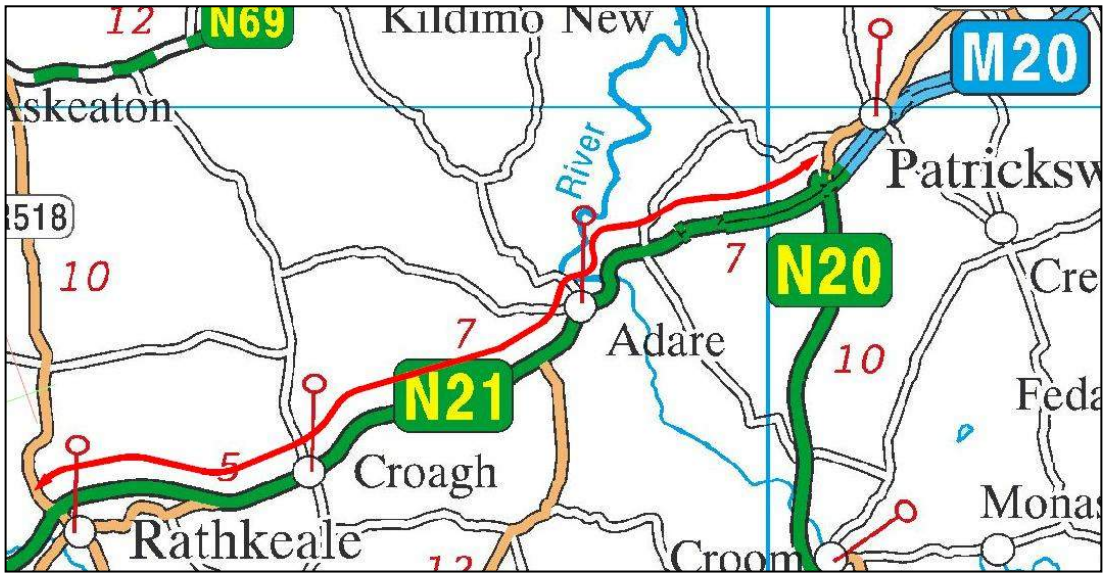
Figure 5.12 Kilcornan Cemetery located along the N69

Source: Google Street View

5.4 N21 National Primary Route – Existing Road Conditions

This section of the N21 extends from Rathkeale to the M20/N20/N21 junction at Attyflin as shown below in Figure 5.13. This section of the N21 passes through the villages of Croagh and Adare over a distance of approximately 18.5 kilometres.

Figure 5.13 N21 Rathkeale to the M20/N20 junction



5.4.1 Traffic Volumes

Two Automatic Traffic Counts (ATC) surveys were carried out along the N21 between the 19th of May and the 1st of June 2014. The two way daily traffic volumes recorded were:

- Rathkeale to Adare 13,300 AADT; and
- Adare to Attyflin 17,100 AADT.

For both sections the recorded traffic volumes are currently above capacity for a Type 1 Single Carriageway in accordance with Table 6/1 of TD 9 (11,600 AADT).

5.4.2 Road Cross-Section

The N21 between Rathkeale and Attyflin is a single carriageway with varying cross-sectional width. The road can be divided into three distinct sections in terms of cross-section and road geometry as follows:

- Rathkeale to east of Croagh;
- East of Croagh to east of Adare; and
- East of Adare through to Attyflin.

The cross-section of the N21 between Rathkeale to east of Croagh can be seen in Figure 5.14. Table 5.2 gives the average cross section dimensions of this section of the N21.

Table 5.2 N21 Rathkeale to East of Croagh

N21 Cross-section	Average Width (m)
Northern Verge	5.6m
Northern Hard Shoulder	3.6m
Carriageway	7.3m (2 x 3.65m metre lanes)
Southern Hard Shoulder	4m
Southern Verge	7.5m
Paved Width *(Overall Width Incl. Verges)*	**14.9m *(28m)***

From Rathkeale to east of Croagh, the N21 carriageway is typically wide, with generous hardshoulders and verges. This section of the N21 was built in 1990 - 1994 to bypass both Rathkeale town and Croagh village. Based on the roads characteristics and cross section this section of the N21 would conform generally to a Type 1 Single Carriageway as defined in TII TD 27, Table 3.

Figure 5.14 N21 from Rathkeale to Croagh

Source: Google Street View

Through the village of Croagh, traffic calming measures were implemented in 2013 including road splitter islands, public lighting and a 60km/h speed limit as seen in Figure 5.15 below.

Figure 5.15 N21 through the village of Croagh

Source: Google Street View.

After Croagh village the N21 carriageway continues with a wide cross-section. However from a point 1.5 kilometres west of Ballingarry Road junction through to the junction itself the carriageway cross-section narrows and has no hardshoulders. The typical cross-section dimensions of this section of the N21 can be seen in Table 5.3 below.

Table 5.3 N21 East of Croagh to East of Adare (excluding Adare Village)

N21 Cross-section	Width (m)
Northern Verge	1.4m
Northern Hard Shoulder	0m
Carriageway	7.3m (2 x 3.65m metre lanes)
Southern Hard Shoulder	0m
Southern Verge	1.3m
Paved Width *(Overall Width Incl. Verges)*	**7.3m *(10m)***

The cross-section of the N21 approaching the Ballingarry Road junction. Adare from the west can be seen in Figure 5.16.

Figure 5.16 N21 East of Croagh

Source: Google Street View

The carriageway and footpath cross-sections through Adare village vary considerably. A typical view of Adare village is shown in Figure 5.17 below. On the main street through Adare both the footpath and carriageways are wide with on street parking. Driver speeds are controlled by traffic lights, traffic islands and a zebra crossing. Typical cross-section dimensions for footpaths vary between 2.5m – 5.5m and for the carriageway (including provision for on street parking) between 9.5m – 15m.

Figure 5.17 N21 through Adare Village

Source: Google Street View

From the River Maigue crossing to the Lantern Lodge roundabout the carriageway cross-section narrows as can be seen in Figure 5.18 below. At this point on the N21 the carriageway width is typically 7.3m, with limited hardshoulders and verges varying between zero and 1.2m.

Figure 5.18 N21 River Maigue to Lantern Lodge

Source: Google Street View

From the Lantern Lodge roundabout outside the village of Adare to Attyflin the road has a typically wide cross-section and widens from a single carriageway to a Dual Carriageway on the approach to Attyflin Junction. The carriageway cross-section is typically 7.3m wide with varying hard shoulders between 2.5 and 4m in width and large verges. The Dual Carriageway has two 3.5m lanes in each direction with 2m hard shoulders and a wide grassed median.

This section of the N21 can be seen in Figures 5.19 - 5.21 below.

Figure 5.19 N21 between Lantern Lodge and Attyflin – Single Carriageway

Source: Google Street View

Figure 5.20 N21 between Lantern Lodge and Attyflin – Change in Cross-Section

Source: Google Street View

Figure 5.21 N21 between Lantern Lodge and Attyflin – Dual Carriageway

Source: Google Street View

5.4.3 Horizontal Alignment

The N21, from Rathkeale to east of Croagh, has a posted speed limit of 100km/h. All of the horizontal curves provided on this section of the N21 are above the desirable minimum for this design speed (R = 720m). As seen in Figure 5.14 the cross-section between Rathkeale and Croagh is a wide single carriageway and the horizontal alignment has large sweeping radii. This section of the N21 may be considered for an online upgrade.

The large radii continue along the N21 to a location approximately 1.5 kilometres west of the Ballingarry Road (R519) junction, Adare. At this point the carriageway cross-section narrows, the posted speed remains at 100km/h up until the Ballingarry Road junction where the speed limit reduces to 60km/h. The horizontal curves provided are below the desirable minimum for a Design Speed of 100km/h with radii generally between 125 metres and 450 metres. It would not be possible to provide an online upgrade of this section of carriageway due to below desirable horizontal curvature, and the narrow width of the existing carriageway. The posted speed limit reduces further to 50km/h through the village of Adare which is appropriate to the controlled conditions encountered in this urbanised location.

Between approximately 1km east of Adare (at the Lantern Lodge roundabout) and Attyflin the posted speed limit is 100km/h, and the horizontal alignment returns to large radii. This section of the N21 should be considered for an online upgrade due to the large carriageway cross-section and the availability of desirable minimum horizontal radii.

5.4.4 Vertical Alignment

The vertical alignment along the existing N21 between Rathkeale and Attyflin is relatively flat.

From Rathkeale through to 1km west of Murphy's Cross at the Ballingarry Road junction the road has been constructed to modern road design standards. From this location to the western approach to Adare over a length of 2 km, the road geometry has not been improved and has a rolling vertical alignment, with limited forward visibility.

5.4.5 Junctions and Accesses

Between Rathkeale and Attyflin (approximately 18.5 kilometres) along the N21 there are approximately:

- Public Road Junctions – 29;
- House and Farm Accesses – 74;
- Field Accesses – 51;
- Business / Community Access – 27.

This is equivalent to 7 junctions and accesses per kilometre (excluding field accesses). Between 6 and 8 junctions per kilometre would be considered as 'Medium' in accordance with the design standard TII TD 9, Section 1.4.

Within Adare there is significant on street parking and loading bays which affects traffic flow through the village. Right turn traffic movements within the town significantly add to delays.

5.4.6 Design Speed

This section of the N21 road has a design speed of 100km/h, consistent with the posted speed restriction. There is a 100km/h speed limit on approximately 85% of the route under assessment. There is a 50km/h speed restriction in Adare with 60km/h speed restrictions in Adare and Croagh.

In accordance with TII TD 9, Chapter 1, this section of the N21 has the following geometric characteristics:

- Alignment Constraint, $A_C = 6.3$
  (Measure of the degree of constraint imparted by the road alignment)
- Layout Constraint, $L_C = 23$
  (Measure of constraint imparted by the road cross-section, verge width, and frequency of junctions and access)

An analysis of the design speed in accordance with TII TD 9 Figure 1/1 indicates that the existing road would meet the requirements for a design speed of 100A (100km/h) and that the mean speed of light vehicles would be approximately 83km/h.

5.4.7 Pedestrians and Cycle Facilities

The only pedestrian facilities along this section of the N21 are within the villages of Adare and Croagh. There are no specific cycle facilities along any of this section of the N21. The hard shoulders from Rathkeale through to east of Croagh are however used by pedestrians and cyclists.

5.4.8 Road Pavement

This section of the N21 appears to be in good condition and does not present any evidence for concern. However with increasing traffic the carriageway will require a structural overlay at some point to extend its life further.

5.4.9 Overtaking Opportunities

Solid white lines over substantial lengths of the route prohibit overtaking. The current overtaking provisions, based on existing road markings are as follows:

- Overtaking Eastbound 36%
- Overtaking Westbound 38%
- Average (both ways) 37%

In accordance with the Traffic Signs Manual (TSM), overtaking is only prohibited where this would be dangerous for all vehicles. The DMRB requires a minimum of 30% overtaking opportunity, in each direction, for new Type 1 Single Carriageway roads. This utilises a more onerous definition of overtaking opportunity than that used in the TSM. However analysis of the geometry of the existing road conditions indicates that the more onerous DMRB requirement would still be achievable for this section of the N21.

It should be noted however that the 2014 average two-way traffic volumes are above the capacity for a Type 1 Single Carriageway in accordance with Table 6/1 TD 9 (11,600 AADT), with the result that even though overtaking visibility exists for the

confident driver, the probability of overtaking on the existing N21 is reduced considerably due to the high levels of oncoming traffic.

5.4.10 Environmental Constraints

The main environmental constraint along this section of the N21 is its crossing of the River Maigue, which is a tributary of the River Shannon and part of the Lower River Shannon SAC. The N21 is also in close proximity to two sections of the Adare Woodlands proposed natural heritage areas (pNHA's) located west of Adare.

5.4.11 Local Constraints to On-Line Improvement

The N21 between Rathkeale and Attyflin has a medium level of frontage and local access along with numerous farm accesses and agricultural buildings. Other constraints limiting on-line improvements to the existing road are:

- The N21 passes through Croagh Village and Adare Village, with traffic control islands (Figures 5.15 and 5.17 above).
- Further urbanisation of Adare Village.
- The River Maigue and associated SAC.
- Two pNHA sites are located west of Adare.

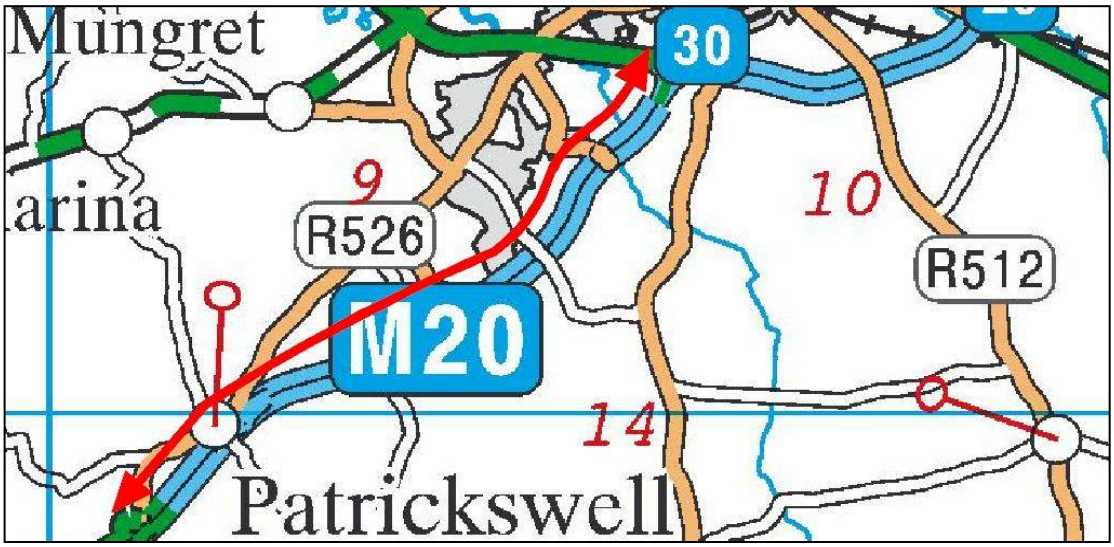
In terms of the existing road alignment, cross-section and frontage the N21 does not meet TEN-T requirements over long lengths of the current route. This is particularly relevant within the villages of Adare and Croagh. Offline bypasses of Adare, Croagh and other sections would be required to remove substandard horizontal curves, improve carriageway widths and avoid impacts on designated sites. All of the direct accesses along the route would need to be removed to meet the requirements of the TEN-T Regulations.

5.5 M20 National Primary Route – Existing Road Conditions

5.5.1 General

The M20 is a dual carriageway Motorway which travels north-easterly from the N20/N21 junction at Attyflin to the M7 junction at Rossbrien. The existing M20 between the Attyflin Junction (J5) and Rossbrien Junction (J1) is approximately 10 kilometres in length and is indicated in Figure 5.22 below. The N20 was re-designated as a Motorway (M20) in 2009.

Figure 5.22 M20 Attyflin to Rossbrien Junctions



5.5.2 Traffic Volumes

The M20 between the Attyflin junction (J5) and Rossbrien junction (J1) has a two-way traffic volume of approximately of 26,500 – 27,000 AADT based on TII permanent traffic counter data (2014). This is below the capacity for a Motorway in accordance with Table 6/1 of TII TD 9 (52,000 AADT).

5.5.3 Road Cross-section

The M20 motorway is a dual carriageway with a relatively consistent cross-section. The typical characteristics of the existing M20 cross-section between Attyflin and Rossbrien are summarised in Table 5.4 below.

Table 5.4 M20 Cross-section Attyflin to Rossbrien

Existing M20 Cross-section	Average Width (m)
Northern Verge	2.5m – 5m
Northern Hard Shoulder	2.5m
Carriageway	14m (2 x 7.0m)
Central Reserve	4.5m -10.5m (Incl. 2 x 0.5m hard strips)
Southern Hard Shoulder	2.5m
Southern Verge	2.5m - 5m
Paved Width (*Overall Width Incl. Verges)*	**20m *(28.5m – 39.5m)***

The carriageway cross section is 14m minimum (2 x 7.0m) and contains hard shoulders of minimum 2.5m. The verge width is generally between 2.5m and 5m. The central reserve is typically between 4.5m and 10.5m and contains a central barrier dividing the carriageways.

5.5.4 Horizontal Alignment

The existing horizontal geometry of the M20 between Attyflin Junction and Rossbrien Junction consists of a number of relatively straight sections connected by curves with radii between 850m and 3900m.

5.5.5 Vertical Alignment

The vertical alignment of the M20 is compliant with a design speed of 120km/h.

5.5.6 Junctions and Access

There are no direct accesses or entrances on to the M20 between Attyflin (J5) and Rossbrien (J1). The only access to the Motorway is via the grade-separated junctions.

5.5.7 Design Speed

Between Rossbrien (J1) and Dooradoyle (J2) on the M20 a speed limit of 100km/h applies while from Dooradoyle (J2) to Attyflin (J5) a speed limit of 120km/h applies.

In accordance with NRA TD 9, Chapter 1, this section of the M20 has the following geometric characteristics:

- Alignment Constraint, A_C= 5.9
  (Measure of the degree of constraint imparted by the road alignment)
- Layout Constraint, L_C = 5.0
  (Measure of constraint imparted by the road cross-section, verge width, and frequency of junctions and access)

An analysis of the design speed in accordance with NRA TD 9 Figure 1/1 indicates that the existing road would meet the requirements for a design speed of 120A (120km/h) and that the mean speed of light vehicles would be approximately 98km/h.

5.5.8 Pedestrians and Cycle Facilities

Walking or cycling is not permitted on Motorways and an alternative route is available on a new cycleway that opened in 2015 between Raheen and Patrickswell on the R526 (old N20).

5.5.9 Road Pavement

This section of the M20 Motorway appears to be in good condition. However, with increasing traffic the carriageway may require a structural overlay at some point to extend its use.

5.5.10 Overtaking Opportunities

The M20 is a dual carriageway, and as such overtaking opportunities are available on 100% of the route under assessment.

The M20 Northbound carriageway between Junction 4 Patrickswell and Junction 3 Raheen is indicated on Figure 5.23.

Figure 5.23 M20 Northbound carriageway between Junction 4 and Junction 3

Source: Google Street View

5.5.11 Environmental Constraints

As there are no proposed works along this section of the M20 there are no significant environmental constraints to consider.

5.5.12 Local Constraints to On-Line Improvement

As the M20 is a motorway and has no direct access to it other than via the grade separated junctions, the road has the geometric and functional characteristics to meet the requirements of a TEN-T road.

5.6 'Do- Nothing' Scenario

The 'Do-Nothing' scenario investigates the existing road infrastructure and its ability to meet future demands for traffic and safety without any upgrade works, other than routine maintenance. The definition in the TII Project Management Guidelines is as follows:

> *The 'Do-Nothing' alternative shall comprise an investigation of the existing road infrastructure and its ability to meet future demands for traffic and safety without any upgrade works, other than routine maintenance. Investigation of the 'Do-Nothing' alternative should include an examination of existing policy on improvements to certain National Routes, safety and levels of service.*

5.6.1 N69 Foynes to Limerick

In terms of road alignment, cross-section and frontage development with frequent accesses the current N69 does not meet the TEN-T requirements of a high quality road.

The geometry of the existing road contains many sub-standard horizontal curves for the posted speed limit of 100km/h. This leads to dubious overtaking conditions and a reduction in safety. The existing road also contains numerous vertical curves which are below standard for a road with a posted speed limit of 100km/h. As outlined in section 5.3.10 above, the sub-standard horizontal and vertical alignment results in limited overtaking opportunities along this section of the N69.

The average traffic flow between Foynes and Limerick is 8,850 AADT (2014), and ranges from 5,500 AADT at the western end to 12,200 AADT at the eastern end. The average traffic flow is anticipated to grow to approximately 6,250 AADT at the western end in the Design Year of 2039, and 14,850 AADT at the eastern end, which will exceed the capacity for a Type 1 Single Carriageway of 11,600 AADT. As a result even though some overtaking opportunities exist, opportunities for overtaking will greatly reduce due to the high levels of oncoming traffic.

Even with improvements in road surfacing and maintenance of existing hedges, journey times and level of service will deteriorate due to predicted increases in traffic volumes.

The accident figures for this section of the N69 are reported in Section 2.5 of this report. These figures are likely to increase in number and frequency as traffic volumes increase. As traffic levels increase and reducing levels of service lead to greater driver frustration and potentially more dangerous overtaking manoeuvres, safety will inevitably be further compromised.

5.6.2 N21 Rathkeale to Attyflin

In terms of the road's alignment, cross-section and frontage development the current N21 does not meet the TEN-T requirements as a high quality road over significant sections of its length.

Some sections of the existing single carriageway N21 may meet the geometrical requirements of a high quality road. These sections are primarily on the Rathkeale Bypass and the N21 east of Croagh for 2km, however these section are already over capacity with regard to traffic volumes.

In terms of providing a connection from the N21 to the Port of Foynes none of the existing regional or local roads are to a suitable standard to meet the TEN-T requirements of a high quality road.

In terms of existing traffic demand and current road design standards the existing N21 road is already deficient. The typical cross section carriageway width of the N21 is 7.3m, and there are also significant areas of the carriageway which do not have a hard shoulder which further limits capacity. The horizontal alignment of the N21 is relatively straight in sections, however some sub-standard horizontal curves also exist. These sub-standard horizontal curves are generally situated in the sections which also have a narrow cross section and no hard shoulder.

This section of the N21 currently carries between 13,300 AADT and 17,100 AADT (2014). These traffic volumes are currently over-capacity for a Type 1 Single Carriageway in accordance with Table 6/1 of TII TD 9 (11,600 AADT). By the Design Year of 2039, the 'Do- Nothing' scenario traffic is anticipated to grow to between 15,050 AADT and 19,400 AADT. These predicted volumes will exceed the road's design capacity by between 30% and 67% leading to increased congestion, limited overtaking opportunities and a reduced Level of Service. The high levels of delay which the road already experiences will only be exacerbated by increased traffic volumes.

As traffic levels increase and reducing levels of service lead to greater driver frustration and potentially more dangerous overtaking manoeuvres, safety will inevitably be further compromised. This section of the N21 forms part of the vital connection between Limerick and the towns of Adare and Rathkeale. It is currently below standard for its function and will continue to inhibit economic growth unless significant improvements are carried out.

5.6.3 M20 Attyflin Junction to the Rossbrien Junction

The M20 motorway meets the requirements of the TEN-T regulations for a Core Network road, however the M20 itself does not provide a connection to Foynes Port. The M20 Motorway between Attyflin (J5) and Rossbrien (J1) is a dual carriageway with a relatively consistent cross-section. The carriageway cross section is generally 14m (2 x 7.0m) and contains hard shoulders of minimum width 2.5m.

The existing horizontal and vertical geometry of the M20 between Attyflin Junction and Rossbrien Junction is consistent with that of modern motorway standards.

The recorded two-way traffic volume along this section of the M20 is currently between 26,300 AADT and 26,800 AADT (2014). This traffic flow is currently below the capacity of a standard Motorway in accordance with Table 6/1 of TII TD 9 (i.e. 52,000 AADT). The traffic flow along this section of the M20 is anticipated to grow to between 29,950 AADT and 31,200 AADT in the Design year of 2039.

As the M20 is a motorway and has no direct access onto it other than via the grade separated junctions, the road has the geometric and functional characteristics required to meet the requirements of a TEN-T core network road. If considered further as an option in the development of a route between Foynes and the rest of the motorway network, the M20 and its junctions would need to be assessed in terms of capacity for any additional traffic. However the projected design year traffic on the M20 in 2039 is still well below the capacity of a standard Motorway.

5.6.4 'Do- Nothing' Scenario Summary

The 10km length of the M20 and the N21 dual carriageway between Adare and Rossbrien meets the objectives of the TEN-T Core Network for a motorway or express road.

Neither the existing N69 between Foynes and Limerick nor the N21 single carriageway between Rathkeale and Adare meet the required standards for the following reasons:

- Both the N69 and N21 roads contain significant sections of sub-standard alignment. These sections of road would not be appropriate for any of the TEN-T road classifications; motorway, express road or conventional strategic road.
- The significant number of direct accesses onto both the N69 and N21 are inappropriate for a TEN-T road.
- The assessed sections of the N69 and the N21 contain long lengths with limited overtaking opportunities which lead to delays, dubious overtaking manoeuvres, and a poor safety record.
- Accident statistics reveal that in the 8 year period from 2005 to 2012 the N69 between Foynes and Limerick had 5 fatal collisions, 9 serious collisions and 74 minor collisions. During this same time period the N21 between Rathkeale and Attyflin had 3 fatal collisions, 10 serious collisions and 53 minor collisions.
- The predicted traffic volume along the N21 in the design year of 2039, for a Do-Nothing scenario, will exceed this road's current design capacity based on road cross section type by approximately 30% to 67% leading to increased congestion, very limited overtaking opportunities and a reduced Level of Service.

In summary, it is concluded that a 'Do-Nothing' scenario for the existing road network will not meet the TEN-T requirements for the required connection between Foynes and the core road network. Furthermore, the existing road network without improvement, will result in unacceptable further deterioration to the level of service and poor safety record along the N69 and N21, which is in conflict with the local, national, and regional planning policies.

5.7 'Do- Minimum' Scenario

The 'Do-Minimum' scenario investigated the potential to replace or upgrade the existing infrastructure to meet TEN-T requirements and the predicted demands for the next 30 years. The 'Do-Minimum' alternative is defined in the TII Project Management Guidelines as follows:

> *The 'Do-Minimum' alternative will generally comprise an investigation of the feasibility of an 'on-line' upgrade of the existing route which would be capable of delivering the required levels of service and safety in accordance with the applicable design standards.*
>
> *This investigation should also examine the feasibility of a partial 'on-line' upgrade, where certain sections of the existing national route may be suitable for upgrade, particularly where the road has been subject to a previous improvement scheme and where additional land-take may not be required or will only be required at a minimum level.*

While speed reducing traffic management measures can be used as part of a Do Minimum scenario to address safety issues, these would lead to increased journey time delays and congestion, leading to a further reduction in the level of service. This is fundamentally at odds with the TEN-T requirements and should not be considered for a TEN-T road.

An analysis of improving each section of the scheme was undertaken and is summarised is the following sections.

5.7.1 N69 Foynes to Limerick

Traffic and Level of Service

To meet both the TEN-T Requirements and the traffic capacity requirements of Table 6/1 of TII TD 9 with the predicted Design Year 2039 traffic flows of between 6,250 AADT and 14,850 AADT, a number of road types could be considered. For the predicted traffic volumes a Type 1 Single Carriageway could be considered for some of the length at the western end of the route. However towards the eastern end of the route a single carriageway road would have insufficient capacity, and as a result there would be a reduced level of service, with reduced average speeds and continued issues related to poor road safety and unpredictable journey times as is experienced presently.

A Type 2 Dual Carriageway could be considered in terms of providing the required capacity for the eastern end of the route. Any such on-line improvement would need to prohibit stopping on the carriageway and remove all direct access to meet TEN-T requirements.

Road Type

Due to the high level of frontage development as described earlier, an on-line upgrade removing direct access to meet the TEN-T requirements would create significant severance and impacts on properties. A Type 2 Dual Carriageway or a Type 1 Single Carriageway would all have significant impacts in terms of their width compared to the existing road cross sections. For any road type considered, parallel access roads would have to be provided to remove direct access which would further

widen the road width and the additional land required for the road. The overall online widening of the road would require the removal of a high number of properties due to their close proximity to the existing road as shown in Figure 5.24.

Figure 5.24 Example of Frontage Development on the N69 at Toreen, Kilcornan (12 properties)

In the case of each of the villages along the route, a bypass solution would appear to be the most practical solution in terms of avoidance of property impacts. As an example, Figure 5.25 below shows the proximity of existing properties to the N69 in Clarina.

Figure 5.25 N69 through Clarina - Bypass Required

Source: Bing Maps

Geometry

Of the horizontal curves along this section of the existing N69, 8 existing tight curves would need to be removed to meet current design standards for either a single or dual carriageway. In addition, for a single carriageway, another 5 curves would need to be removed to eliminate dubious overtaking manoeuvres. The assessment concluded that it would not be possible to utilize the existing horizontal alignment and that significant sections of off-line construction would be required. To remove the sub-standard curve geometry from the alignment approximately 12 kilometres, or 36%, of the total route would need to be constructed offline of the current route.

Vertically the road has an undulating alignment which would require additional road realignment and earthworks to achieve the required standard, resulting in further significant local impacts and land requirements.

Junctions and Access

The TEN-T regulations requires the removal of all direct access and only controlled junction access. There is a high level of direct access from existing houses, farms and businesses along the road. These would all need to be removed and connected to parallel access roads which would in turn connect to the existing local road network. The existing Local Road accesses would all need to be upgraded to meet the geometric and visibility requirements of TII TD 41-42.

Land and Property Impacts

Additional lands would be required along the majority of the length of the N69 to accommodate any improved road cross-section. Should an online improvement through Kildimo, Clarina and Mungret be considered, the proposal would result in considerable disruption with over 100 properties that would need to be acquired. An online improvement with bypasses of these villages with a Type 1 Single Carriageway would, as a minimum, require the acquisition of a high number of properties including houses and businesses. This number would rise considerably if a Dual Carriageway were considered. In addition to impacts on houses, impacts may

also occur on Kilcornan Church and Cemetery, Ballybrown GAA pitch and further Clubhouse in Clarina, the Cemetery and Franciscan Friary National Monument in Askeaton.

The current N69 runs adjacent to the Lower River Shannon SAC, Barrigone SAC, Curraghchase Woods SAC and the Askeaton Fen Complex SAC and changes in alignment or cross-section will impact these protected areas.

Viability of Upgrade Alternative

An assessment of the "Do Minimum" online improvement of this road to meet TEN-T requirements, by removing and limiting access and improving the road cross section and alignment, indicates that this would not be feasible without very significant property acquisition, environmental impacts at several designated sites, and other impacts for agriculture, residences and local businesses.

A further complication would be the requirement to provide for local accesses and slow-speed traffic on the route if it were on-line, which is fundamentally incompatible with a motorway or express road as required for the TEN-T Core Network.

It is therefore considered that an online upgrade of the N69, as part of a Do-Minimum alternative, will not meet the requirements of a TEN-T route. A new off-line route is the most appropriate proposal should a route be proposed on the N69 corridor in terms of minimising impacts, delivering value for money and meeting the objectives of the TEN-T Regulations. There is the option of upgrading the N69 Askeaton to maximize the use of existing infrastructure.

5.7.2 N21 Rathkeale to Attyflin

Traffic and Level of Service

Predicted Design Year (2039) traffic flows to the east of Adare are predicted to be in the region of 19,400 AADT while traffic between Adare and Rathkeale is expected to be in the range of 14,100 - 15,500 AADT. To provide adequate levels of service and improved journey times along this section of the N21 a Type 2 Dual carriageway road cross section would be required. An on-line improvement of the existing N21 could be considered as part of a Do-Minimum scenario to address this requirement.

Suitability for Online Improvement

Of the 14km length between the western end of the N21 dual carriageway at Attyflin and the R518 junction on the Rathkeale Bypass, there are just two sections, amounting to a combined length of 7km, which are suitable for on-line widening to a dual carriageway. This consists of 5km between Rathkeale and Croagh village and 2km east of Croagh.

Bypasses will be still required at Adare and Croagh. To combine such bypasses with a 2km long section of upgraded road between those villages will involve an overall additional length of 2km compared to a more direct offline route. There would be no economic benefit therefore in seeking to incorporate the existing N21 between Adare and Croagh in the Foynes to Limerick Scheme. The Do-Minimum scenario would therefore incorporate just 5km of the existing N21 and 9km of new alignment consisting of bypasses of Adare and Croagh.

Road Type

Even though the sections of road being considered for on-line improvement have previously been improved, there is still some existing road frontage development that will need to be catered for. Widening of the existing carriageway to accommodate either a Type1 or Type 2 Dual Carriageway will result in impacts on property frontage due to the additional land required. Some new parallel access roads will also be required for local roads that currently have at-grade junctions and to remove all direct access, which is likely to increase the road width and the additional land required.

Geometry

The existing road has horizontal and vertical geometry that could be considered for on-line improvements and would be compliant for a Design speed of 100km/h apart from the villages of Adare and Croagh.

Junctions and Access

TEN-T Requirements are such that no direct access is provided and that controlled junctions are used. Although the level of access on the N21 is not as great as on the N69 a number of direct accesses from existing houses, farms and businesses along the road would need to be removed and collected to parallel access roads which would in turn connect to the existing local road network or collected to new junctions. Bridging over or under the N21 may also be required as a treatment for local roads.

Land and Property Impact

The existing road reservation is approximately 28 metres from fence to fence but varies depending on location. Additional lands would be required along the majority of this length to accommodate any improved road cross section as well as required parallel access roads. An on–line improvement to a dual carriageway road would as a minimum, impact on approximately 15 properties.

Viability of Upgrade Alternative

An assessment of the 'Do-Minimum' online improvement of this road to meet the requirements of the TEN-T, by removing and limiting access and improving the road cross section and alignment, indicates that the N21 from Rathkeale to Croagh and the section of the improved N21 east of Adare could be improved on-line to accommodate an improved road to TEN-T standards.

The road would still require bypasses of Adare and Croagh connected along with a new offline section, together with a new link road to Foynes. Existing regional and local roads are not deemed suitable to accommodate this last requirement.

It is therefore considered that the Do-Minimum scenario of only upgrading the N21 online to meet the scheme objectives is not feasible. However sections of the N21 could be considered in terms of being used in options for the development of the scheme to maximise the reuse of existing infrastructure.

5.7.3 M20 Attyflin Junction to the Rossbrien Junction

The M20 motorway meets the requirements of the TEN-T regulations for a Core Network road, and could form part of a route connection to Foynes Port.

5.7.4 'Do-Minimum' Scenario Conclusion

The feasibility of the 'Do-Minimum' alternative for the N69 and N21 is negatively impacted by the significant amount of off-line construction required for both routes and the large scale impact on the adjacent properties along the route.

It is concluded that the 'Do-Minimum' alternative investigated does not provide a solution which is in accordance with the scheme objectives and is therefore not deemed to be feasible. However, some sections of the existing N21 and N69 could be considered in terms of being used within some of the new route options for the development of the scheme to maximise the reuse of existing infrastructure.

Chapter 6 Options Assessment

6.1 Introduction

The route selection for the scheme followed the definition of the extent of the study area and constraints studies as outlined in Chapter 3. The Route Selection process was undertaken in two stages broadly in accordance with the TII Project Management Guidelines 2010 as follows:

Stage 1 Develop a number of feasible route options (typically 6 or more and including 'Do-Nothing' and 'Do-Minimum' alternatives) and carry out a Preliminary Options Assessment using a Framework Matrix (comprising the assessment criteria of Engineering, Environment and Economy). This will result in the number of route options being refined to a maximum of 3 - 5.

Stage 2 After Stage 1, carry out a Project Appraisal of these routes using the Project Appraisal Matrix (comprising the 5 Common Appraisal Criteria of Economy, Safety, Environment, Accessibility & Social Inclusion and Integration. These are set out in the Department of Transport, Tourism and Sport Guidelines on a Common Appraisal Framework for Transport Projects & Programmes, and enable the selection of a Preferred Route Corridor.

6.2 Stage 1 Assessment

The Stage 1 Assessment was undertaken in three phases as follows:

- ***Stage 1A*** - Definition of 1km broad route corridors and an initial sift of these corridors to identify any corridors that could be excluded from further consideration;
- ***Stage 1B*** - Definition of 300m route corridor options and comparison of these corridors in groups to determine the best option between common points; and
- ***Stage 1C*** - Involved the selection of the shortlisted Route Corridor Options for presentation at the Public Consultation.

6.3 Stage 1A Assessment

6.3.1 Initial Constraints

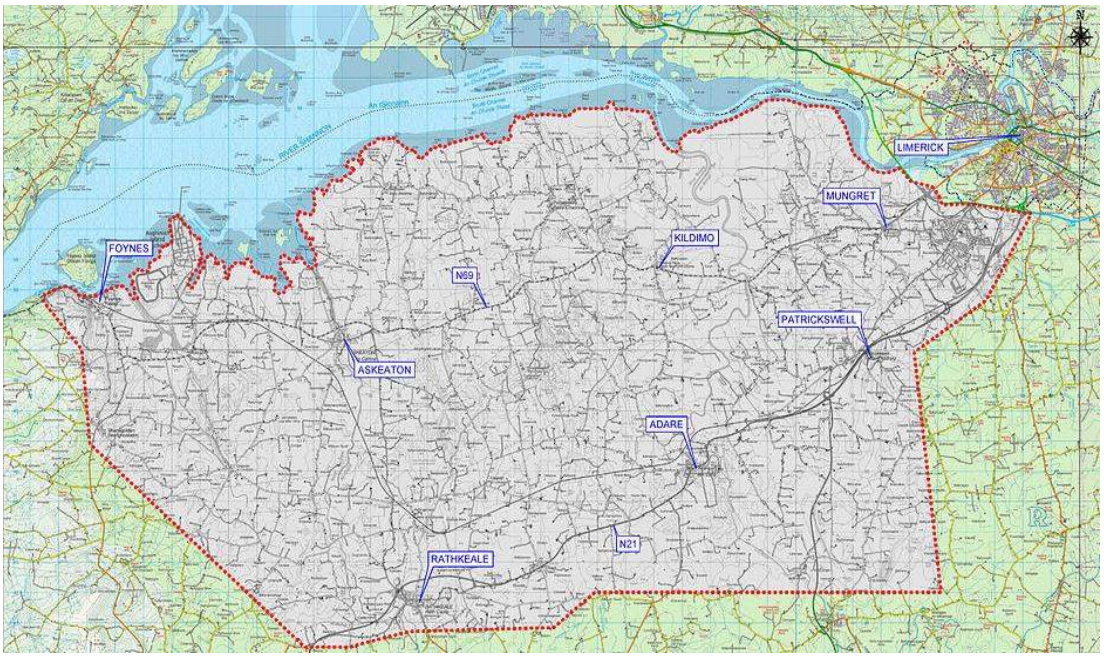
In developing the initial broad route corridors cognisance was taken of the study area and of significant constraints as well as utilising corridors previously identified for other schemes that could be incorporated into the development of a route between Foynes and Limerick. The study area is shown in Figure 6.1 overleaf. This figure is reproduced to a larger scale as Drawing No. CS-002 in Volume 2 of this report.

Significant constraints that informed the development of the initial corridors included, but were not limited to, the following:

- Areas with ecological protection status - SACs, pNHA's and SPA's;
- Existing National Roads including the N69, N21, N18 and N20/M20 and significant Regional Roads;

- Towns and villages along the N69, including, Foynes, Askeaton, Kilcornan, Kildimo, Clarina and Mungret;
- Towns and Villages along the N21 and M20 including Rathkeale, Croagh, Adare, Patrickswell, Raheen Business Park and Dooradoyle;
- Other villages including Pallaskenry, Shanagolden, Ballysteen and Cappagh;
- The River Maigue;
- Curraghchase Forest Park;
- The Askeaton Fen Complex;
- Barrigone Woods;
- The Foynes Limerick Rail Line; and
- Commercial Industries.

Figure 6.1 Constraints Study Area



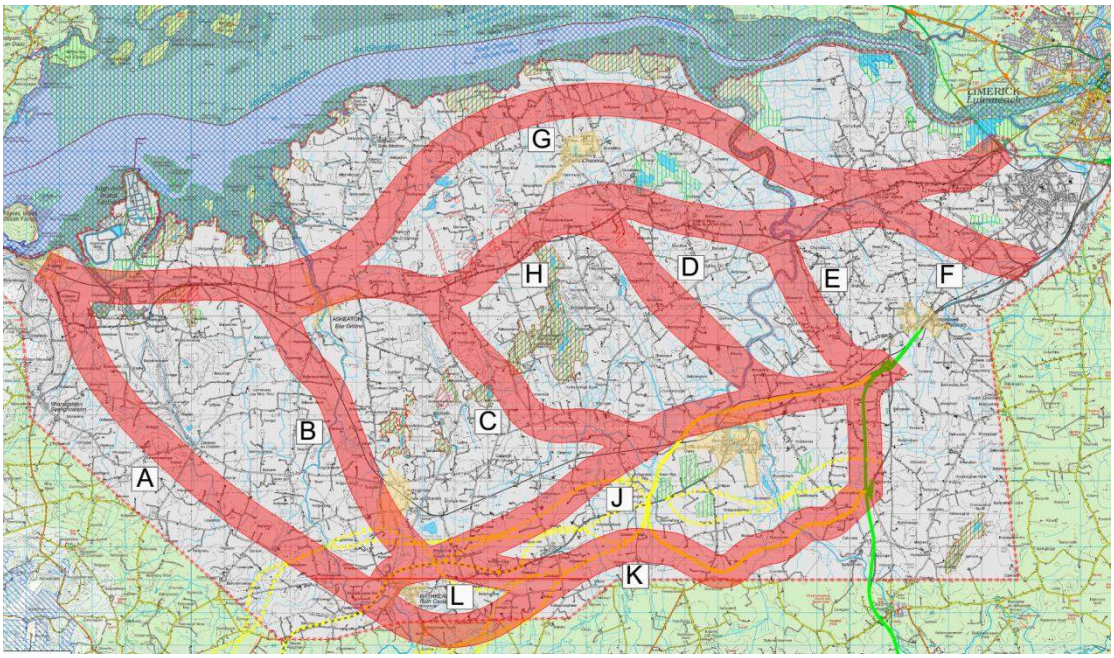
6.3.2 Definition of Corridors

Following on from the examination of the initial constraints identified, initial broad route corridors were developed which could be used to develop feasible routes for the scheme. The corridors selected were approximately 1 km in width so as to generate sufficient scope for later development of routes, noting that on closer examination of more detailed constraints information, other options may emerge outside of these broad route corridors.

6.3.3 Stage 1A Assessment

The initial broad route corridor options are presented in Figure 6.2 below (This figure is reproduced to a larger size with some additional detail as Drawing No. RS-001 in Volume 2 of this report).

Figure 6.2 Broad Route Corridor Options – Stage 1A



In order to assess the initial broad route corridors in terms of preference and to potentially eliminate those corridors that are not suitable at an early stage from further detailed assessment, the initial corridors were assessed in accordance with the TII Project Management Guidelines 2010 as part of the Stage 1 Preliminary Options Assessment process. All options were initially examined under the headings of Engineering, Environment and Economy.

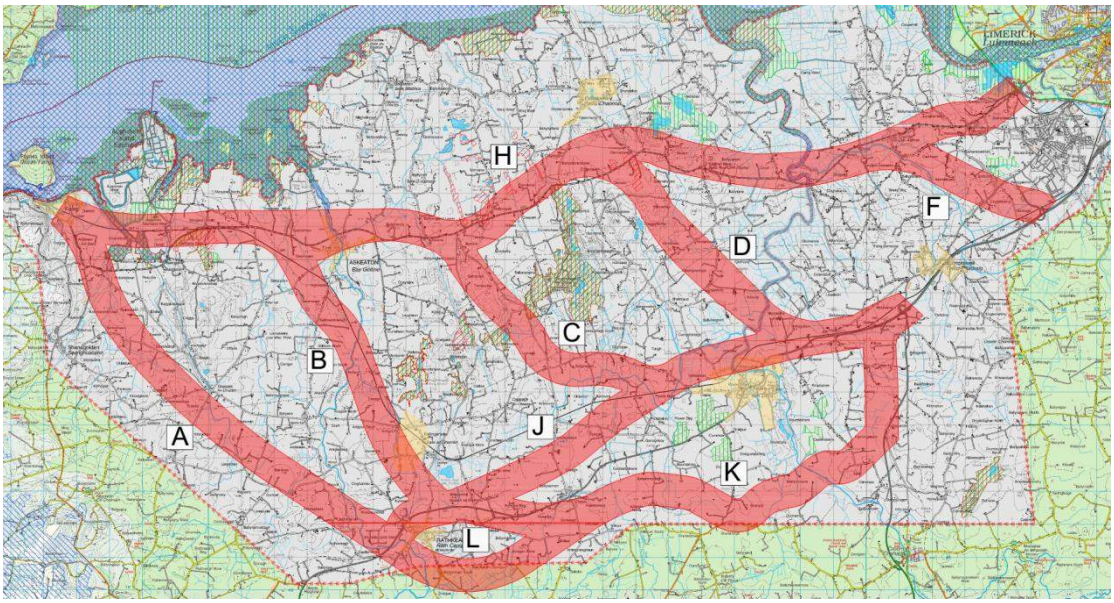
On the basis of the assessment, selected options were carried through to the next phase and those that could be discounted were eliminated from further assessment. As part of this assessment the broad corridor options of G and E were discounted from further consideration.

Corridor G had low preference under all three assessment headings of Engineering, Environment and Economy. When compared to Corridor H this corridor requires a significantly wider crossing of the River Maigue and has a longer length in poor ground. Environmentally this option had a low preference in terms of impacts on archaeology and cultural heritage, agronomy, landscape and visual characteristics and impacted Pallaskenry Agricultural College. When compared to Corridor H the additional length of this route means that this options fared poorly. As a result Corridor G was discounted when compared to Corridor H.

Corridor E also had a low preference under the three assessment headings. The corridor passes through an area of floodplain associated with the River Maigue over most of its length and as a result had a low preference with regard to Engineering. In terms of the environment the corridor performed poorly in terms of ecology, geology, hydrology and hydrogeology being located close to the Maigue River and in an area that was subject to flooding. The cost of construction in the floodplain means this option had a low economic preference. On the basis of low preferences under the headings of engineering and economy and when compared to adjacent north south links of D and F, Corridor E was discounted from further consideration.

The broad route corridors brought forward to the next stage of assessment are presented in Fig. 6.3 below (and reproduced to a larger size as Drawing No. RS-002 in Volume 2 of this report).

Figure 6.3 Broad Route Corridor Options brought forward from Stage 1A



6.4 Stage 1B Assessment

The aim of the Stage 1B Assessment was to identify, where possible, the best route corridor option within each of the initial broad route corridors carried forward from Stage 1A, through a process of elimination. For this process 300m wide route corridor options were identified within the 1km broader corridors, taking all known constraints into account. During this process, some of the route corridor options developed fell outside the initial broad corridors examined at Stage 1A. This arose as other potential route corridor options were identified which were deemed feasible in response to the opportunities presented by geometric refinement taking more detailed constraints into account.

A preferred single option within each of the initial broad corridors was identified except for corridors A, J and K where multiple options remained. These options were then taken through to Stage 1C for further consideration.

As was the case in Stage 1A the assessment was undertaken in accordance with the TII Project Management Guidelines 2010 as part of the Stage 1 Preliminary Options Assessment process, using the criteria of Engineering, Environment and Economy. Generally the assessment compared route corridor options between common points in groups of two or more, and those which could be eliminated based on the comparison exercise were discounted from further consideration.

6.5 Stage 1C Assessment

The Stage 1C Route Option Assessment followed on from Stage 1B and its purpose was to select a group of shortlisted route corridor options which would be brought forward for public consultation. Generally the assessment consisted of a further phase of paired or grouped corridor option alternatives between common points.

Broad route corridor K which followed the route of the 2010 N21 Adare Bypass was examined and discounted from further consideration for the Foynes to Limerick Road Improvement Scheme. This was based on an additional length of over 2.5 kilometres of road compared to the northern bypass options around Adare now under consideration with broad route corridor J. A southern bypass of Adare would avoid crossing the River Maigue where it falls within the Lower River Shannon SAC. However the additional length of the southern bypass, increased construction costs, journey times and the effect of carbon emissions were considered on balance less preferable to the impacts on the Maigue which, in any event, can be mitigated by suitable design including the provision of a clear-spanning bridge of the river.

Four distinct corridors were identified and brought forward arising from the Stage 1C assessment and these are described and assessed in the following section. The four corridors are presented in Fig. 6.4 below.

6.6 Stage 2 Appraisal

The Stage 1 Appraisal resulted in the number of route corridor options being refined to four. These four options were assessed with regard to the recommendations of TII Project Management Guidelines 2010 as follows:

Stage 2
After Stage 1, carry out a Project Appraisal of these routes using the Project Appraisal Matrix comprising the 5 Common Appraisal Criteria of Economy, Safety, Environment, Accessibility & Social Inclusion and Integration leading to the selection of a Preferred Route Corridor. These criteria are as set out in the Department of Transport, Tourism and Sport Guidelines on a Common Appraisal Framework for Transport Projects & Programmes.

The Stage 2 Options Appraisal consisted of the following:

- Definition of Route Corridor Options;
- Public Consultation (PC – March 2015);
- Appraisal of Route Corridor Options and Selection of Preferred Route Corridor; and
- Public Display (PD – December 2015).

6.7 Corridor Options

The four shortlisted route corridor options resulting from the Stage 1 Assessment are as follows:

- ***Route Corridor Option 1*** **(Red)** – Closely follows the current N69 diverting south at Clarina to tie in with the M20 Raheen Junction (J3)

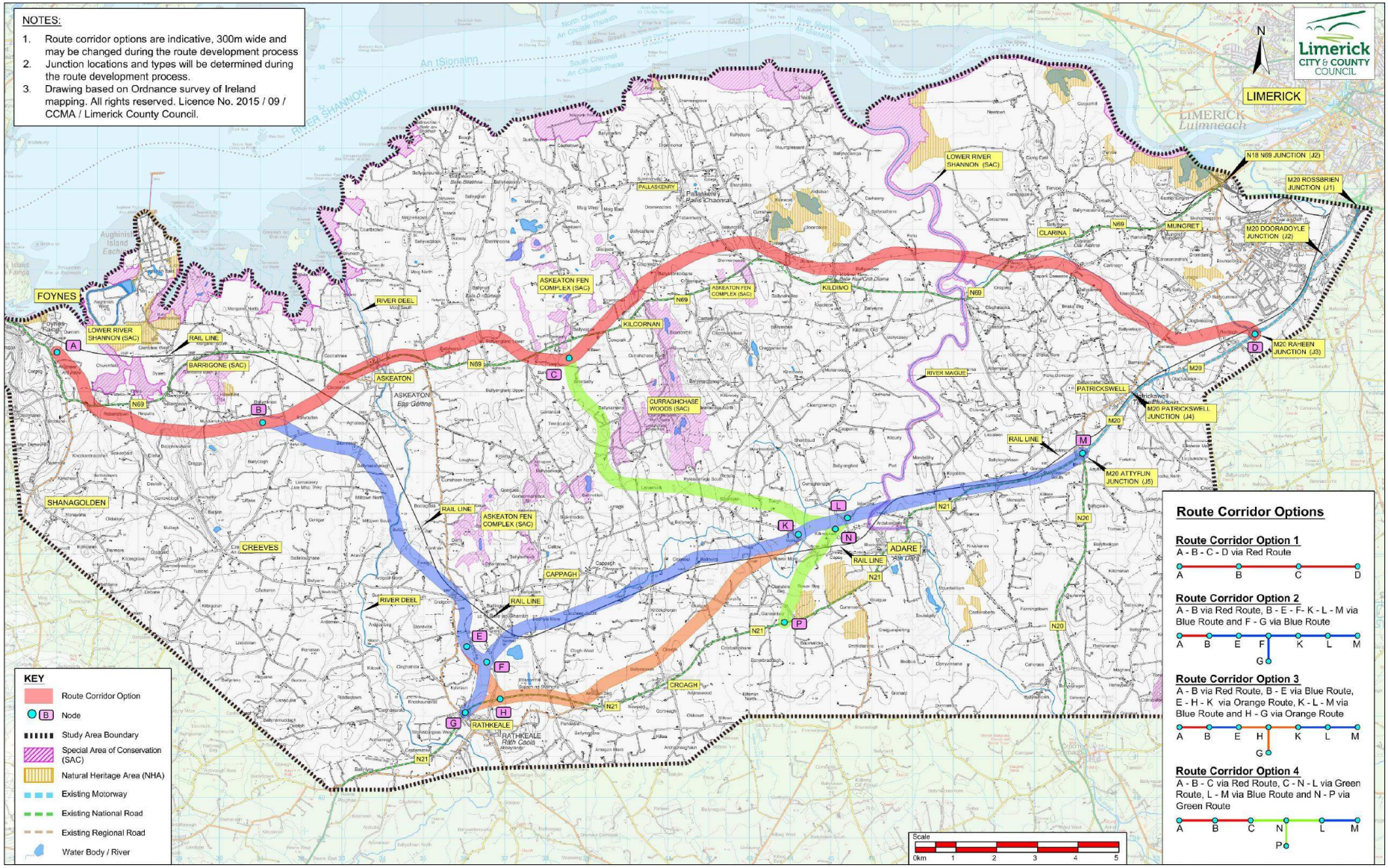
- ***Route Corridor Option 2*** **(Blue)** – Closely follows the N69 before heading south of Rincullia and closely following the Foynes – Limerick Rail line to Rathkeale. From Rathkeale running to the north of the rail line to Adare, bypassing Adare to the north and tying into the N21 before the M20/N20 Attyflin Junction (J5)

- ***Route Corridor Option 3 (Orange)*** – Closely follows the N69 before heading south of Rincullia and closely following the Foynes – Limerick Rail line to Rathkeale. From Rathkeale running along the existing N21 before heading in a north easterly direction, bypassing Adare to the north and tying into the N21 before the M20 Attyflin Junction (J5)

- ***Route Corridor Option 4 (Green)*** – Closely follows the N69 through to Kilcornan and heading south, along the western edge of Curraghchase tying in with a Northern Bypass of Adare at Curraghbeg crossing the River Maigue and tying into the N21 before the M20/N20 Attyflin junction (J5). In addition, a link is provided in a south westerly direction from Curraghbeg to tie in with the existing N21 at Garraunboy.

These 300m wide route corridor options are shown in Figure 6.4 overleaf and in Drawing No. RS-003 in Volume 2 of this report. These options were presented at the Public Consultation in March 2015 for the Foynes to Limerick Road Improvement Scheme as discussed in the following section.

Figure 6.4 Route Options – Public Consultation



6.8 Public Consultation - March 2015

6.8.1 Introduction

The 300m wide route corridor options that emerged from the Stage 1 assessment were presented to the public at Public Consultation events held at the South Court Hotel in Limerick on 10th March 2015 and at the Flying Boat & Maritime Museum in Foynes on the 11th March 2015.

6.8.2 Objectives

The purpose of the public consultation was to inform the public of the route corridor options under consideration and to afford an opportunity for the public to engage with the process and to raise questions, concerns and comments for consideration as part of the assessment in identifying the preferred route corridor.

6.8.3 Publicity Campaign

In order to raise public awareness for the upcoming public consultation the following measures were undertaken by Limerick City and County Council:

Newspaper Advertisements

A press advertisement relating to the Public Consultation events was published in the Limerick Leader on the 7th March 2015. Further public notices together with a map showing the route corridor options were published in the Limerick Leader on the 21st and 28th March 2015.

Radio Advertisements

Notices of the public consultation events were announced on Live 95FM from the 9th to the 11th March 2015.

Project Website

A project website, www.foyneslimerick.ie, was established to provide additional information on the scheme and included drawings of the Route Corridor Options.

Limerick City & County Council Website & Twitter

Notice of the public consultation events were posted on the Limerick City & County Council's website and Twitter feed.

6.8.4 Public Consultation Events

Brochures with comment sheets enclosed were available at the events. This provided information on the scheme and the Route Corridor Options. A copy of the brochure is included in Appendix A of Volume 3 of this Report. Comments and observations in relation to the Route Corridor Options were invited from the public by 27th March 2015, with responses to be submitted by post or by hand to the Mid West National Roads Design Office. An e-mail address was also established specifically for any responses or submissions - *foynes@midwestroads.ie* .

As a result of the high level of interest from the public the final date for receipt of submissions was extended from the Friday 27th March 2015 for a further two weeks until the 10th April 2015. This extension was also advertised by means of notices in

the Limerick Leader on the 21st and 28th March 2015, and by updates on the Project and LC&CC websites and Twitter feeds.

Approximately 700 people attended the two days of public consultation and over 1000 submissions were received from the public in relation to the four Route Corridor Options displayed. During the public consultation events members of the project team were available for discussions with the attendees and to address any comments or queries they may have raised.

Subsequent to the public consultation events all requests from members of the public for individual meetings were facilitated. Where more than one meeting was requested these were facilitated also.

The concerns raised by the public in their submissions covered a broad spectrum. However dominant amongst these were the potential impacts on agriculture, commercial businesses, equestrian holdings, ecology, archaeology and cultural heritage and hydrology/hydrogeology.

The main issues raised in the submissions included the following:

- Severance of communities;
- Severance of farm land and impacts to farm buildings;
- Impacts on farms currently undergoing expansion, and the loss of high quality land;
- Impacts on private homes and quality of life;
- Impacts to ecology;
- Impacts to archaeological artefacts and protected structures;
- Impacts to equine businesses;
- Impacts to the serene nature of the area through noise and visual disturbance;
- Devaluing of property;
- Sentimental value of property passed down through generations;
- Flooding concerns;
- Impacts to schools and businesses;
- Severance and impacts on communities; and
- Impact on current access arrangements.

In terms of all the submissions received, the greatest proportion related to impacts on farms and land. These submissions were largely concerned with diminishing the value of land and property. A large number of submissions were also concerned with archaeological and cultural heritage. Community severance and the removal of access routes (i.e. to family members living elsewhere in the area or to community / commercial facilities) were issues raised in a large proportion of submissions. A number of submissions showed support for the road by-passing Adare and highlighted the subsequent benefits that would ensue from the bypass.

Figure 6.5 Public Consultation Event in The Flying Boat & Maritime Museum, Foynes

6.9 Refinement of Route Corridor Options

As part of the Stage 2 Corridor Assessment, further environmental assessments were carried out along the Route Corridor Options presented at PC 1. The purpose of these assessments was to identify specific issues likely to affect the assessment and selection of a Preferred Route Corridor.

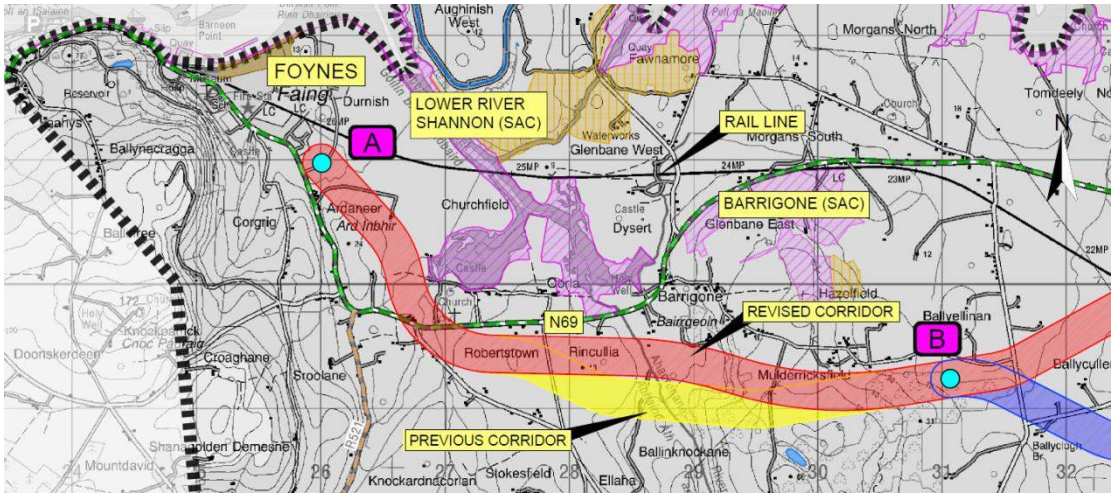
These environmental assessments coupled with findings from the public consultation lead to the adoption of four changes to the route corridor options as follows:

- Nodes A – B at Craggs
- Nodes B – E at Milltown
- Nodes B – Q at the Askeaton Bypass
- Nodes E – H at Rathkeale

6.9.1 Node A – B at Craggs (Route Corridor Options 1, 2, 3 and 4)

During ecological field surveys, a section of Alluvial Woodland was identified to the southwest of the Barrigone SAC in the townland of Craggs along the Ahacronane River. The surveys revealed an extensive length of woodland along the river which was located within the initial Route Corridor Options. Options to the north and south of the initial corridor were investigated and based on the assessments, the option of moving the corridor approximately 350 metres to the north was considered the preferred option when the balance of the various impacts were considered. This change is common to all four Route Corridor Options 1 to 4. Figure 6.6 below shows the previous corridor along with the revised corridor.

Figure 6.6 Node A – B at Craggs



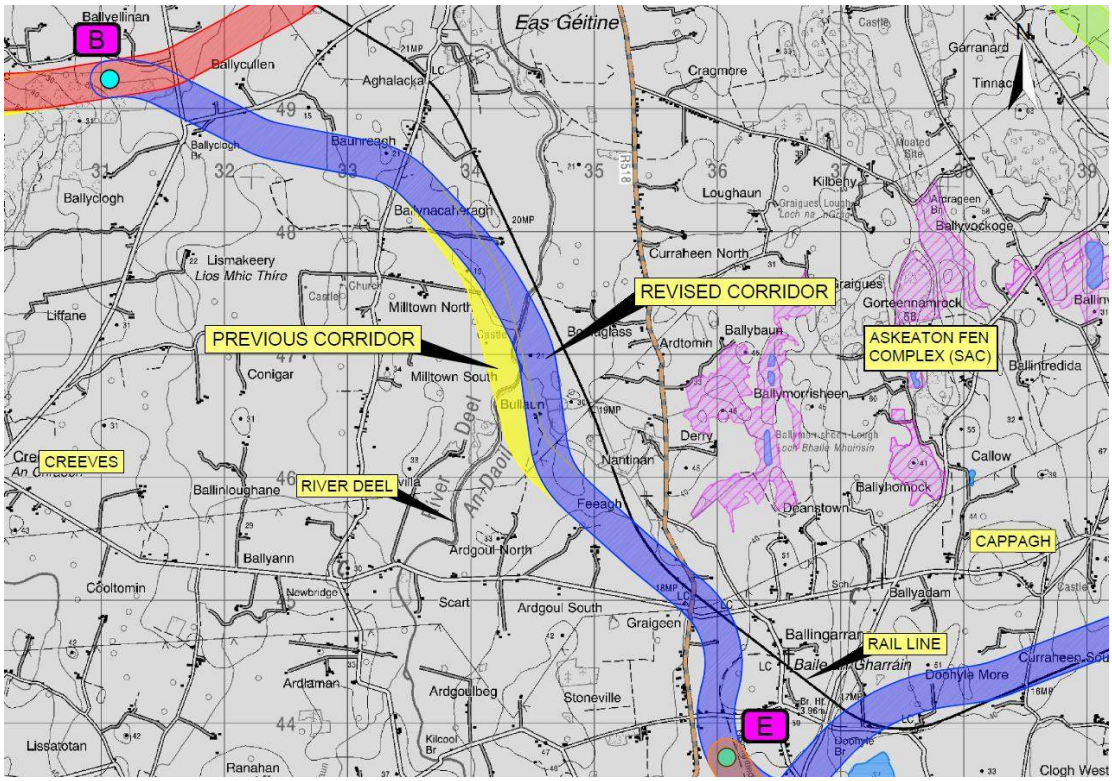
6.9.2 Node B – E at Milltown (Route Corridor Options 2 and 3)

During the assessment further archaeological appraisal was carried out of the recorded cashel in the townland of Milltown (RMP LI020-004001), located to the west of the River Deel. The assessment concluded that the site possessed a significant landscape setting. This was the only site within the Study Area to be designated with a Preservation Order under National Monuments Legislation. In addition a further possible enclosure was identified to the immediate east of the cashel (directly under the route corridor) which may be an associated significant feature. Therefore consideration was given to possible alternative route corridors that could reduce the impact on the setting of the cashel in question. Any direct impacts on potential

associated features were considered both east and west of the cashel site to determine the preferred alternative to the original route corridor.

A revised alignment for the route corridor approximately 250 metres to the east of the initial corridor was selected as having the least impact on the Cashel setting. This change is common to Route Corridor Options 2 and 3. Figure 6.7 below shows the previous corridor along with the revised corridor.

Figure 6.7 Node B – E at Milltown

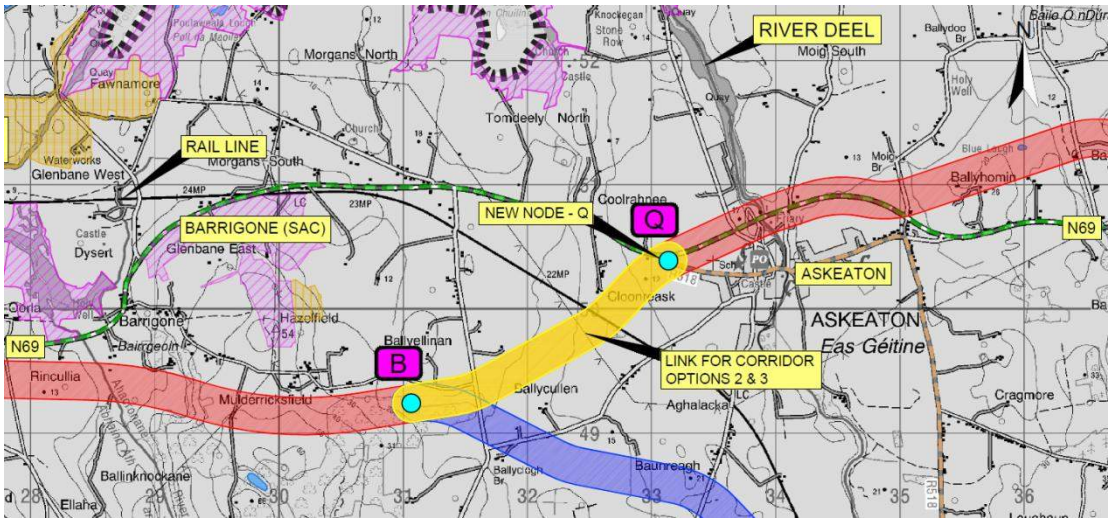


6.9.3 Node B - Q at the Askeaton Bypass (Route Corridor Options 1, 2, 3 and 4)

This link was provided as part of Route Corridor Options 1 and 4. Figure 6.8 below shows the common link from Node B to Node Q at the start of the existing Askeaton Bypass.

Arising from the public consultation and on investigation of the potential junction strategy it was determined that a link from Node B to a new Node at Q on the Askeaton Bypass would be required as part of the route corridors for Options 2 and 3 to provide connectivity between the industrial centres in the vicinity of Askeaton and the new road. At the same time this link provides a longer improved section of road along the N69 corridor, resulting in improved safety and economic benefits to the overall road network when compared to not providing this link.

Figure 6.8 Node B - Q at the Askeaton Bypass



6.9.4 Node E – H at Rathkeale (Route Corridor Option 3)

From the public consultation and development of a potential junction strategy for the route it was determined that the Route Corridor Option 3 from Node E towards Node H would need to be moved by up to 100 metres to the west. This was to provide a suitable junction for the route while simultaneously further avoiding land provided for future expansion of the cemetery to the northeast of Rathkeale, adjacent to the L1203 local road. This change applies only to Route Corridor Option 3. The previous corridor together with the revised corridor are shown on Figure 6.9 below.

Figure 6.9 Node E - H at Rathkeale

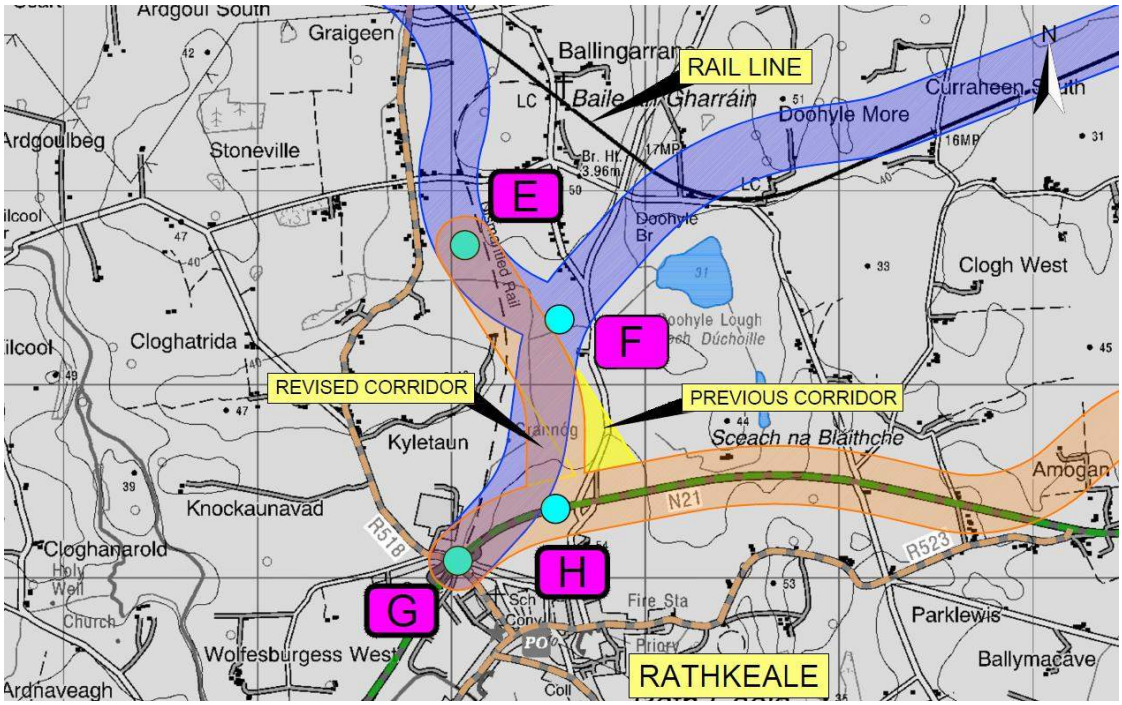
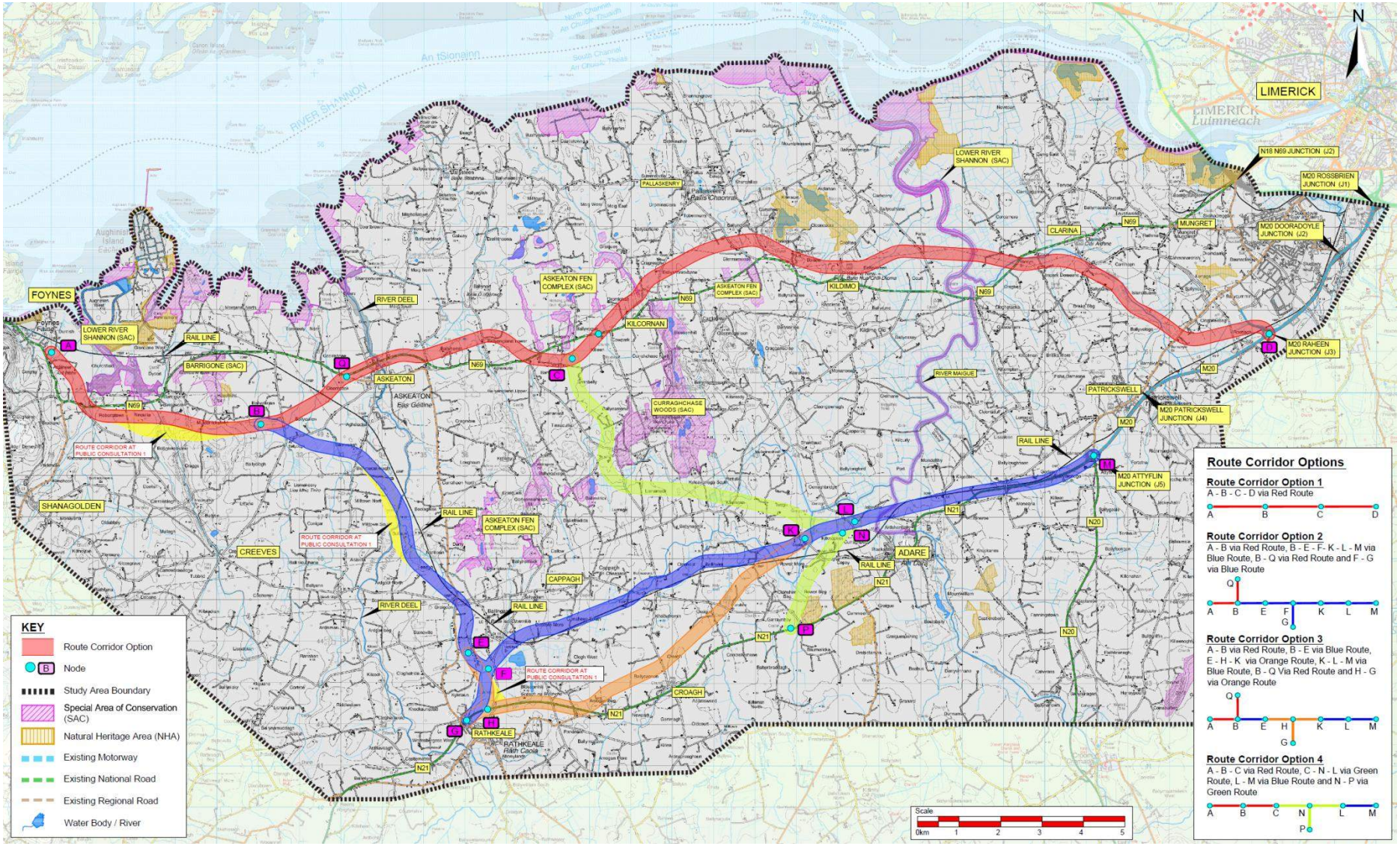


Figure 6.10 overleaf shows the extent of the revised corridors with details contained in Drawing No. RS-004 in Volume 2 of this report.

Figure 6.10 Stage 2 Assessment – Revised Route Corridor Options



6.10 Description of Route Corridor Options

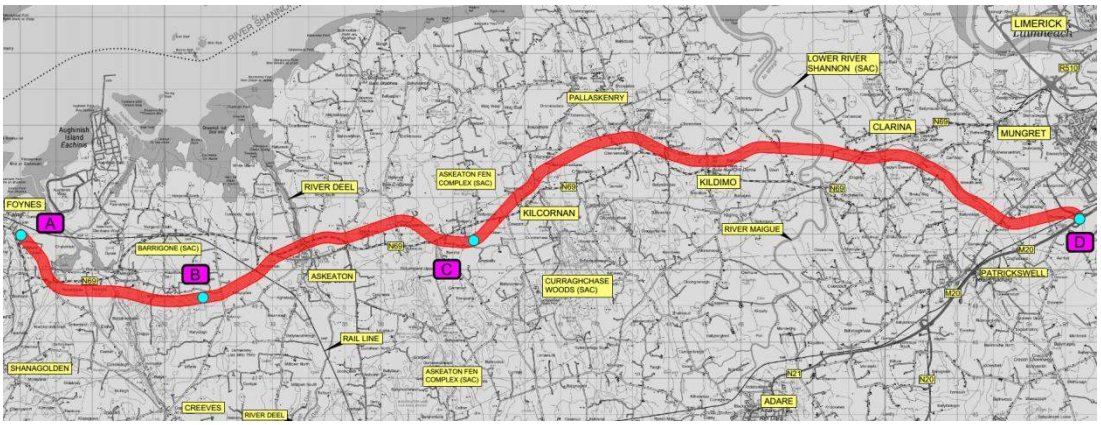
6.10.1 Development & Description of Route Corridor Options

The four revised route corridor options are assessed and appraised in this section. They are shown in Figure 6.10 above and in more detail in Drawing Nos. RS-004 to RS-009 in Volume 2 of this report. It should be noted that the nodes represented in this report are used to describe the various route corridor options and do not represent the location of proposed junctions.

6.10.2 Route Corridor Option 1

Route Corridor Option 1 passes between the nodes of A, B, C and D and is approximately 33 kilometres long. This route corridor option closely follows the existing N69 alignment. A full online upgrade of the N69 was not considered feasible for the reasons discussed in Section 5.6 - 'Do-Nothing' Scenario of this report. Figure 6.11 below shows the extent of Route Corridor Option 1.

Figure 6.11 Route Corridor Option 1



Node A – B

Route Corridor Option 1 commences at Node A which is located just south of Foynes port, on the Foynes Port Access road. Here the route heads in a south-easterly direction meeting the N69 in the townland of Sroolane North. From here the route turns to head in an easterly direction south of the current N69 at Barrigone meeting the Ahacronane River and going through the townlands of Robertstown, Rincullia, Craggs and Muldericksfield to Node B. Node B is located in the townland of Ballyclogh approximately 3 kilometres south-west of Askeaton.

Node B – C

From Node B the route travels in a north easterly direction almost immediately meeting the L1220 local road, and then meeting the Foynes – Limerick rail line before following the route of the existing N69 Askeaton Bypass. The route continues along the existing N69 Askeaton bypass for approximately 1.8 kilometres, crossing the River Deel before veering away from the existing national road and running to the north. In the townland of Ballyengland Lower the route turns to head in a south easterly direction before meeting the N69 again to arrive at Node C. This node is located in the townland of Ballyvogue, south of the N69 and approximately 2 km west of the entrance to Curraghchase Forest Park off the N69.

Node C – D

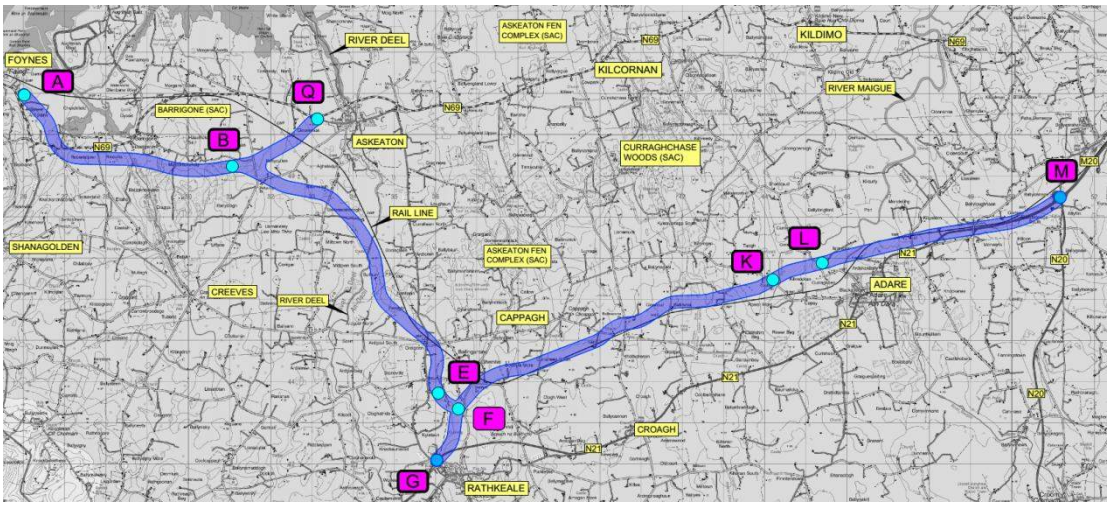
From Node C, this option travels north eastwards and meets the N69 for the third time. The route then passes to the north of Kilcornan village, keeping north of

Curraghchase and south of Pallaskenry before turning in a south easterly direction past Dromore Lough and through the townland of Bolane to a location north of Kildimo (New). The road continues eastwards crossing the River Maigue approximately one kilometre north of the Ferrybridge on the N69, then crosses the Barnakyle River and the N69 for the fourth time. The route continues to the south of Clarina before veering in a south easterly direction away from the N69. The route then follows the Barnakyle River before crossing it and joining in with the R510 Regional Road and M20 at Raheen (Junction 3) at Node D.

6.10.3 Route Corridor Option 2

Route corridor option 2 links nodes A, B, Q, E, F, G, K, L and M and is approximately 32 kilometres long. This route option connects Foynes Port to Limerick and will bypass Rathkeale and Adare. The route option will connect to the existing M20 at Attyflin (Junction 5). Figure 6.12 below shows the extent of Route Corridor Option 2.

Figure 6.12 Route Corridor Option 2



Node A – B

Route Corridor Option 2 commences at Node A which is located just south of Foynes port, on the Foynes Port Access road. Here the route heads in a south-easterly direction meeting the N69 in the townland of Sroolane North. From here the route turns to head in an easterly direction south of the current N69 at Barrigone meeting the Ahacronane River and going through the townlands of Robertstown, Rincullia, Craggs and Muldericksfield to Node B. Node B is located in the townland of Ballyclogh approximately 3 kilometres south-west of Askeaton.

Node B - Q

This section provides a link from the route corridor to the existing N69 bypass of Askeaton at Node Q over a length of approximately 2 kilometres.

Node B – E

From node B the route travels in a south easterly direction towards Rathkeale. The route heads towards the Foynes - Limerick rail line before turning in a more southerly direction to follow the route of the rail line crossing the River Deel adjacent to the townland of Milltown South. Continuing southward the route meets the R518 Askeaton - Rathkeale Regional Road near the Foynes - Limerick rail line before arriving at Node E. Node E is located in the townland of Ballingarrane near a section of dismantled rail line that linked Listowel to the Foynes - Limerick rail line.

Node E – F

This short section of route, approximately 0.5 kilometres in length, connects the section of the route between Foynes and Rathkeale to the Adare to Rathkeale section at Node F, in the vicinity of the townlands of Ballingarrane and Kyletaun to the north of Rathkeale.

Node G – F

The Rathkeale to Adare Section of this route option commences at Node G which is located at the existing N21/R518 Junction on the N21 Rathkeale Bypass. The route heads in a north easterly direction to Node F, over a length of approximately 1.4 kilometres.

Node F – K

The length of the route between Nodes F and K is approximately 8.5 kilometres. From Node F, the route travels in a north easterly direction meeting a couple of local roads as it approaches the Foynes – Limerick rail line. The route crosses to the north of the rail line and travels parallel to it until Node K. The route meets a number of local roads, including the L6022, L1203, L6023, L8027, L8029, L1421, L8032, L8024 and L1422 as well as crossing over the Clonshire River at two locations. Node K is located to the west of the Greananagh River in the townland of Tuogh.

Node K – L

The length of route between Nodes K and L is approximately 1.3 km. From Node K the route bridges over the Greananagh River and meets Station Road, Adare before arriving at Node L to the east.

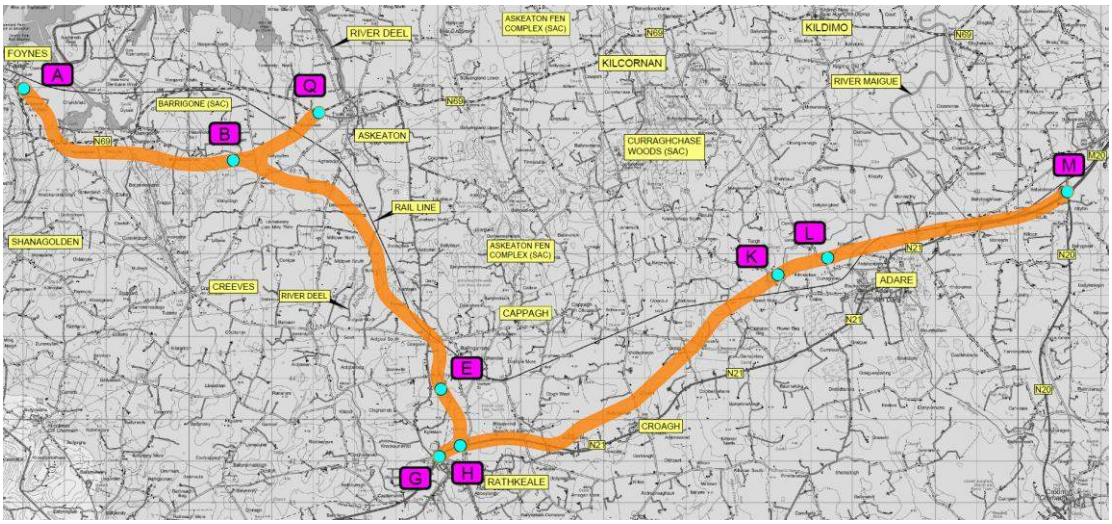
Node L – M

The length of the route between Nodes L and M is approximately 6 km. Almost immediately after Node L, the route bridges over both the River Maigue (Lower River Shannon SAC), and the Foynes – Limerick rail line. The Limerick – Foynes rail link is now north of the route with the existing N21 and Adare village to the south. The route then connects back onto the existing N21 and follows the existing N21 over a length of approximately 2.8 kilometres through to Node M located at the M20/N21 Junction (J5) at Attyflin.

6.10.4 Route Corridor Option 3

Route Corridor Option 3 links nodes A, B, Q, E, H, G, K, L and M and is approximately 33 kilometres long. Figure 6.13 below shows the extent of Route Corridor Option 3.

Figure 6.13 Route Corridor Option 3



Node A – B

Route Corridor Option 3 commences at Node A which is located just south of Foynes port, on the Foynes Port Access road. Here the route heads in a south-easterly direction meeting the N69 in the townland of Sroolane North. From here the route turns to head in an easterly direction south of the current N69 at Barrigone meeting the Ahacronane River and going through the townlands of Robertstown, Rincullia, Craggs and Muldericksfield to Node B. Node B is located in the townland of Ballyclogh approximately 3 kilometres south-west of Askeaton.

Node B - Q

This section provides a link from the route corridor to the existing N69 bypass of Askeaton at Node Q over a length of approximately 2 kilometres.

Node B – E

From node B the route travels in a south easterly direction towards Rathkeale. The route heads towards the Foynes - Limerick rail line before turning in a more southerly direction to follow the route of the rail line crossing the River Deel adjacent to the townland of Milltown South. Continuing southward the route meets the R518 Askeaton - Rathkeale Regional Road near the Foynes - Limerick rail line before arriving at Node E. Node E is located in the townland of Ballingarrane near a section of dismantled rail line that linked Listowel to the Foynes - Limerick rail line.

Node E – H

The length of the route between Nodes E and H is approximately 1.5 kilometres. The link starts at Node E located in the townland of Ballingarrane near the dismantled rail line that linked Listowel to the Foynes - Limerick rail line and finishes at Node H, located along the existing N21 Rathkeale Bypass.

Node G – H

The Rathkeale to Adare Section of the route commences at Node G which is located at the existing N21/R518 Junction on the N21 Rathkeale Bypass. The route heads in an easterly direction along the existing N21 to Node H, over a length of approximately 0.9 kilometres.

Node H – K

The length of the route between Nodes H and K extends from north of Rathkeale through to a location north west of Adare over a distance of approximately 8.7 kilometres. From Node H this section of route runs along the existing N21 Rathkeale Bypass corridor before diverging to head in a north easterly direction west of the N21/R523 Regional Road junction. The Route passes to the north of Croagh village before crossing the Clonshire River and the townlands of Clonshire More, Gortnagrour and Clonshire Beg. The route then crosses the Foynes - Limerick rail line in the townlands of Clonshire Beg and Rower More and extends to Node K located to the west of the Greananagh River.

Node K – L

The length of route between Nodes K and L is approximately 1.3 km. From Node K the route bridges over the Greananagh River and meets Station Road, Adare before arriving at Node L to the east.

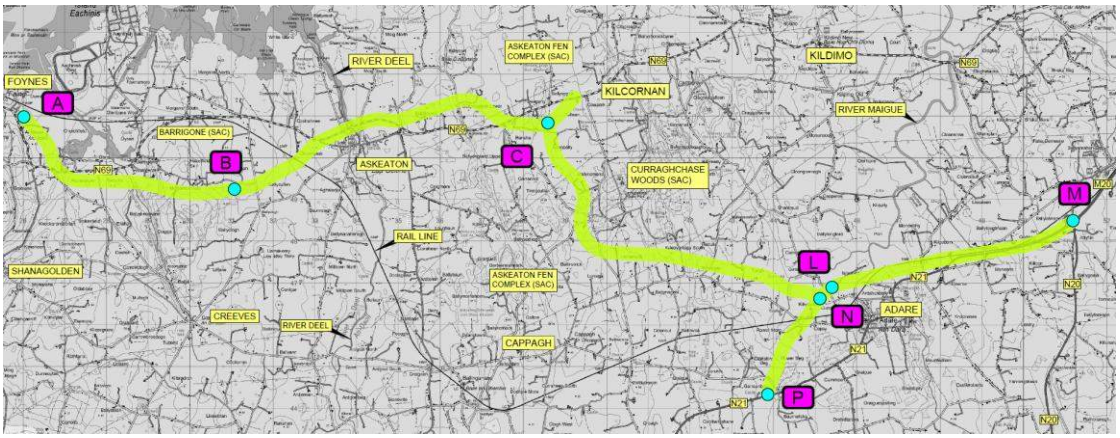
Node L – M

The length of the route between Nodes L and M is approximately 6 km. Almost immediately after Node L, the route bridges over both the River Maigue (Lower River Shannon SAC), and the Foynes – Limerick rail line. The Limerick – Foynes rail link is now north of the route with the existing N21 and Adare village to the south. The route then connects back onto the existing N21 and follows the existing N21 over a length of approximately 2.8 kilometres through to Node M located at the M20/N21 Junction (J5) at Attyflin.

6.10.5 Route Corridor Option 4

Route Corridor Option 4 links nodes A, B, C, N, P, L and M and is approximately 32 kilometres long. Figure 6.14 below shows the extent of Route Corridor Option 4.

Figure 6.14 Route Corridor Option 4



Node A – B

Route Corridor Option 4 commences at Node A which is located just south of Foynes port, on the Foynes Port Access road. Here the route heads in a south-easterly direction meeting the N69 in the townland of Sroolane North. From here the route turns to head in an easterly direction south of the current N69 at Barrigone meeting the Ahacronane River and going through the townlands of Robertstown, Rincullia, Craggs and Muldericksfield to Node B. Node B is located in the townland of Ballyclogh approximately 3 kilometres south-west of Askeaton.

Node B – C

From Node B the route travels in a north easterly direction almost immediately meeting the L1220 local road, and then meeting the Foynes – Limerick rail line before following the route of the existing N69 Askeaton Bypass. The route continues along the existing N69 Askeaton bypass for approximately 1.8 kilometres, crossing the River Deel before veering away from the existing national road and running to the north. In the townland of Ballyengland lower the route turns to head in a south easterly direction before meeting the N69 again to arrive at Node C. This node is located in the townland of Ballyvogue, south of the N69 and approximately 2 km west of the entrance to Curraghchase Forest Park off the N69.

Node C – N

The section of route between Nodes C and N is approximately 8.9km long. This section of route generally runs in a south easterly direction from just south of the N69 at Node C towards Adare. From Node C the route passes southwards west of Curraghchase Woods before turning to head in a south easterly direction towards Adare, travelling south of Curraghchase Woods and tying in to a northern bypass of Adare at Node N.

Node P – N

Node P is located along the existing N21 in the townland of Garraunboy approximately 3 km west of the centre of Adare. From Node P the route heads in a north easterly direction through the townlands of Clonshire Beg, Rower Beg and Rower More. The route then meets the Blackabbey Road and Foynes - Limerick rail line before reaching Node N in the townland of Kilknockan.

Node N - L

This 0.4 kilometre section connects the sections from C – N and P – N to Section L - M and is located in the townlands of Kilknockan, Curraghbeg and Islandea, north of the Foynes - Limerick rail line and meeting the Station Road, Adare.

Node L – M

The length of the route between Nodes L and M is approximately 6 km. Almost immediately after Node L, the route bridges over both the River Maigue (Lower River Shannon SAC), and the Foynes – Limerick rail line. The Limerick – Foynes rail link is now north of the route with the existing N21 and Adare village to the south. The route then connects back onto the existing N21 and follows the existing N21 over a length of approximately 2.8 kilometres through to Node M located at the M20/N21 Junction (J5) at Attyflin.

6.11 Corridor Assessment

In accordance with the TII Project Management Guidelines 2010, the comparison of the four route corridor options was carried out using the five Common Appraisal Criteria of Environment, Economy, Safety, Accessibility & Social Inclusion, and Integration.

The route corridor option assessments were undertaken in line with the TII Project Appraisal Guidelines, which follow guidance provided within the Department of Transport, Tourism and Sport Common Appraisal Framework.

Each of the assessment criteria is then further divided into a number of different sub-criteria detailed below.

Environment

The Environmental Assessment was carried out under the following subheadings:

- Noise and Vibration
- Air Quality
- Landscape and Visual
- Agriculture & Agronomy
- Non-Agricultural Properties
- Ecology
- Archaeology, Built Heritage and Cultural Heritage
- Hydrogeology
- Hydrology
- Soils, Geology and Waste

Economy

- Economic Benefit (COBA - Efficiency and Effectiveness)
- Transport Reliability
- Wider Economic Impacts
- Funding Impacts

Safety

Under the heading of safety the overall benefit of the scheme is assessed in terms of reduction in traffic collisions and an improved road environment. All of the options will offer an improvement on the existing road network, but the route options which result in the largest transfer of vehicles from the existing road network to newer safer roads will have the greatest benefit in terms of traffic safety.

Accessibility & Social Inclusion

The objective of the scheme under the Accessibility and Social Inclusion criterion is to avoid any impact on vulnerable groups and at the same time meet the objectives of revitalising the area under the headings of impact on disadvantaged geographic areas.

Integration

In terms of Integration the scheme was assessed in terms of compatibility with various policies under the following headings:

- Transport Integration
- Land Use Integration
- Geographical Integration
- Integration with other Government Policies.

Each of the sub-criteria was given a score on a seven point scale, as follows:

- 7 - Highly Positive
- 6 - Moderately Positive
- 5 - Slightly Positive
- 4 - Neutral
- 3 - Minor Negative
- 2 – Moderately Negative
- 1 - Major Negative

Assessment of the four route corridor options was undertaken under each of the above criteria and is described in the sections following. All of these assessments were then summarised in an assessment matrix which was used as the basis for selection of the Preferred Route Corridor.

The four route corridor options under consideration are shown in Drawing Nos. RS-004 to RS-014 in Volume 2 of this report.

6.12 Environmental Assessment

6.12.1 Noise and Vibration

The assessment of noise and vibration impacts is based primarily upon property counts, likely changes in traffic flow and a review of the likely requirement for mitigation measures in accordance with TII guidelines.

All properties within 300m of the centre line of each Route Corridor Option have been identified and put into one of four bands in accordance with the TII Guidelines for the Treatment of Noise and Vibration in National Road Schemes. These bands are defined by their distance to either side of the centre line of each Route Corridor Option and are described as follows;

- Band 1: 0 - 50m
- Band 2: 50 - 100m,
- Band 3: 100 - 200m, and
- Band 4: 200 - 300m.

The total number of receptors in each band was multiplied by a rating factor. The rating factor is 4 for Band 1, 3 for Band 2, 2 for Band 3 and 1 for Band 4. The resultant values were totalled to give a single number for each Route Corridor Option, termed the Potential Impact Rating (PIR). The PIR values were used to assess the potential impact of each Route Corridor Option, the larger the PIR the greater the potential impact.

The likely requirement for noise mitigation was determined making reference to an indicative vertical and horizontal alignment of each route option, the expected traffic flows and traffic speeds. This information was used to establish the potential 'noise footprint' of each route option on the surrounding environment. Using the noise footprint graphs, the number of properties likely to exceed 60dB L_{den} along each route option was counted.

An assessment of the changes in noise levels which would result from changes to traffic volumes along existing roads was also undertaken. Traffic flow predictions between the Do Something and Do Minimum scenarios for each route have been reviewed to determine the likely change in noise levels during the operational phase of each route. The number of properties within 50m from the edge of existing roads was counted to determine the number of properties likely to be impacted by the traffic flow changes.

Overall, the reduction in traffic on the existing road networks will result in a reduction in noise levels and an improvement in noise at properties close to the existing main roads. Due to the variation of route alignments proposed, the re-distribution of traffic flows will vary depending on the route alignment chosen.

Taking account of the assessments carried out on the route options there are a number of considerations which give rise to the preference of one route corridor over another. Table 6.1 below summarises the results of the main assessments to provide a summary overview.

Table 6.1 Summary assessments for each route corridor option

Assessment criteria	Option 1	Option 2	Option 3	Option 4
Potential Impact Rating (PIR)	773	506	578	697
No. of properties likely to require noise mitigation	20	37	29	26
No of properties with reduction in noise >3dB(A)	219	191	191	169
Noise impact	Moderately Negative	Moderately Negative	Moderately Negative	Moderately Negative
Preference	**Least Preferred**	**Intermediate**	**Preferred**	**Least Preferred**

On consideration of the above assessment criteria, the route options are considered to have a ranking of Moderately Negative.

Whilst there are marginal differences between all route options from a noise point of view, on consideration of the Potential Impact Assessment (PIR) value for Route Corridor Option 1, this would indicate that a high number of properties overall would be affected by this option. In addition to the above, should Route Corridor Option 1 proceed as the preferred option, traffic volumes through Adare village would remain nominally unchanged. This would result in a missed opportunity to address one of the key "hotspots" identified in the Limerick County Council Noise Action Plan as an area which would benefit from noise mitigation and noise management measures. In this regard, whilst this route corridor option is considered to be moderately negative, it is least preferred from a noise point of view.

A moderately negative ranking has been applied to Route Corridor Option 2 given this option has the highest number of properties calculated to require noise mitigation compared to the other route options, albeit a lower PIR.

A moderately negative ranking has also been applied to Route Corridor Option 3. This has been applied taking account of the PIR when compared to the other options, the lower requirement for noise mitigation and the benefit in terms of noise reduction to existing properties.

A moderately negative ranking has similarly been applied to Route Corridor Option 4 given the relatively higher PIR calculated for this route and the number of properties likely to require noise mitigation compared to the other route options in addition to the least benefit provided in terms of noise reduction to existing properties.

On consideration of the above, route corridor options 1 and 4 are considered to be least preferred given the high PIR values and the missed opportunity to bypass Adare village with Option 1.

Route Corridor Option 3 has a marginal preference over Route Corridor Option 2. This is due to the overall noise footprint of Option 2 compared to Option 3. On assessment of the indicative horizontal and vertical alignment of both, a higher number of properties are calculated to exceed 60dB L_{den} for Option 2 compared to Option 3. Taking account these factors with the other assessment criteria being similar, Option 3 has been ranked ahead of Option 2 from a noise point of view.

The detailed impact assessment of the route corridor options is contained in the Noise and Vibration Report in Volume 3 – Appendix C of this Report.

6.12.2 Air Quality

This section assesses the four route corridor options in terms of air quality impact in accordance with the TII Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes.

TII Guidelines state that sensitive receptor locations for air quality include: residential housing, schools, hospitals, places of worship and shopping areas, i.e. locations where members of the public are likely to be regularly present. Designated habitats are also potentially sensitive receptors. Such sites include, Natural Heritage Areas (NHA), Special Areas of Conservation (SAC) and Special Protection Areas (SPA). The reason for the designation will define if the designated habitat is considered a sensitive ecosystem in respect of air quality.

The objective at this stage of the route selection process is to indicate whether there are likely to be significant air quality impacts associated with any of the route corridor options. In the current assessment, the number of sensitive receptor locations (i.e. residential housing) has been identified together with designated habitats (i.e. sensitive ecosystems) within 200m of the route corridor centreline. At this stage of the assessment no further distinction is made between different types of sensitive receptor locations.

A comparison of the proposed routes has been carried out based on a calculation of the Index of Overall Change in Exposure to NO_2 and PM_{10} resulting from each individual route. This index is based on identifying the number of sensitive receptors within the assumed zone of interest (assumed as 200m either side of the centrelines of the route corridor options, or within 50m of the edge of existing roads, as appropriate) that would experience a significant change in traffic for each of the routes. Fifty metres represents the distance within which detectable impacts of road traffic might be found, while a significant change can be considered to be an increase or decrease in traffic flow (AADT) of 5% or more. The number of properties is then multiplied by the predicted change in the emission rate along that link, and then summed across all links for that route option. The results of this comparison are outlined in Table 6.2. Detailed results of the sensitive receptors along each route are included in the detailed Air Quality Report included in Volume 3 of this Report – Appendix B.

The TII Guidelines state that the local air quality assessment should focus on NO_2 and PM_{10}, as these are the pollutants of greatest concern with respect to road traffic conditions. At the national / international level, emissions of nitrogen oxides (NO_x) are of concern with respect of nitrogen deposition (impact on sensitive ecosystems) and the formation of ozone, while emissions of carbon dioxide (CO_2) are associated with climate change.

Long-term NO_2 monitoring is carried out at the two rural Zone D locations, Emo (Laois) and Kilkitt (Monaghan) in 2014. The NO_2 annual average in 2014 for Emo and Kilkitt was 3 $\mu g/m^3$. These concentrations are significantly lower than the limit value and would be broadly representative of the prevailing NO_2 concentrations at distances of 250m or greater from the national roads within the study area. A conservative estimate of the current rural background NO_2 concentration in the study area is 10 $\mu g/m^3$.

The results of NO_2 monitoring carried out at the urban Zone D locations of Castlebar (Mayo) and Enniscorthy (Wexford) in 2014 indicated an average NO_2 concentration of 8 and 13 $\mu g/m^3$, respectively, with no exceedances of the 1-hour limit value.

Furthermore, the NO_2 annual average in 2014 for the Zone C locations of Kilkenny Seville Lodge, Portlaoise and Mullingar (Westmeath) ranged from 4-16 µg/m^3. Hence long-term average concentrations measured at these locations were significantly lower than the annual average limit value for NO_2 of 40 µg/m^3. Based on the above information, a conservative estimate of the current background NO_2 concentration close to the national roads within the study area and at small towns and villages in the study area is 12 µg/m^3.

Long-term PM_{10} monitoring is carried out at the rural Zone D location of Kilkitt (Monaghan). The average concentration measured at Kilkitt in 2014 was 9 µg/m^3. This concentration would be broadly representative of the prevailing PM_{10} concentration at distances of 250m or greater from the national roads within the study area. A conservative estimate of the current rural background PM_{10} concentration in the study area is 12 µg/m^3.

Long-term PM_{10} measurements carried out at urban Zone D locations in Castlebar, Enniscorthy and Claremorris (Mayo) in 2013 gave average levels of 10 - 22 µg/m^3. Data from the Phoenix Park in Dublin also provides a good indication of urban background levels, with an annual average in 2014 of 12 µg/m^3. Hence long-term average concentrations measured at these locations were significantly lower than the annual average limit value for PM_{10} of 40 µg/m^3. Based on the above information, a conservative estimate of the background PM_{10} concentration close to the national roads within the study area and at small towns and villages in the study area is 15 µg/m^3.

The UK DMRB air dispersion model was used to determine the impact of each of the routes on ambient levels of NO_x at each of the sensitive ecosystems listed in Table 6.2. Predicted NO_x concentrations are below the limit value of 30 µg/m^3 for the protection of ecosystems for each of the locations assessed. While the predicted annual average NO_x level of 27.66 µg/m^3 is close to the limit value, the vegetation of the lower River Shannon SAC is not nitrogen sensitive and the project ecologist has confirmed there will be no significant impact.

Table 6.2 Impact Assessment of Routes on Sensitive Ecosystems – Predicted NO_x Concentrations in the Opening Year (2024).

Route Option	Townland	Ecosystem	NO_x (µg/m^3)[Note 1]
Option 1	Foynes South	Lower River Shannon SAC / River Shannon and River Fergus Estuaries SPA / Inner Shannon Estuary - South pNHA	15.28
	Askeaton	River Shannon and River Fergus Estuaries SPA	19.76
	Ballyvogue	Askeaton Fen Complex SAC	20.11
	Curraghchase	Curraghchase Woods SAC	15.39
	Dromore	Dromore and Bleach Loughs pNHA	16.17
	Kildimo	Lower River Shannon SAC	25.37
Option 2	Foynes South	Lower River Shannon SAC / River Shannon and River Fergus Estuaries SPA / Inner Shannon Estuary - South pNHA	15.13
	Adare	Lower River Shannon SAC	27.61

…Table 6.2 Continued Over/

Table 6.2 (Cont.) Impact Assessment of Routes on Sensitive Ecosystems – Predicted NO_x Concentrations in the Opening Year (2024).

Route Option	Townland	Ecosystem	NO_x ($\mu g/m^3$)[Note 1]
Option 3	Foynes South	Lower River Shannon SAC / River Shannon and River Fergus Estuaries SPA / Inner Shannon Estuary - South pNHA	15.11
	Adare	Lower River Shannon SAC	27.66
Option 4	Foynes South	Lower River Shannon SAC / River Shannon and River Fergus Estuaries SPA / Inner Shannon Estuary - South pNHA	15.12
	Askeaton	River Shannon and River Fergus Estuaries SPA	20.24
	Ballyengland Lower	Askeaton Fen Complex SAC	14.96
	Ballynamona	Curraghchase Woods SAC	13.79
	Rower Beg	Adare Woodlands pNHA	26.22
	Adare	Lower River Shannon SAC	27.16
	Limit Value		*30*[Note 2]

Note 1 Including a conservative background NO_x concentration for 2012 of 12.7 $\mu g/m^3$
Note 2 EU Council Directive 2008/50/EC (as an annual average)

Table 6.3 Summary assessments for each route corridor option

Assessment criteria	Option 1	Option 2	Option 3	Option 4
NOx Exposure Index	19512	-76122	-34846	-45397
PM10 Exposure Index	189	-1784	-194	-376
Air Quality Impact	Minor Negative	Slightly Positive	Neutral	Neutral
Preference	**Least Preferred**	**Preferred**	**Intermediate**	**Intermediate**

The results in Table 6.3 above show that Option 2 will have a slightly positive impact on ambient air quality. Options 3 and 4 will have neutral impact on air quality and Option 1 will have a minor negative impact on ambient air quality.

Option 2 would result in the greatest potential improvement in air quality of all four routes and so is the preferred route corridor from the point of view of air quality solely. The emission levels of NO_x and PM_{10} are lower for the "Do Something" scenario than the "Do Nothing". The number of receptors directly impacted by Option 2 is less than those impacted by the existing N69 Foynes to Limerick Road and N21 Tralee to Limerick Road. This will therefore result in an improvement in air quality in the region of the aforementioned roads.

The detailed impact assessment of the route corridor options is contained in the Air Quality Report in Volume 3 – Appendix B of this Report.

6.12.3 Landscape and Visual

This section assesses the four route corridor options in terms of landscape and visual impact. The assessment has been undertaken in accordance with the *TII Project Management Guidelines*, the UK *Design Manual for Roads and Bridges* (DMRB) and the *Guidelines for Landscape and Visual Impact Assessment* by The Landscape Institute / Institute of Environmental Assessment.

The landscape and visual impact was assessed with regard to the vulnerability of the landscape to change and the location of visual receptors relative to the proposed road development. The landscape and visual impacts associated with the scheme were assessed approximately 500m to either side of the edge of the route corridor option.

All of the proposed route corridors would generate negative effects on the existing landscape and visual environment. Due to the nature of the settlement pattern within the study area, there are few parts of the proposed route corridor options that do not have visual sensitive receptors (i.e. residential dwellings or important views) within a short distance and therefore visual impact registers particularly high on the scale. The most significant impacts occur where the proposed road would form a new element in the view.

Landscape impacts are highest where the route impacts on the Shannon Coastal zone and the rural landscape, particularly where these areas are removed from existing development. Removal of mature trees, hedgerows and woodlands also generates significant negative impacts.

All routes will have consequential negative effects in several respects. In summary the effects of the routes are tabulated in the following table 6.4. The higher the score, the more negative the impact. These numbers were calculated by rating each of the identified landscape and visual receptors from 1-9. This rating was based on their value in the landscape, according to pre-determined criteria, and the level of potential impact in order to assign a numerical value. Thus, the relative level of impact generated by each of the routes could be evaluated, with the aim of determining a preferred route corridor.

Table 6.4 Summary of Impacts

Impact	Option 1	Option 2	Option 3	Option 4
Overall landscape impact	144	92	91	98
Overall visual impact	2827	851	924	1041
Total	2971	942	1015	1139
Landscape and Visual Impact	Major Negative	Moderately Negative	Moderately Negative	Moderately Negative
Preference	**Least Preferred**	**Preferred**	**Intermediate**	**Intermediate**

As can be seen from the above table, Option 2 is the preferred option from a landscape and visual perspective, although it has some significant negative effects. The principal advantages of this option are that the proposed route corridor passes a relatively smaller number of dwellings than the other routes and avoids some of most sensitive landscapes. It also follows the route of the railway line closely for a substantial part of the route which is a less sensitive and less populated area. There will be residual impacts relating to removal of trees, woodland and visual impacts to

dwellings that are close to this alignment. An assessment rating of Moderately Negative is assigned to this option.

Option 1 is the least desirable route from a landscape and visual perspective as the route traverses the Shannon Coastal zone to the north of the study area and this generates significant landscape impact due to the high scenic value of this area. This is also a heavily populated area of the study area, so the proposed road would result in significant visual impacts to the dwellings and the intrinsic scenic quality. A new crossing structure close to the mouth of the River Maigue would also generate significant negative effects, as it would be larger and more visible at this point than at almost any other in the study area. An assessment rating of Major Negative is assigned to this option.

Options 3 and 4 are marginally less favourable than Option 2, primarily because they run through more sensitive landscapes and more densely populated areas. Option 4 runs within 30m west of the Curraghchase Woods (SAC and forest park) and Askeaton Fen Complex (SAC) which add to the scenic quality in this area, and there are more sensitive visual receptors in this area, consistent with the general increase in housing density on the eastern side of the study area, closer to Limerick City. Where Option 3 diverges from Option 2, it runs close to Rathkeale and Croagh and as a result has the potential to affect more sensitive visual receptors in open countryside than Option 2, which runs parallel to the railway line for much of the comparable route.

An assessment rating of Moderately Negative has been assigned to Options 3 and 4.

The detailed impact assessment of the route corridor options is contained in the Landscape and Visual Effects Report in Volume 3 – Appendix D of this Report.

6.12.4 Agriculture, Agronomy and Non-Agricultural Property

The Route Corridor Options were evaluated in terms of the impact on agricultural and non-agricultural property so as to inform the overall route selection. The selection of a preferred option does not generally allow for a preference common to both agriculture and property and as a result, the assessment selects a preference in each respective area.

The assessment has been prepared with due consideration of the TII guidelines *"Project Management Guidelines" 2010* and *"Environmental Impact Assessment of National Road Schemes – A Practical Guide" 2008*.

Agriculture

The agricultural assessment considered the impact on agricultural holdings such as residential farm holdings, farm buildings and agricultural lands within and intersected by the 300m route corridor widths. The impact on agricultural property was determined by a qualitative assessment of land use and land quality and a quantitative assessment of landtake, farm houses, farm buildings and key agricultural enterprises.

A summary of the assessment of the impact on agricultural property is presented in Table 6.5 below.

Table 6.5 Summary of agricultural property assessment

Assessment criteria	Option 1	Option 2	Option 3	Option 4
Offline landtake (ha)	154.1 ha	168.0ha	156.5ha	145.3ha
Land Use (% area)				
- Grassland	85.6%	93.5%	94.4%	89.0%
- Rough Grassland / Scrub	10.7%	4.2%	4.1%	7.8%
- Forestry, Woodland	3.7%	2.3%	1.5%	3.2%
Land quality (% area)				
- Good	56.4%	66.8%	74.6%	54.3%
- Average	28.2%	23.7%	19.5%	34.8%
- Poor	15.4%	9.5%	5.9%	10.9%
Agricultural property (No.)				
- Farm houses	8	6	6	8
- Farmyards	18	22	21	21
Key agricultural enterprises (No.)				
- Dairy	9	9	8	8
- Equine	2	2	4	2
- Beef / Other	0	1	1	0
Agricultural property impact	**Moderately Negative**	**Major Negative**	**Major Negative**	**Moderately Negative**
Preference	**Preferred**	**Least Preferred**	**Intermediate**	**Preferred**

A major negative ranking has been applied to both Route Corridor Options 2 and 3 due to a higher level of land quality, more productive land use and allowing for a more intensive level of agricultural activity. There are a similar number of key

agricultural farm enterprises within route corridor options 2 and 3. Both options may significantly impact on the operation of an equestrian centre at separate locations along their respective route corridor options. Route Corridor Option 2 was identified as the least preferred due to the potential for more significant agricultural impacts on key agricultural enterprises.

A moderately negative ranking has been applied to Route Corridor Options 1 and 4 due to overall land quality being lower and higher levels of rough grassland / scrub and forestry / woodland. The impact on agriculture is similar with a slight preference for Option 4 over Option 1 due to the lower level of agricultural landtake and potential for less impact on key agricultural enterprises.

Non-Agricultural Property

This section of the assessment considered the impact on non-agricultural property within the 300m corridor widths. The impact on non-agricultural property was determined by a quantitative assessment of residential housing, commercial and community property.

A summary of the assessment of the impact on non-agricultural property is presented in Table 6.6 below.

Table 6.6 Summary of non-agricultural property assessment

Assessment criteria	Option 1	Option 2	Option 3	Option 4
Non-agricultural property (No.) - Residential - Commercial - Community	 100 4 4	 74 3 3	 89 3 4	 90 3 4
Non-agricultural property impact	**Moderately Negative**	**Moderately Negative**	**Moderately Negative**	**Moderately Negative**
Preference	**Least Preferred**	**Preferred**	**Intermediate**	**Intermediate**

A moderately negative impact has been applied to all four Route Corridor Options 1 to 4. Every effort has been made to reduce the number of residential properties within the route corridor options identified, and it should be noted that the number of residential properties impacted will reduce significantly as the road alignment is developed within the preferred route corridor. There was a low level of commercial and community properties on each of the route corridor options.

Option 1 was identified the least preferred due to it having the highest number of properties within the route corridor option while Option 2 was identified as the preferred due to it having the least number of properties.

The detailed impact assessment of the route corridor options is contained in the Agriculture, Agronomy and Property Report in Volume 3 – Appendix E of this Report

6.12.5 Ecology

This section looks at the impacts of the Route Corridor Options on the ecology of the study area. The assessment draws on the identified Key Ecological Receptors (KERs) and the impacts on the designated sites. The assessment was carried out in line with the TII "Guidelines for Assessment of Ecological Impacts of National Road Schemes" 2009.

A broad assessment was undertaken of the likely impacts of each of the four route corridor options on the key ecological receptors identified on or within the zone of influence, with an indication as to which, if any, of these were likely to be significant, and at what geographic level. The number of significant impacts at each geographic level associated with the various route options is presented, characterized and compared in tabulated format below. The levels of impact assigned to particular route corridor options make the assumption that general mitigation measures will be implemented where practicable. The order of preference is determined on the basis of the number and significance of ecological receptors impacted by each route corridor option.

An assessment of bat activity from the study area was undertaken by Conor Kelleher of Aardwolf Wildlife Surveys. This was based on existing data and records, and included reviewing the National Parks and Wildlife Service National Lesser Horseshoe Bat (LHB) Roost Database and bat distribution records held by Bat Conservation Ireland. In May and August 2015, fieldwork was undertaken onsite to appraise the existing habitats and to assess bat activity in the overall area of the proposed route corridor options.

Table 6.7 below presents a summary of the ecological sites impacted by the various options, their evaluation and the number of impacts by each of the route corridors.

Table 6.7 Ecological Sites impacted by the various route options

Site No	Townland	Value (Note 1)	Brief site description	Number of impacts			
				Option 1	Option 2	Option 3	Option 4
1	Aughinish West	A	R. Shannon & R. Fergus SPA	2	1	1	2
2	Churchfield	A	Lower R. Shannon SAC	1	1	1	1
6	Ardaneer	D	Rocky ridges with gorse scrub - recently cleared. Spring emerging from low rock face in north corner.	1	1	1	1
7	Rincullia	C	Area of shallow soils with patches of scrub. Linear fen in south. Recent clearance along Ahacronane River.	1	1	1	1
8	Craggs	C/B	Mosaic of scrub-woodland on higher ground with linear strip of alluvial woodland and marsh along Ahacronane River.	1	1	1	1
9	Ballyclogh	C	Mosaic of scrub-woodland on higher ground	1	1	1	1
23	Ballyhomin	C	Blue Lough - alkaline oligotrophic lake with surrounding fen.	1			1
30	Bansha	D	Potential fen habitat Adjacent Askeaton Fen SAC	1			1

…Table 6.7 Continued Over/

Table 6.7 (Cont.) Ecological Sites impacted by the various route options

Site No	Townland	Value (Note 1)	Brief site description	Number of impacts			
				Option 1	Option 2	Option 3	Option 4
31	Shanbally	C	Mosaic irregular small fields and patches scrub				1
34	Tinnacullia	C/B	Fen in valley (Cladium) with surrounding scrub-woodland.				1
35	Ballynamona	D/C	Block scrub adjacent Curraghchase Woods SAC				1
39	Boherboy	D/C	Adjacent Curraghchase SAC	1			
40	Ballynamona	A	Curraghchase Woods SAC				1
41	Ballycahane	C/B	Mosaic scrub and grassland, much of it recently cleared. Numerous small areas of fen with adjacent willow woodland fringe. Scrub-woodland on elevated ground.	1			
42	Ballyshonickbane	C/B	Linear patch fen running N-S. Scrub on higher ground with recent clearance in parts.	1			
44	Dromore	C/B	Adj. Dromore & Bleach Lough pNHA. Mixed woodland on hilly ground. Potential LHB corridor to south.	1			
46	Bolane	C	Mixed woodland around old castle site	1			
56	Ballyvareen	D	Two blocks young plantation - conifer & broadleaves	1			
62	Bullaun	D	Mosaic plantation with some old woodland in south around Nantinan House.		1	1	
68	Doohyle Beg	C/B	Doohyle lake and fen extending south to smaller lake. Adjacent scrub-woodland to east of S. lake & wet grassland to W.		1	1	
72	Rower Beg	B	Adare Woodlands pNHA. Clonshire Beg (site 71) to NW with linking hedgerows and parkland.				1
73	Ballinvirrick	D	Area of wet grassland drained - residual patch of fen in south of site outside of corridor.				1
77	Kyleavarraga South	D	Plantation conifers - mixed ages. Some potential corridor for LHB to south towards Hollywood House.				1
79	Hollywood House	C/B	Wood-Parkland with high LHB value.		1		

Note 1: The TII Guidelines for the Assessment of Ecological Impacts of National Road Schemes 2009 Site Evaluation key.
A = International importance
B = National importance
C = County importance
D = Local importance (higher value)

The preference for the route options is based on the options with the least number and severity of impacts on the various ecological receptors and for potential interference with the movement of Lesser Horseshoe Bats. The selection, which is presented in Table 6.8 below, identifies Option 3 as being the preferred option, Option 2 as being marginally less favourable, while Options 1 and 4 have the most adverse overall potential impact on ecology and Lesser Horseshoe Bat movement and are the least preferred. Lesser Horseshoe Bat sites outside of the route corridors may also be impacted indirectly due to the potential severance of flight paths between sites, in particular between Clonshire Beg and Ballywilliam and Curraghchase. Similarly, the red listed Barn Owl may be prone to collision risk where a route runs within the hunting territories which include Roberstown and Rincullia in the north of the scheme and Ballinvira and Clonshire Beg to the west of Adare.

Based on the above, assessment ratings of Major Negative are assigned to Options 1 and 4, and ratings of Moderately Negative are assigned to Options 2 and 3.

Table 6.8 Order of Preference for Route Options

Preference	Option 1	Option 2	Option 3	Option 4
General Ecology	2nd	1st	1st	2nd
Lesser Horseshoe Bat	3rd	2nd	1st	4th
Combined	3rd	2nd	1st	3rd

Table 6.9 Summary of Ecology Assessment

Assessment criteria	Option 1	Option 2	Option 3	Option 4
Ecology Impact	**Major Negative**	**Moderately Negative**	**Moderately Negative**	**Major Negative**
Preference	**Least Preferred**	**Intermediate**	**Preferred**	**Least Preferred**

The detailed impact assessment of the route corridor options for Ecology is contained in the Ecology Report included in Volume 3 – Appendix F of this Report.

6.12.6 Archaeology, Built Heritage and Cultural Heritage

An archaeological, built heritage and cultural heritage study has been undertaken of the four route corridor options at Stage 2 in order to inform the selection of the preferred route corridor and follows on from the Constraints Study described in Chapter 3, together with the Stage 1 assessment described above. The study has been carried out in accordance with the TII (formerly the NRA) *Guidelines for the Assessment of Archaeological Heritage Impacts of National Road Schemes* (2005) and TII *Guidelines for the Assessment of Architectural Heritage Impacts of National Road Schemes* (2005).

The study involved detailed interrogation of the archaeological, historical and architectural background of the receiving environment containing the route options, with assessment of a 580m corridor width in each case (i.e. 290m either side of the route corridor option centreline). This is equivalent to 250m either side of a generic road footprint of 80m (i.e. 40m either side of the route corridor option centreline), which has been applied to the more specific assessment. Prior to detailed design this is assumed to be the maximum landtake required for the construction of the road. All measurements referenced in this chapter are taken from the edge of the road footprint to the upstanding remains of the recorded site (or to the centre of the site, where no upstanding remains occur).

Research has been undertaken in several phases. The first phase comprised a paper survey of all available archaeological, architectural, historical and cartographic sources. The second phase involved a drive-over of the study area containing the route corridor options in an attempt to assess the current state of any recorded archaeological and built heritage sites that were accessible from the existing road network. The third phase involved a public consultation, which resulted in the identification of additional sites from local knowledge and oral history.

Once all known sites of archaeological, built heritage and cultural heritage significance were recorded, an impact assessment was carried out for each route option. The route option with the least potential direct impacts (based on an 80m-wide road alignment footprint) was deemed to be the preferred route corridor.

The following sources were consulted as part of the paper survey:

- Record of Monuments and Places for County Limerick;
- Sites and Monuments Record for County Limerick;
- Monuments in State Care Database County Limerick;
- Preservation Orders County Limerick;
- Register of Historic Monuments County Limerick;
- Topographical Files of the National Museum of Ireland;
- Cartographic and written sources relating to the study area;
- National Inventory of Architectural Heritage County Limerick (Architectural & Garden Survey);
- Excavations Bulletin (1970-2015);
- Limerick County Development Plan (2010-2016);
- Askeaton Local Area Plan (2015-2021);
- Adare Local Area Plan (2015-2021);
- Rathkeale Local Area Plan (2012-2018);

- Aerial photographic coverage.

The detailed impact assessment of the route corridor options for archaeology, built heritage and cultural heritage is contained in Volume 3 – Appendix G of this Report.

Drawing Nos. RS-027 to RS-031 in Volume 2 of this report show the location of the archaeology, built heritage and cultural heritage sites included within this Route Selection (Stage 2) assessment.

Table 6.10 Summary of Potential Impacts of Proposed Route Options

Impacts	Option 1	Option 2	Option 3	Option 4
Profound negative	2	4	5	6
Significant negative (recorded sites)	10	9	6	8
Significant negative (previously unrecorded sites or structures)	20	25	21	25
Significant negative (demesne landscapes)	3	1	1	1
AAP's (significant or moderately negative)	31	29	25	22
Moderately negative	30	33	27	33
Moderately negative (townland boundaries)	46	43	41	40
Slight negative	56	69	79	59
Imperceptible negative	21	17	15	24
Neutral*	2	17	19	18
None**	10	16	18	9
Potentially positive	8	4	4	4
Archaeology, Built Heritage and Cultural Heritage Impact	**Major Negative**	**Major Negative**	**Major Negative**	**Major Negative**
Preference	**Least Preferred**	**Intermediate**	**Preferred**	**Intermediate**

* "Neutral" indicates no change to the receiving environment where the site feature continues to exist.
** "None" relates to a site where the feature has been removed, even though still mentioned on the record.

Route Corridor Option 1

This route will have a profound impact on a newly identified enclosure and a protected structure. The latter is subject to statutory protection under the Planning and Development Act. The enclosure (CH 62) has been identified within the aerial photographic resource and is likely to represent an early medieval ringfort that measures c. 32m by 26m. It should be noted that the protected structure will be

impacted upon by all four route corridor options and consists of a concrete pill box (BH 5).

A further seven significant direct impacts have been predicted on recorded archaeological sites. These consist of five recorded enclosures, which are likely to represent early medieval ringforts and more significantly, a burial ground. It should be noted that the impact on AH 8 (enclosure) is common to all four route options. There is also the potential for a significant impact on the National Monument at Askeaton (Franciscan Friary), although it is likely that the route would follow the footprint of the existing bypass at this location.

The Franciscan Friary is also further protected as an Architectural Conservation Area (ACA). The route option has the potential to have a significant impact on this designated area, although again, it is likely that the option would be online at this location, enabling direct impacts to be avoided.

The proposed route would have a significant indirect impact on two protected structures, consisting of Bolane House (BH 16) and a former forge structure (BH 18). Whilst the route will not physically impact on these structures, the proximity of the scheme would result in a significant negative impact on their setting.

In addition, three significant impacts on demesne landscapes have also been identified. DL 4 consists of Bolane House demesne. This landscape is directly associated with a protected structure (BH 16) and survives in good condition. DL 3 (Ballynolan House demesne) is associated with a principal structure that is not covered by any statutory protection. Again the demesne survives in good condition. DL 7 (Elm Park) has lost its principal structure, although numerous elements relating to the demesne survive within the landscape, including the main entrance and lodge and an extensive complex of gardens and outbuildings. The proposed route option would severely truncate this landscape.

Detailed assessment has shown that the proposed route would have a significant impact on 20 previously unrecorded sites of archaeological or built heritage significance. These include enclosures as well as a number of vernacular heritage sites, relic field systems, two circular mounds and three limekilns. Of these, five of the sites can be considered as being of particular significance. CH 5 is formed by a relict field system visible in a Google Earth photograph (2010). It is possible that these relict boundaries, which are apparent as crop marks, are associated with a recorded enclosure to the north (AH 4). CH 43 is a large circular enclosure apparent as a partial earthwork within Bing Maps aerial photographs. The site measures c. 76m by c. 93m and it is possible that further enclosing elements are also present. CH 9 consists of a large circular enclosure visible as an anomaly within pasture (Google Earth 2010), which measures c. 67m by c. 63m. It should be noted that the predicted level of impact on these sites is shared by all four route options.

CH 55 and 56 are located in close proximity to one another and appear to represent an enclosure and associated relic field system within the Elmpark Demesne. These may be associated with recorded enclosure AH 37 and be representative of a large scale early medieval landscape.

A total of 31 areas of archaeological potential (AAPs) have been identified where a significant or moderate impact could be predicted.

A large number of potential moderate impacts have been identified as a result of the Option 1 assessment. This includes 12 recorded archaeological or built heritage sites

and 17 previously unrecorded sites or structures. The route option would also have a direct moderate impact on the demesne associated with Dromore Castle (DL5), which is a protected structure.

Forty-six townland boundaries will be directly impacted upon by the route but the impact level has been defined as moderate.

Multiple indirect impacts have been identified during the course of the assessment including 56 slight negative impacts, 21 imperceptible negative impacts and two occurrences where the impact is deemed to be neutral. There are 10 sites within the receiving environment where no impact will occur.

A number of positive impacts have been identified, two of which relate to Currahchase demesne and an associated entrance. In addition, positive impacts have been identified at two schools, a public house, a thatched house, a lodge and a bridge. These impacts are deemed to be potentially positive due to the movement of traffic away from the immediate environs of the heritage assets.

Route Corridor Option 2

This route option would result in profound negative impacts on three recorded archaeological sites (which covers five enclosure sites) and one protected structure. The enclosures are likely to represent early medieval ringforts and these impacts are common to route options 2, 3 and 4. The protected structure consists of a concrete pill box (BH 5), which is common to all four route options under assessment. These sites are subject to statutory protection under the National Monuments Act and Planning and Development Act.

This route also has the potential to have a significant impact on a further nine recorded archaeological sites. These sites consist of early medieval ringforts or enclosures, with the exception of one site, which has already been partially excavated and is listed as a medieval moated site. Four of these impacts are common within Routes 3 and 4 (AH 58, 61, 63, 72) and the potential impact on AH 8 is shared by all four options.
A further 25 significant impacts on previously unrecorded sites or structures of cultural heritage merit have been identified. These include relict field systems, enclosures, upstanding or buried remains relating to vernacular structures (or sites of), a former school house and infrastructure relating to the former Limerick & Foynes Branch Line and the Rathkeale and Newcastle Junction Railway. Of these, four of the sites can be considered as being of particular significance. CH 5, CH 43 and CH 9 are described in the above Option 1 summary and the predicted level of impact on these sites is shared by all four route options.

CH 13 consists of a circular enclosure that measures c. 25m in diameter, which was identified in Google Earth aerial photographs (2010). This is likely to represent an early medieval enclosure or ringfort.

With the exception of BH 5, which will be impacted on by all four route options, this route option will not profoundly or significantly impact upon any recorded BH sites. However, it has the potential to significantly impact on the entrance into Ballycullen House and demesne (CH 108), which is associated with the proposed protected structure. The route will also have a significant impact on the extended demesne (as shown within the historic mapping resource) of Ballycullen House (DL 8).

A total of 29 areas of archaeological potential (AAPs) have been identified where a significant or moderate is be predicted.

A large number of potential moderate impacts have been identified as a result of the Option 2 assessment. A total of 11 recorded archaeological or built heritage sites will be subject to moderately negative impacts; whereas 22 previously unrecorded sites or structures will be subject to the same impact level.

In addition, 43 townland boundaries will be subject to a moderate impact, whereas six will be slightly impacted upon.

Multiple indirect impacts have been identified during the course of the assessment including a 69 slight negative impacts, 17 imperceptible negative impacts and 17 occurrences where the impact is deemed to be neutral. There are 16 sites within the receiving environment where no impact will occur.

Several positive impacts have been identified which relate to Adare Manor demesne (part of the Adare ACA), an associated gate lodge (Limerick Lodge), the demesne walls and a gate lodge associated with Fort Union House. These impacts are deemed to be potentially positive due to the movement of traffic away from the immediate environs of the structures.

Route Corridor Option 3

This route option would result in profound negative impact on three recorded archaeological sites (which covers five enclosure sites) and one protected structure. The enclosures are likely to represent early medieval ringforts and these impacts are common to route options 2, 3 and 4. The protected structure consists of a concrete pill box (BH 5), which is common to all four route options under assessment. These sites are subject to statutory protection under the National Monuments Act and Planning and Development Act. One further potential profound impact has been identified in the form of a standing stone, which is located adjacent to the Rathkeale Bypass (AH 110). However, the route option is likely to be online at this location and as such a direct impact would be relatively easy to avoid.

This route also has the potential to have a significant impact on a further six recorded archaeological sites. These sites consist of probable early medieval ringforts or enclosures, with the exception of one site, which has already been partially excavated and is listed as a medieval moated site. Four of these impacts are common within Route Options 2 and 4 (AH 58, 61, 63, 72) and the potential impact on AH 8 is shared by all four options.
An additional 21 significant impacts on previously unrecorded sites or structures of cultural heritage merit have been identified. These include relic field systems, enclosures, upstanding or buried remains relating to vernacular structures (or sites of), several bridges, lime kilns and infrastructure relating to the former Limerick & Foynes Branch Line and the Rathkeale and Newcastle Junction Railway. Of these, four of the sites can be considered as being of particular significance. CH 5, CH 43 and CH 9 are described in the above Option 1 summary and the predicted level of impact on these sites is shared by all four route options.

CH 13 consists of a circular enclosure that measures c. 25m in diameter, which was identified in Google Earth aerial photographs (2010). This is likely to represent an early medieval enclosure or ringfort.

With the exception of BH 5, which will be impacted on by all four route options, this route option will not profoundly or significantly impact upon any recorded BH sites. However, it has the potential to significantly impact on the entrance into Ballycullen House and demesne (CH 108), which is associated with the proposed protected structure. The route will also have a significant impact on the extended demesne (as shown within the historic mapping resource) of Ballycullen House (DL 8).

A total of 25 areas of archaeological potential (AAPs) have been identified where a significant or moderate impact could be predicted.

Fifty two townland boundaries will be directly impacted upon by the route but the impact level has been defined as moderate for 41 of these and slight for the remaining 11.

A large number of potential moderate impacts have been identified as a result of the Option 3 assessment. A total of 11 recorded archaeological or built heritage sites will be subject to a moderately negative impact; whereas 15 previously unrecorded sites or structures will be subject to the same impact level.

Multiple indirect impacts have been identified during the course of the assessment including 79 slight negative impacts, 15 imperceptible negative impacts and 19 occurrences where the impact is deemed to be neutral. There are 18 sites within the receiving environment where no impact will occur.

Several positive impacts have been identified which relate to Adare Manor demesne (part of the Adare ACA), an associated gate lodge (Limerick Lodge), the demesne walls and a gate lodge associated with Fort Union House. These impacts are deemed to be potentially positive due to the movement of traffic away from the immediate environs of the heritage sites.

Route Corridor Option 4

This route option would result in profound negative impacts on three recorded archaeological sites (which covers five enclosure sites) and one protected structure. The enclosures are likely to represent early medieval ringforts and these impacts are common to route options 2, 3 and 4. The protected structure consists of a concrete pill box (BH 5), which is common to all four route options under assessment. These sites are subject to statutory protection under the National Monuments Act and Planning and Development Act. This route would also result in a profound impact on two previously unrecorded circular enclosures in the townland of Tuogh (CH 148, CH 149). These have the potential to represent early medieval ringforts and are located adjacent to one another within a small demesne landscape associated with Tuogh Cottage demesne (DL 20).

This route would also have a significant impact on a further seven recorded archaeological sites, including five enclosures and a partially excavated medieval moated site. Four of these impacts are common within Routes 2 and 3 (AH 58, 61, 63, 72) and the potential impact on AH 8 is shared by all four options.

There is also the potential for a significant impact on the National Monument at Askeaton (Franciscan Friary) (AH 18), although it is likely that the route would follow the footprint of the existing bypass at this location.

The Franciscan Friary is also further protected as an Architectural Conservation Area (ACA). The route option has the potential to have a significant impact on this

designated area, although again, it is likely that the option would be online at this location, enabling direct impacts to be avoided.

A further 25 significant impacts were identified during the assessment with respect to previously unrecorded sites or structures of cultural heritage merit. These include relic field systems, enclosures, upstanding or buried remains relating to vernacular structures (or sites of), limekilns and a circular mound. Of these, three of the sites can be considered as being of particular significance. CH 5, CH 43 and CH 9 are described in the above Option 1 summary and the predicted level of impact on these sites is shared by all four route options.

With the exception of BH 5 and potential impacts at the Franciscan Friary, this route will not significantly impact on the built heritage resource. One designed landscape, associated with Tuogh Cottage (DL20), will be significantly impacted upon. This small demesne also contains two circular enclosures and whilst the principal structure is extant, it is not subject to statutory protection.

A total of 22 areas of archaeological potential (AAPs) have been identified where a significant or moderate impact could be predicted.

A large number of potential moderate impacts have been identified as a result of the Option 4 assessment. A total of 12 recorded archaeological or built heritage sites will be subject to a moderately negative impact; whereas 21 previously unrecorded sites or structures will be subject to the same impact level.

A further 48 townland boundaries will be directly impacted upon by the route. Of these, 40 will be subject to a moderately negative impact, whereas eight will be slightly impacted on.

Multiple indirect impacts have been identified during the course of the assessment including 59 slight negative impacts, 24 imperceptible negative impacts and 18 occurrences where the impact is deemed to be neutral. There are nine sites within the receiving environment where no impact will occur.

Several positive impacts have been identified which relate to Adare Manor demesne (part of the Adare ACA), an associated gate lodge (Limerick Lodge), the demesne walls and a gate lodge associated with Fort Union House. These impacts are deemed to be potentially positive due to the movement of traffic away from the immediate environs of the heritage sites.

Summary of Route Corridor Option Assessment

Whilst the total number of potential profound and significant negative impacts identified within the Route Corridor Option 1 assessment is similar when compared to the other route options, the nature of the sites and landscapes to be impacted upon are more significant in character. Multiple impacts on potential early medieval enclosures have been identified but the route will also directly impact a recorded burial ground, which is more significant due to potential disturbance of human remains. In addition, several significant landscapes will be severely truncated by this route option. These include Elmpark Demesne, which is important in the context of a post medieval designed landscape, but equally contains an extensive early medieval landscape. The route will also sever Bolane House, a protected structure, from its associated demesne. Based on the significance of the sites and landscapes to be impacted upon, this option would have a major negative impact on the

archaeological, built heritage and cultural heritage resource and is deemed to be the least preferred route option.

The total number of potential profound and significant negative impacts identified within the Route Corridor Option 2 assessment is similar when compared to the other route options. However, this route will have less of an impact on the recorded built heritage resource and designed landscapes than route corridor option 1. In addition, no known burial grounds will be impacted upon. However, of all the route options, this route will have the greatest impact on the recorded archaeological resource, which is formed, in the most part, by early medieval enclosures. Whilst these sites are common within the archaeological record and eight of the impacts are shared with Options 3 and 4, 11 enclosures or ringforts will be directly impacted upon by route corridor option 2. Option 2 would result in a major negative impact upon the archaeological, built heritage and cultural heritage resource and is deemed to be an intermediate preference.

The total number of potential profound and significant negative impacts identified within the route corridor option 3 assessment is similar when compared to the other route options. However, this route will have less of an impact on the recorded built heritage resource and designed landscapes than route option 1. In addition, no known burial grounds will be impacted upon. Route Option 1 is the least preferred route due to the nature and scale of potential impacts and the level of significance of the sites and landscapes involved. However, of the remaining three options, Option 3 will have slightly less of an impact on the archaeological, architectural and cultural heritage resource based on the scale and significance of the sites and areas involved. Although this option will have a major negative impact on the cultural heritage resource, Option 3 is nevertheless the preferred route option.

The total number of potential profound and significant negative impacts identified within the route corridor option 4 assessment is similar when compared to the other route options. However, this route will have less of an impact on the recorded built heritage resource and designed landscapes than Route Corridor Option 1. In addition, no known burial grounds will be impacted upon. Route Corridor Option 1 is the least preferred route due to the nature and scale of potential impacts and the level of significance of the sites and landscapes involved. However, of the remaining three options, Option 4 will have slightly less of an impact on the archaeological, built heritage and cultural heritage when compared to Option 2, but slightly more than Option 3. It is acknowledged that this route, whilst having a major negative impact upon the archaeological, built heritage and cultural heritage resource, is deemed to be an intermediate preference, though slightly ahead of Option 2.

It is noted that the impact of all four options under the Archaelogy & Cultural Heritage is Major Negative.

6.12.7 Hydrogeology

Geology considerations that contribute to the selection of a preferred route corridor were assessed in terms of ground conditions and potential geohazards along the route corridor options. This assessment was prepared in accordance with the NRA (TII) publication '*Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2008).* Hydrogeological evaluations were assessed in terms of the type and nature of the underlying aquifers and their protection in terms of groundwater vulnerability characterisation.

Geological and hydrogeological characteristics can influence route selection in terms of engineering and environmental reasons. The underlying geology (Quaternary and bedrock geology) provides the foundation for the road. Certain geological features (such as karst features) can pose a geohazard to road development. Similarly certain subsoils can be problematic for road construction (such as peats). These features and the potential for such features were assessed with regard to these characteristics.

The underlying groundwater is an important resource, particularly Regionally Important Aquifers and as such need to be protected for both current and future usage. This assessment was based upon the aquifer classification and groundwater vulnerability along the Route Corridor Options as identified by the Geological Survey of Ireland (GSI).

In order to assess the four route corridor options from the perspective of hydrogeology, it was appropriate to consider each option in the context of both the underlying aquifer classification and the vulnerability of the groundwater system. The GSI have classified Irish aquifers based on their productivity and associated potential value as a resource. Groundwater vulnerability is defined as being a measure of how susceptible an aquifer body is to contaminants and pollutants entering it from the ground surface. Another important factor that was considered in assessing the route corridor options with respect to hydrogeology was their proximity to Groundwater Dependant Terrestrial Ecosystems (GWDTEs) with the Askeaton Fen Complex being of primary interest in this regard. The Askeaton Fen complex consists of a number of small fen areas located both to the east and southeast of Askeaton in County Limerick and is designated as a Special Area of Conservation (SAC) by the National Parks and Wildlife Service. Fen wetlands typically form complex hydro-ecological systems and can be fed by surface water and/or groundwater as well as receiving direct input from rainfall. Consideration must therefore be given in the route selection process to any potential changes in local groundwater flow regimes arising from the road scheme as the fen complex may be receiving inflows from groundwater springs.

Each of the route corridor options was examined to assess what proportion of the corridor passes through the various bedrock aquifer classifications and therefore assess the potential risk that is posed to the aquifer as a resource and the results are given in Table 6.11 below. Four classes of bedrock aquifer are traversed by each of the proposed route options:

- L_l – Locally important bedrock aquifer which is moderately productive only in local zones;
- L_m – Locally important bedrock aquifer which is generally moderately productive;
- R_{kd} – Regionally important karstified bedrock aquifer dominated by diffuse flow; and

- R_{kc} – Regionally important karstified bedrock aquifer dominated by conduit flow.

All route corridor options are predominantly underlain by karstified regionally important aquifers that are either dominated by conduit or diffuse flow and it is therefore not possible to avoid these potentially sensitive areas. Given that conduit flow in karstified aquifer can typically allow shorter travel times for contaminants or pollutants entering from the ground surface, this class of aquifer can therefore pose a greater risk in relation to resource protection. In this regard, Route Corridor Option 1 passes through the highest proportion of Regionally Important aquifer dominated by karstified conduit flow (R_{kc}) when compared to the other route corridor options. Route Corridor Option 3 is underlain by the lowest proportion of conduit dominated regionally important aquifer (R_{kc}).

Table 6.11 Proportion of each route corridor option that passes through each of the GSI Bedrock Aquifer Classifications

Route Option	L_l	L_m	R_{kd}	R_{kc}
Option 1	10%	23%	-	67%
Option 2	32%	-	18%	50%
Option 3	33%	-	28%	39%
Option 4	26%	-	15%	59%

In a similar manner, each of the route options were examined to assess what proportion of the corridor passes through the various groundwater vulnerability classifications and the results are given in Table 6.12 below. With the exception of route corridor Option 3 at 49%, all route options pass over aquifer classified as extremely vulnerable for more than 59% of their length. A high proportion of the areas classified as being underlain by extremely vulnerable aquifer are reported as having rock exposed at the ground surface which poses a higher risk of contaminants directly entering groundwater. All route options have low proportions of their length crossing moderate or low vulnerability areas typically less than 11%.

Table 6.12 Proportion of each route option that passes through each of the GSI Groundwater Vulnerability Classifications

Route Option	Extreme	High	Moderate	Low
Option 1	59%	24%	11%	6%
Option 2	64%	32%	4%	-
Option 3	49%	45%	6%	-
Option 4	62%	34%	4%	-

Each of the route corridor options pass within close proximity of the Askeaton Fen Complex and given that this is likely a GWDTE, particular attention must be given to local groundwater flow in these areas. The area in which the Askeaton Fen complex is located is underlain predominantly by Regionally Important karstified aquifer with a locally important aquifer occurring beneath the northern portion of the complex. Surface water and groundwater interchanges are likely to exist within the fen hydro-

ecological regime. Table 6.13 below, summarises the length of fen along each route and proximity to the fen complex.

Table 6.13 Summary of the areas where each of the routes passes the Askeaton Fen Complex

Route Option	Length (m)	Distance of Fen from route corridor (at the closet point)
Option 1	5,500 2,000	*Inside route corridor* 50m
Option 2	1,500 2,000	350m 1,390m
Option 3	1,500	350m
Option 4	2,000 1,100	255m 30m

Each of the route corridor options and their location with respect to the Askeaton Fen complex are shown in Drawing No. RS-026 in Volume 2 of this Report which shows local surface water features together with the inferred groundwater flow directions at each of the locations.

Route Corridor Option 1 passes through a portion of the northern Fen Complex adjacent the route of the N69 and east of Askeaton town. Between the townlands of Ballyengland Lower and Ballyvogue both route corridors for Options 1 and 4 also pass close to the Fen Complex with Route Option 4 coming within 30m of the Fen at Deegerty – see Table 6.13. There is a topographical high to the south of the Fen at this location in the area surrounding Curraghchase Woods and surface water is generally draining in a northerly direction with some local flows to the north-west towards the River Deel. Similarly groundwater is likely moving in a northerly direction towards the Shannon Estuary with some local variations. The Fen wetlands occur in close proximity to both the Deegerty and Dromlohan streams at this location and are therefore likely to be substantially surface water fed. Groundwater springs may also be providing a portion of base flow both to these streams and also directly to the wetlands themselves. Given that Option 1 passes directly through a portion of the Fen, it is not possible to exclude changes to the Fen hydro-ecological regime in this area. However both route Options 1 and 4 would pass directly through the area likely providing surface and/or groundwater to the Fen and were either of these options selected it is anticipated that significant mitigation measures would be required in order to ensure that the impacts to the Fen complex are minimised. There is therefore little to differentiate between these two Route Options, however given that Route Option 1 would result in direct disruption to the Fen hydro-ecological regime, Route Option 1 would be the least preferred of the four options with respect to GWDTEs.

Route Corridor Options 2 and 3 follow the same corridor along a section south of Askeaton town and pass within 350m at their closest point to the Askeaton Fen Complex adjacent the R518 north of Ballingarrane. At this location the Fen wetlands occur in an area of low-lying lands with a topographical high to the east at Gorteennamrock hill. The area is drained to the west by the Milltown North and Nantinan Streams which both discharge to the Cloghatrida Stream. The Cloghatrida Stream then flows northwards for a short section before joining the River Deel ultimately discharging to the Shannon Estuary north of Askeaton town. Locally groundwater is likely following surface topography and flowing to the west away from

Gorteennamrock hill; however overall flow is predominantly to the north at catchment scale. The portion of the route to the south of the Fen complex is therefore unlikely to have any impact of the Fen's hydro-ecological regime. The Fen wetland is probably fed substantially by surface water (through both overland and interflow); however it is likely that groundwater springs exist at the base of the hill which provides a portion of baseflow to the wetland and the streams. The predominant risk to the Fen is a change in its hydro-ecological regime due to either cuttings into the bedrock which may change local groundwater flows or changes in local surface water flows due to road development works. It is likely however, that with the inclusion of appropriate mitigation measures, any potentially negative impacts to the Askeaton Fen Complex can be fully mitigated and the Fen wetlands can be maintained in their current state. Given the similarity between Route Corridor Options 2 and 3 they are assessed equally, as moderately negative. However as Route Corridor Option 2 has an additional section in proximity (1,390m) to the Askeaton Fen Complex, Route Corridor Option 3 is preferred over Route Corridor Option 2.

As mentioned in Table 6.13 above Route Corridor Option 4 passes within 30m of the Askeaton Fen Complex at Deegerty. Route Corridor Option 4 also passes within 255m of the Askeaton Fen Complex south-west of Curraghchase Woods in the townlands of Ballynamona and Lisnamuck. At this location, the Fen wetlands occur in lowlands adjacent to a small lake at the base of topographical highs to both the north and south and are drained to the east by the Garranard Stream. The Garranard stream forms part of the River Maigue catchment which discharges to the Shannon estuary north of Kildimo village. Locally, groundwater is likely to be flowing to the east away from Gorteennamrock hill. Groundwater springs may be providing inflow to the wetlands west of the small lake and groundwater is also likely to be providing a portion of baseflow to the Garranard stream itself. Given the close proximity of the route corridor at this location to the Fen wetlands there is a risk of disruption to the Fen hydro-ecological regime. Significant cuttings into bedrock may alter groundwater flow locally and may affect surface hydrology in the area. In addition changes will also be affected in surface water flows due to road development works. Appropriate mitigation measures would be required to exclude potentially negative impacts to the Fen wetlands. It is anticipated however that these issues could be fully mitigated and that the Fen wetlands could be maintained in their current state should this route be selected.

In order to develop a ranking system and recommend a preferred route option based on hydrogeology the bedrock aquifer, groundwater vulnerability and potential impacts on GWDTE were considered. Each of the Route Corridor Options was assigned a ranking based on the proportion of extreme vulnerability and regionally important karst (conduit flow) bedrock aquifers over which they traverse. These areas were considered to be the most vulnerable and therefore routes which traverse the lowest proportion of each were preferred. Route Options were also ranked on their potential to impact GWDTE (Askeaton Fen Complex) with the route likely to have the least impact ranked highest. Given the high sensitivity of the Askeaton Fen Complex and its designation as a SAC, these rankings were doubled to assign a greater weighting to the potential impacts. Based on this ranking exercise Route Corridor Option 3 is the preferred route corridor based on hydrogeology.

Table 6.14 Ranking of the route options based on hydrogeology

Route Option	Bedrock Aquifer	Groundwater Vulnerability	Potential Impact on GWDTE	Score	Overall Ranking
Option 1	4	2	8	14	**4**
Option 2	2	4	2	8	**2**
Option 3	1	1	2	4	**1**
Option 4	3	3	6	12	**3**

Each of the options must be assigned a score based on their potential impact to hydrogeology using the seven point scale from Highly Positive to Highly Negative as outlined in Section 6.11. All routes are generally underlain by karstified regionally important aquifer (R_{kc}) and these aquifers are predominantly classified as being extremely vulnerable to contaminants and pollutants entering from the ground surface. It is anticipated that the impacts to groundwater can be mitigated through careful engineered solutions, however there are potential risks posed from all routes due to the prevailing conditions across the entire study area. In this regard all route corridor options were initially assigned a score of 2 – moderately negative potential impact. However both Route Corridor Options 1 and 4 directly impact on a GWDTE (Askeaton Fen Complex) by encroaching directly on its boundary, and so the associated potential negative impacts on groundwater flow regimes and hydro-ecology is more profound. These route corridor options have therefore been assigned a Major Negative potential impact. These ratings are summarised in Table 6.15.

Table 6.15 Summary of Hydrogeology Assessment

Assessment criteria	Option 1	Option 2	Option 3	Option 4
Hydrogeology	**Major Negative**	**Moderately Negative**	**Moderately Negative**	**Major Negative**
Preference	**Least Preferred**	**Intermediate**	**Preferred**	**Least Preferred**

6.12.8 Hydrology

The hydrological impact of each route corridor option was assessed by considering the impact of each route on the watercourses and floodplains in the study area. This assessment was prepared in accordance with the NRA (TII) document "*Guidelines on Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*" The impact on watercourses was measured by the number of watercourse crossings required for each route corridor option with the impact on the flood plains determined by the length of each route option within the predicted fluvial, tidal and groundwater flood extents. Pluvial flooding was not used in the assessment of the impact on flood plains as there are no significant overland flow paths within the study area and pluvial flooding is limited to localised low points in the topography.

Ordnance Survey Discovery Series mapping was used in the assessment of watercourses impacted by each route corridor option. Route Corridor Option 1 crosses 24 watercourses, the largest of all the options, with option 4 crossing the least number of watercourses at 18. Many of the watercourses in the study area are relatively small tributaries of the larger rivers.

The length of each route corridor option within a fluvial or tidal floodplain was estimated from the draft Shannon Catchment Flood Risk Assessment and Management Plan (CFRAM) mapping. This mapping is the most current and accurate mapping of fluvial and tidal flood extents in the study area. Despite being located closest to the River Shannon, Route Corridor Option 1 has the least impact on fluvial and tidal floodplains with approximately 1km of the route indicated to be within fluvial or tidal flood extents. The majority of this length is in the flood plain of the Barnakyle River. The remaining options all have a similar impact on flood plains with between 1.6km and 1.7km of each route being located within a fluvial or tidal flood plain. These routes all impact on the flood plain of the River Maigue to the north of Adare.

The length of each route option within groundwater flood extents has been estimated from the OPW Preliminary Flood Risk Assessment (PFRA) mapping. Route Corridor Options 1 and 4 do not pass through any area at risk of groundwater flooding while approximately 900m and 550m of route options 2 and 3 respectively are indicated to be within groundwater flood extents. This is a result of both route options passing through the vicinity of Doohyle Lough, where a significant area of groundwater flooding is indicated. A summary of the hydrology impacts of each option is provided in Table 6.16 below. Each of the options was assigned a score based on their potential impact on the hydrology of the study area using the seven point scale from Highly Positive to Major Negative outlined in section 6.11 with a summary of the assessment in Table 6.17.

Table 6.16 Hydrology Impacts on Route Options

Route Option	No of watercourse crossings	Length of route within fluvial/tidal flood plain (km)	Length of route within groundwater flood extent (km)
Option 1	24	1.0	0
Option 2	21	1.6	0.9
Option 3	20	1.6	0.6
Option 4	18	1.7	0

Table 6.17 Summary of Hydrology Assessment

Assessment criteria	Option 1	Option 2	Option 3	Option 4
Hydrology	Minor Negative	Major Negative	Moderately Negative	Minor Negative
Preference	Preferred	Least Preferred	Intermediate	Preferred

6.12.9 Soils, Geology and Waste

An outline earthworks assessment was undertaken for the four route corridor options for earthworks balance and disposal of known unsuitable material. Due to the flat nature of the surrounding topography and the presence of vulnerable aquifers for much of the constraints area, the ability to excavate material for use in providing earthworks construction material is limited. To make up for this deficiency, material will generally need to be imported from quarries and from other alternative borrow sources. Similarly unsuitable or waste material that is too poor to be reused in construction requires removal and disposal or alternative methods for improvement such as piling or ground stabilisation. An assessment of waste materials to be taken to spoil sites or disposed of on-site was undertaken based on the amount of known poor ground intercepted by each of the route corridor options.

Table 6.18 outlines the shortfall in fill material, the amount of unsuitable ground requiring removal or stabilisation and the total deficit in fill material, based on preliminary calculations.

Table 6.18 Fill, Waste and Deficit Material Volumes

Route Option	Fill Requirements m^3 (millions)	Unsuitable m^3 (millions)	Total Deficit m^3 (millions)
Option 1	2.8	0.8	3.6
Option 2	1.0	0.4	1.4
Option 3	1.3	0.3	1.6
Option 4	2.4	0.2	2.6

Route Corridor Options 1 and 4 require the greatest quantities of imported material and are considered to be major negative, with Route Corridor Option 1 ranked lower due to the greater deficit of material. These options are ranked lower than Options 2 and 3 which are considered to be moderately negative. Table 6.19 summarises the findings of the assessment.

Table 6.19 Summary of Soils, Geology and Waste Assessment

Assessment criteria	Option 1	Option 2	Option 3	Option 4
Soils, Geology and Waste	**Major Negative**	**Moderately Negative**	**Moderately Negative**	**Major Negative**
Preference	**Least Preferred**	**Preferred**	**Preferred**	**Intermediate**

6.13 Economy

The economic assessment was carried out under criteria in accordance with the Project Appraisal Guidelines (PAG) published by TII (Unit 6.1 of TII Project Appraisal Guidelines) in accordance with the recommendations of the Common Appraisal Framework (Dept. of Transport, Tourism and Sport, 2016)

6.13.1 Efficiency and Effectiveness

Cost Benefit Analysis (CBA) was undertaken for each of the route corridor options. For this analysis the benefits and costs of the proposed options are assessed using agreed traffic growth scenarios. Costs were based on estimated overall costs for each of the route corridor options. These costs included construction and supervision costs, design costs, land costs; other advance works costs and project contingencies.

Costs for all of the options ranged between €285 million and €305 million. Route Corridor Option 1 has one of the highest construction costs, which is related to long lengths of poor ground near the River Maigue requiring improvement with a long bridge crossing of the River Maigue and more road bridges related to all of the roads off the existing N69.

This CBA assessment was undertaken using the Transport User Benefit Analysis (TUBA) v1.9 CBA software programme. The CBA assessment uses a Discount Rate of 5%, with all costs and benefits discounted back to a common base year of 2009. The analysis was carried out in accordance with TII PAG Unit 6.5: Guidance on Using TUBA.

Table 6.20 below shows the overall scheme cost for each option as well as the range of benefit to cost ratios obtained.

Table 6.20 Economic Benefit

Route Option	Estimate Scheme Cost €M	Benefit to Cost Ratio Range (BCR)		Ranking
		Low	High	
Option 1	*305*	*0.25*	*0.50*	Major Negative
Option 2	*305*	*1.0*	*1.25*	Slightly Positive
Option 3	*300*	*1.0*	*1.25*	Slightly Positive
Option 4	*285*	*1.0*	*1.25*	Slightly Positive

Route Corridor Options 2, 3 and 4 have BCR's in the same range and are assigned as Slightly Positive, as values for these three options are greater than 1.0. Option 1 has the lowest cost to benefit ratio, due to the lower traffic volumes on the N69 when compared to options along the N21 corridor, and has a high construction cost due to the poor ground conditions and difficulties related to crossing the River Maigue closer to the Shannon Estuary. This Option offers a poor BCR with very poor economic return and so is assigned a rating of Major Negative.

Route Corridor Options 2, 3 and 4 are joint preferred options under this heading and Route Corridor Option 1 is the least preferred option.

Table 6.21 Economic Benefits Assessment

Assessment criteria	Option 1	Option 2	Option 3	Option 4
Wider Economic Benefits	**Major Negative**	**Slightly Positive**	**Slightly Positive**	**Slightly Positive**
Preference	**Least Preferred**	**Preferred**	**Preferred**	**Preferred**

6.13.2 Funding Impacts

There is currently no non-exchequer funding (i.e. EU funding) available for the project, therefore each of the route corridor options score as 4 (Neutral) with an Intermediate Preference for all the options.

6.13.3 Transport Reliability

For road vehicles, reliability is defined as the variability in travel time. Factors affecting this include the occurrence of unexpected traffic incidents and unpredictable variability in travel time as compared to the expected average. For each of the route corridor options considered transport reliability will be improved on the network when compared to the existing situation.

All four options provide an improved level of reliability in journey times due to the bypassing of towns and villages, removal of direct access and reducing the number of speed restricted sections that are below the National Road speed limit of 100km/h.

The restriction of accesses on the new National Road will help reduce the number of slow moving vehicles along this road to further improve journey time reliability for all road users. Improved overtaking opportunities will contribute further to the level of improvement required.

Options 2, 3 and 4 provide the largest improvements in journey time reliability for the greatest number of road users, particularly in the case of the N21 traffic. A high quality link road to Foynes will improve the journey time reliability for current N69 road users seeking to access the motorway network. These options are rated Highly Positive. While Route Corridor Option 1 provides improvements to journey times for road users along the N69 the number of road users benefitting from this is lower than is the case of the other three options and provides no additional benefits to N21 traffic. This option is therefore rated Moderately Positive.

Table 6.22 Transport Reliability

Assessment criteria	Option 1	Option 2	Option 3	Option 4
Transport Reliability	**Moderately Positive**	**Highly Positive**	**Highly Positive**	**Highly Positive**
Preference	**Least Preferred**	**Preferred**	**Preferred**	**Preferred**

6.13.4 Wider Economic Benefits

These benefits include any means by which the transport efficiency and effectiveness measures proposed are not encompassed in the direct benefits of the proposed

transport scheme, direct benefits being time and fuel savings, together with the effect of accident reductions.

The wider economic benefits can include:

- Re-organisation impacts
- Agglomeration effects;
- Increased competition in the economy;
- Increased output of firms;
- Tax benefits arising from increased labour supply;
- Employment impacts; and
- Inward investment impacts.

These benefits are supported by the implementation of the TEN-T regulations and the overall improvement in transport provision which will support Foynes Port, and in so doing, greatly assist in the development of the region.

Improvements along the current N69 corridor will support the objectives of the TEN-T initiative but provide fewer additional benefits. Option 1 will be moderately positive in addressing the wider benefits of the TEN-T policy and associated economic benefits but not achieving the development potential of opening up the currently constrained N21 corridor.

Corridors which include improvements to the N21 will have wider economic benefits in terms of improved accessibility to the west of Limerick and Kerry while improving conditions for growth within Adare through the removal of long distance through traffic and commuter traffic. The TEN-T Regulations require a high quality road to be in place between Foynes and Limerick by 2030 and along the N21 corridor by 2050. Options 2, 3 and 4 will be highly positive in respect of achieving both of these aims. As the length of improved route for the N21 corridor will be less with Option 4 than for Options 2 and 3, this option has an intermediate preference.

Table 6.23 Wider Economic Benefits Assessment

Assessment criteria	Option 1	Option 2	Option 3	Option 4
Wider Economic Benefits	**Moderately Positive**	**Highly Positive**	**Highly Positive**	**Highly Positive**
Preference	**Least Preferred**	**Preferred**	**Preferred**	**Intermediate**

6.14 Safety

Under the Project Appraisal Guidelines, two principal road safety impacts are considered through the appraisal process, these are collision reduction and security of road users. Assessment of the route options for Safety was carried out in accordance with Unit 6.1 of the *TII Project Appraisal Guidelines* which outlines the approach to be adopted at the Constraints Study and Route Corridor Selection phases.

6.14.1 Collision Reduction

The TUBA programme does not calculate safety benefits. Therefore the assessment of safety benefits is undertaken using the TII programme COBALT-Ireland.

COBALT assesses the safety aspects of road schemes using detailed inputs of links that may be impacted by the scheme. The assessment is based on a comparison of collisions by severity and associated costs across an identified network in 'Without-Scheme' and 'With-Scheme' forecasts, using details of link characteristics, relevant collision rates and costs and forecast traffic volumes.

The predicted reduction in the total number of collisions over the period 2024 to 2039, as a result of each route corridor option is presented in Table 6.24, alongside the reduction in the number of casualties by severity. The monetised safety benefits of each route corridor option are presented in Table 6.25.

Table 6.24 Predicted Collision Reduction (2024-2039)

Route Option	Collision Reduction	Casualty Reduction		
		Fatal	Serious	Minor
Option 1	-1	0	-1	-10
Option 2	481	18	25	625
Option 3	463	17	24	605
Option 4	317	9	12	364

Table 6.25 Predicted Monetised Safety Benefits (2024-2039)

Route Option	Safety Benefits (€m)
	(5% Discount Rate)
Option 1	-€0.5
Option 2	€23.9
Option 3	€23.0
Option 4	€12.7

Options 2 and 3 will provide the greatest safety benefits in terms of collision reduction and associated value since these options will cater for the greatest amount of traffic over a longer length of new route. These options are ranked Highly Positive. Options 1 and 4 are ranked neutral and moderately positive respectfully.

Table 6.26 Summary of Collision Reduction Assessment

Assessment criterion	Option 1	Option 2	Option 3	Option 4
Collision Reduction Assessment	Neutral	Highly Positive	Highly Positive	Moderately Positive
Preference	Least Preferred	Preferred	Preferred	Intermediate

6.14.2 Security of Road Users

Security of road users is concerned with improving the personal security of road users and their property and the security of vulnerable road users, such as pedestrians and cyclists. All route corridor options will remove significant levels of traffic from the existing road network, which will improve the security of vulnerable road users. However Option 2 and 3 remove higher levels than Options 1 and 4 and so are rated Highly Positive and deemed the Preferred Route Corridors. On a similar basis Option 4 is ranked above Option 1 as it will remove higher levels of traffic from the existing road network than Option 1.

Table 6.27 Summary of Security Assessment

Assessment criterion	Option 1	Option 2	Option 3	Option 4
Security Assessment	Slightly Positive	Highly Positive	Highly Positive	Moderately Positive
Preference	Least Preferred	Preferred	Preferred	Intermediate

6.15 Accessibility & Social Inclusion

The accessibility and social inclusion appraisal has been carried out in accordance with the Project Appraisal Guidelines and has considered the impact of each route corridor option on vulnerable groups and the impact on deprived geographic areas.

6.15.1 Impact on Vulnerable Groups

All of the options are in the same geographic region and will not impact any vulnerable groups, as such all options are considered neutral in terms of impact with an Intermediate Preference for all the options.

6.15.2 Impact on Disadvantaged Geographic Areas

In terms of impact on disadvantaged geographic areas all of the options could be considered neutral. In terms of government policy all of the proposed options would deliver the same level of accessibility to the three Rapid areas within Limerick City. However Options 2 and 3 provide improved access to the Rathkeale Rapid area so they are ranked slightly positive under this heading.

Table 6.28 Impact on Disadvantaged Geographic Areas

Assessment criterion	Option 1	Option 2	Option 3	Option 4
Accessibility and Social Inclusion	**Neutral**	**Slightly Positive**	**Slightly Positive**	**Neutral**
Preference	**Intermediate**	**Preferred**	**Preferred**	**Intermediate**

6.16 Integration

The appraisal of integration has assessed the impact of each route corridor option in terms of achieving the objectives of national, regional, and local planning policy, together with EU Regulation and integration with previous infrastructure investments. This assessment has been carried out in accordance with the TII Project Appraisal Guidelines.

6.16.1 Transport Integration

Transport Integration addresses the promotion of the integration of transport infrastructure and services through the development of missing transport links, and improving opportunities for interchange and through ticketing. In this respect the scheme aims to link the core port of Shannon Foynes to the core road network. In this respect all options provide this critical link to complete the TEN-T core network in Ireland, and are considered highly positive in meeting this objective. Dis-benefits to alternative transport modes such as rail do not arise as the rail development from Foynes to Limerick also needs to be undertaken to support the aims of the core port under the TEN-T initiative. All of the route options proposed accommodate the future reopening of the rail line and recognise that the development of both the road and rail are mutually beneficial.

All options are rated Highly Positive under this rating and are Preferred for all options.

6.16.2 Land Use Integration

Options that reduce traffic, including heavy traffic, through urban areas revitalise these areas by providing opportunities for non–vehicular traffic and general improvement in quality of life. In this respect all of the options offer relief in terms of heavy traffic though towns and villages and provide a slight benefit.

Options 2, 3 and 4 are rated Moderately Positive as the offer enhanced benefits with regard to improved conditions in Adare in particular. Option 1 is rated Slightly Positive.

Table 6.29 Summary of Land-Use Integration Assessment

Assessment criterion	Option 1	Option 2	Option 3	Option 4
Land-Use Integration	**Slightly Positive**	**Moderately Positive**	**Moderately Positive**	**Moderately Positive**
Preference	**Intermediate**	**Preferred**	**Preferred**	**Preferred**

6.16.3 Geographical Integration

Geographical Integration aims to improve transport links within Ireland, Europe and the rest of the world and specifically supports the objectives of the TEN-T. The Port of Shannon - Foynes and the road and rail Infrastructure connecting to the core transport networks are included within the TEN-T programme. All of the options address this need by providing the necessary infrastructure to support the TEN-T in providing the necessary road link between the core network and the port. This in turn will support the core port link to European and international shipping routes.

All options are rated Highly Positive under this rating and are Preferred for all options.

6.16.4 Integration with Other Government Policy

Infrastructure projects which provide access to international ports and airports are considered highly beneficial in addressing Government policy on Regional Balance. Furthermore, any infrastructural development which increases the expansion potential of ports and airports should lead to increased economic activity through direct employment in the region and thus support policies to Enhance Regional Income. This is important in regions where average earnings are particularly low. All of the options considered are included within and meet the objectives of the Governments' Building on Recovery: Infrastructure and Capital Investment 2016 – 2021.

All options are rated Highly Positive under this rating and are Preferred for all options.

6.17 Route Corridor Assessment Matrix

The above assessments are drawn together in the route corridor assessment matrix, as presented in Table 6.30 below. Each Route Corridor Option was given an overall score based on the seven point scale ranging from Highly Positive to Major Negative as described in Section 6.11 above.

The summation of the scores under each of the five appraisal criteria shows that Route Corridor Options 2 and 3 achieve equal scoring, each obtaining a total of 93 as compared to 89 for Option 4 and 77 for Option 1.

Table 6.30 Route Corridor Option Assessment Matrix

	Route Corridor Option 1		Route Corridor Option 2		Route Corridor Option 3		Route Corridor Option 4	
Environment								
Noise and Vibration	Moderately Negative	2	Moderately Negative	2	Moderately Negative	2	Moderately Negative	2
Air Quality	Minor Negative	3	Slightly Positive	5	Neutral	4	Neutral	4
Landscape & Visual	Major Negative	1	Moderately Negative	2	Moderately Negative	2	Moderately Negative	2
Agriculture	Moderately Negative	2	Major Negative	1	Major Negative	1	Moderately Negative	2
Impact on Properties (Non Agricultural)	Moderately Negative	2	Moderately Negative	2	Moderately Negative	2	Moderately Negative	2
Ecology	Major Negative	1	Moderately Negative	2	Moderately Negative	2	Major Negative	1
Archaeology & Cultural Heritage	Major Negative	1	Major Negative	1	Major Negative	1	Major Negative	1
Hydrogeology	Major Negative	1	Moderately Negative	2	Moderately Negative	2	Major Negative	1
Hydrology	Minor Negative	3	Major Negative	1	Moderately Negative	2	Minor Negative	3
Soils, Geology and Waste	Major Negative	1	Moderately Negative	2	Moderately Negative	2	Major Negative	1
Sub-Total	**17**		**20**		**20**		**19**	
Economy								
Economic Benefit (COBA - Efficiency and Effectiveness)	Major Negative	1	Slightly Positive	5	Slightly Positive	5	Slightly Positive	5
Funding Impacts	Neutral	4	Neutral	4	Neutral	4	Neutral	4
Transport Reliability	Moderately Positive	6	Highly Positive	7	Highly Positive	7	Highly Positive	7
Wider Economic Benefits	Moderately Positive	6	Highly Positive	7	Highly Positive	7	Highly Positive	7
Sub-Total	**17**		**23**		**23**		**23**	
Safety								
Collision reduction	Neutral	4	Highly Positive	7	Highly Positive	7	Moderately Positive	6
Security	Slightly Positive	5	Highly Positive	7	Highly Positive	7	Moderately Positive	6
Sub-Total	**9**		**14**		**14**		**12**	
Accessibility and Social Inclusion								
Impact on Vulnerable Groups	Neutral	4	Neutral	4	Neutral	4	Neutral	4
Impact on deprived geographic areas	Neutral	4	Slightly Positive	5	Slightly Positive	5	Neutral	4
Sub-Total	**8**		**9**		**9**		**8**	
Integration								
Transport Integration	Highly Positive	7	Highly Positive	7	Highly Positive	7	Highly Positive	7
Land Use Integration	Slightly Positive	5	Moderately Positive	6	Moderately Positive	6	Moderately Positive	6
Geographical Integration	Highly Positive	7	Highly Positive	7	Highly Positive	7	Highly Positive	7
Integration with Other Government Policies	Highly Positive	7	Highly Positive	7	Highly Positive	7	Highly Positive	7
Sub-Total	**26**		**27**		**27**		**27**	

Summary of Scores				
Environment	17	20	20	19
Economy	17	23	23	23
Safety	9	14	14	12
Accessibility and Social Inclusion	8	9	9	8
Integration	26	27	27	27
Overall	77	93	93	89

Under the Route Corridor Assessment Matrix Route Corridor Options 2 and 3 achieve equal scores of 93, with Route Corridor Option 4 achieving 89 points and Route Corridor Option 1 obtaining 77 points.

An analysis has also been carried out of the preferences identified under each of the assessment criteria applied in sections 6.12.1 to 6.16.4 above. This is presented in Table 6.31 below. The following is noted:

Route Corridor Option 3 is the Preferred option under the Environmental heading, achieving five "Preferred" and five "Intermediate" ratings under the sub headings considered.

Under the Economy heading, Route Corridor Options 2 and 3 achieve joint "Preferred" rating overall.

Similarly under the headings of Safety, and Accessibility and Social Inclusion, Route Corridor Options 2 and 3 achieve joint "Preferred" rating overall.

Route Corridor Options 2, 3 and 4 achieve joint "Preferred" rating under the Integration heading.

The above assessment is presented in overall summary form at the end of Table 6.31. Based on this approach Route Corridor Option 3 is identified as the preferred route corridor.

Table 6.31 Route Corridor Option Preference Matrix

	Route Corridor Option 1	Route Corridor Option 2	Route Corridor Option 3	Route Corridor Option 4
Environment				
Noise and Vibration	Least Preferred	Intermediate	Preferred	Least Preferred
Air Quality	Least Preferred	Preferred	Intermediate	Intermediate
Landscape & Visual	Least Preferred	Preferred	Intermediate	Intermediate
Agriculture	Preferred	Least Preferred	Intermediate	Preferred
Impact on Properties (Non Agricultural)	Least Preferred	Preferred	Intermediate	Intermediate
Ecology	Least Preferred	Intermediate	Preferred	Least Preferred
Archaeology & Cultural Heritage	Least Preferred	Intermediate	Preferred	Intermediate
Hydrogeology	Least Preferred	Intermediate	Preferred	Least Preferred
Hydrology	Preferred	Least Preferred	Intermediate	Preferred
Soils, Geology and Waste	Least Preferred	Preferred	Preferred	Intermediate
Ranking	4	2	1	3
Economy				
Economic Benefit (COBA - Efficiency and Effectiveness)	Least Preferred	Preferred	Preferred	Preferred
Funding Impacts	Intermediate	Intermediate	Intermediate	Intermediate
Transport Reliability	Least Preferred	Preferred	Preferred	Preferred
Wider Economic Benefits	Least Preferred	Preferred	Preferred	Intermediate
Ranking	4	1	1	3
Safety				
Collision reduction	Least Preferred	Preferred	Preferred	Intermediate
Security	Least Preferred	Preferred	Preferred	Intermediate
Ranking	4	1	1	3
Accessibility and Social Inclusion				
Impact on Vulnerable Groups	Intermediate	Intermediate	Intermediate	Intermediate
Impact on deprived geographic areas	Intermediate	Preferred	Preferred	Intermediate
Ranking	4	1	1	3
Integration				
Transport Integration	Preferred	Preferred	Preferred	Preferred
Land Use Integration	Intermediate	Preferred	Preferred	Preferred
Geographical Integration	Preferred	Preferred	Preferred	Preferred
Integration with Other Government Policies	Preferred	Preferred	Preferred	Preferred
Ranking	4	1	1	1

Overall Summary				
	Route Corridor Option 1	Route Corridor Option 2	Route Corridor Option 3	Route Corridor Option 4
Environment	Least Preferred	Intermediate	Preferred	Intermediate
Economy	Least Preferred	Preferred	Preferred	Intermediate
Safety	Least Preferred	Preferred	Preferred	Intermediate
Accessibility and Social Inclusion	Least Preferred	Preferred	Preferred	Least Preferred
Integration	Least Preferred	Preferred	Preferred	Preferred
Ranking	4	2	1	3

It is noted that one of the two methodologies adopted (Table 6.30 above) identified joint Route Corridor Options 2 and 3 as equal preferred solutions, while the second methodology utilised (Table 6.31 above) resulted in Route Corridor Option 3 being

preferred. On account of the closeness of the result it was considered that further examination of the assessment carried out in Table 6.30, using the seven point scoring system, was warranted.

Table 6.30 shows that the only areas of difference between Route Corridor Options 2 and 3 occur under the environmental assessment headings considered. The two options achieved the same totals under the criteria of Economy, Safety, Accessibility and Social Inclusion and Integration. The scores presented under the Environmental criterion are based on an assessment of the various environmental sub-headings considered over the entire length of both routes in question i.e. from Node A to M (Figure 6.10 refers). It will be noted that Route Corridor Options 2 and 3 follow a common route apart from the sections which diverge between Node E (Ballingarrane) and Node K (Tuogh). In order to investigate the differences between these particular sections of route in more detail a separate assessment was carried out under each of the key environmental sub headings. This assessment is described in the following paragraphs, and the results are presented in Table 6.32.

Noise and Vibration - When comparing the diverged sections in isolation, the relevant sections of route corridor between Node G and K were assessed to determine the potential impact rating (PIR). Based on this assessment, Route Corridor Option 3 has a higher value (i.e. a PIR of 299) compared to Route Option Corridor 2 (i.e. a PIR of 227) over the full length of the diverged section. This count, however, includes all properties along the existing N21 Road from Rathkeale (Node G) to node K a large proportion of which are already exposed to road traffic noise.

An important consideration when ranking routes for noise relates to the potential change in the noise environment and hence, the significance of the impact. Analysis of traffic flows for both route corridor options indicates that noise levels along the On-line sections of the N21 will not alter by more than 25% between the Do Nothing and Do Something scenarios and hence no perceptible change in noise level will be experienced at these properties. The PIR values counted for 'Off line' sections of road, i.e. for properties which will be impacted by a new road alignment only, are considered to represent a more realistic assessment for comparison of both routes.

When properties along the 'Online' section of the N21 are removed from the PIR assessment, Route Corridor 3 has a lower PIR value (111) compared to Route Corridor 2 (170).

Further analysis was carried out on the number of properties which are likely to be specifically impacted by the scheme and which exceed an operational noise level of 60dB L_{den} through consideration of traffic volumes, the vertical alignment and road surfaces.. Based on this assessment, a total of 16 properties along Route Corridor Option 3 were determined to require noise mitigation compared to Route Corridor Option 2 where 26 properties were identified.

Taking the above assessments in consideration, Route Corridor 3 has been ranked as minor negative and Route Corridor Option 2 has been ranked as moderately negative.

Air Quality - Over the divergent sections both options are rated Moderately Negative. Although there would be a slight preference for Route Corridor Option 2 under this heading, the difference is not deemed sufficient to separate the ratings. The divergent section of Route Corridor Option 2 received a NO_X exposure index score of 197831 and the divergent section of Route Corridor Option 3 received a NO_X

exposure index score of 208129. A higher level of exposure is represented by a higher number.

Landscape and Visual Effects - Over the divergent sections both options are rated Moderately Negative. Although there would be a slight preference for Route Corridor Option 2, because Route Corridor Option 3 runs close to Rathkeale and Croagh and as a result has the potential to affect more sensitive visual receptors than Route Corridor Option 2 which runs parallel to the rail line for much of the divergent sections. However, under this heading, the difference is not deemed sufficient to separate the ratings.

Agriculture/Agronomy - Both options may significantly impact on the operation of an equestrian centre at separate locations along their respective route corridor options. Route Corridor Option 2 was identified as having a more significant impact on equine activities. Whereas Route Corridor Option 3 has potentially higher land severance and individual farm impacts, including dairy activity. Based on these factors both options are given a rating of Major Negative under this heading.

Non-Agricultural Properties - In the case of impact on non-agricultural properties, greater impacts might occur on residential, commercial and community properties on Route Corridor Option 3 (52 properties within the corridor) as compared to Route Corridor Option 2 (36 properties). For comparison purposes, over the divergent sections, Route Corridor Option 3 is rated Major Negative and Route Corridor Option 2 is rated Moderately Negative.

Ecology – Route Corridor Option 3 over the divergent length would have less of an impact on Lesser Horseshoe Bats than Route Corridor Option 2. Route Corridor Option 2 passes through the south of Hollywood House demesne which consists of a mosaic of mixed woodland and parkland with high potential value for lesser horseshoe bats. Route Corridor Option 3 avoids this sensitive area. Route Corridor Option 2 is also less desirable as it would also impact on a small alkaline lake with some surrounding and adjacent scrub-woodland and wet grassland habitats at Doohyle. In comparative terms Route Corridor Option 2 is rated Moderately Negative and Route Corridor Option 3 is ranked Minor Negative.

Archaeology & Cultural Heritage – It should be noted that to the east of Rathkeale, Route Corridor Option 3 has the potential to have a profound impact on a recorded standing stone (AH 110). This site is located adjacent to the existing Rathkeale Bypass. A conservative assessment has been made resulting in a profound impact to the standing stone. It should be noted that at the next stage of the assessment, there is potential for this level of impact to be substantially reduced depending on the alignment selected within the assessed corridor and considering the proximity of the existing road infrastructure. Nevertheless this opportunity for mitigation has been ignored in the comparative assessment carried out on Option 2 versus Option 3.

No other sites that are subject to statutory protection will be directly impacted upon by Route Corridor Option 3 where it runs between Rathkeale and Adare. This route option will directly impact on five previously unrecorded sites of cultural heritage significance, two areas of archaeological potential and twelve townland boundaries.

In comparison, Route Corridor Option 2 will result in a direct significant impact on three recorded ringforts between Rathkeale and Adare. In addition, nine previously unrecorded sites of cultural heritage significance will be directly impacted upon, along with six areas of archaeological potential and eight townland boundaries. This section

of Route Corridor Option 2 has a much greater impact therefore on the cultural heritage resource than is the case for Route Corridor Option 3.

The assessment has identified that both Route Corridor Options 2 and 3 would result in a number of profound and significant impacts upon sites that are subject to statutory protection. However, Route Corridor Option 3 will result in the least number of direct impacts on the protected cultural heritage resource. In comparative terms Route Corridor Option 3 is rated Minor Negative whereas Route Corridor Option 2 is rated Moderately Negative, so Option 3 is preferred over the divergent section.

Hydrogeology - In terms of Hydrogeology, Route Corridor Option 3 is preferred over Route Corridor Option 2. In terms of groundwater resources, Route Corridor Option 3 crosses the least proportion of Regionally Important Karstified Aquifer (Conduit) which poses a greater risk in relation to resource protection. Route Corridor Option 3 crosses a much lower proportion of Extreme Vulnerability groundwater aquifer with bedrock at or close to the surface, when compared with Route Corridor Option 2. Route Corridor Option 3 is located further away from the sensitive groundwater dependant habitat of Askeaton Fen Complex. This will serve to further mitigate any potential impacts arising from cuttings which may intercept groundwater flow paths. Overall, over the divergent section, Route Corridor Option 3 is rated Minor Negative and Route Corridor Option 2 is rated Moderately Negative.

Hydrology - In terms of Hydrology, Route Option 3 is preferred over Route Corridor Option 2 due to the reduced interaction with mapped groundwater flooding extents. The route corridor for Route Corridor Option 2 crosses an area indicated as being within the extents of mapped OPW PFRA groundwater flooding adjacent to Doohyle Lough over a length of c.0.9km, while Route Corridor Option 3 crosses a shorter section of this flood extent at c0.6km. In comparative terms, Route Corridor Option 3 is rated Minor Negative and Route Corridor Option 2 is rated Moderately Negative.

Soils, Geology and Waste - Based on the anticipated deficits in fill material over the compared lengths Route Corridor Option 2 is rated minor negative and Route Corridor Option 3 is rated moderately negative.

Table 6.32 Localised Comparison of Options 2 and 3 – Environmental Criteria

	Route Corridor Option 2		Route Corridor Option 3	
Environment				
Noise and Vibration	Moderately Negative	2	Minor Negative	3
Air Quality	Moderately Negative	2	Moderately Negative	2
Landscape & Visual	Moderately Negative	2	Moderately Negative	2
Agriculture	Major Negative	1	Major Negative	1
Impact on Properties (Non Agricultural)	Moderately Negative	2	Major Negative	1
Ecology	Moderately Negative	2	Minor Negative	3
Archaeology & Cultural Heritage	Moderately Negative	2	Minor Negative	3
Hydrogeology	Moderately Negative	2	Minor Negative	3
Hydrology	Moderately Negative	2	Minor Negative	3
Soils, Geology and Waste	Minor Negative	3	Moderately Negative	2
Sub-Total	**20**		**23**	

Based on the comparison carried out as summarised in Table 6.32 above, Route Corridor Option 3 is preferred over Route Corridor Option 2 when the divergent

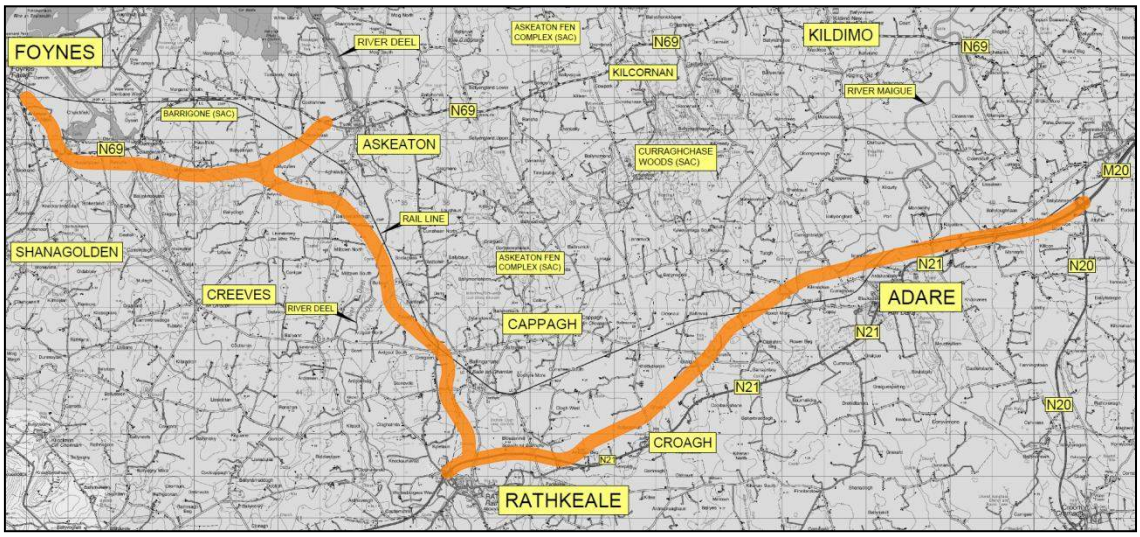
sections between Node E (Ballingarrane) and K (Tuogh) are examined, on the basis of a score of 23 for option 3 as compared to 20 for option 2. The difference in scoring is noteworthy when compared to the overall result presented in Table 6.30 above which scored Route Corridor Options 2 and 3 the same when assessed over their entire lengths. This finding, taken in conjunction with the preference identified under table 6.31, confirms Route Corridor Option 3 as the Preferred Route Corridor for the Foynes to Limerick Improvement Scheme.

In support of the decision to recommend Route Corridor Option 3, the following should also be noted in relation to the overall scheme:

- Route Corridor Option 3 is the preferred overall option under the heading of Noise and Vibration
- Route Corridor Option 3 is preferred over Route Corridor Option 2 under the heading of agronomy. Both options may significantly impact on the operation of an equestrian centre at separate locations along their respective route corridor options, together with significant agricultural enterprises including dairy activities. However on balance Route Corridor Option 2 was identified as having a more significant impact on equestrian activities, and on the assumption that appropriate accommodation works and compensation can be provided in the case of other agricultural activity including dairying, Route Corridor Option 3 is preferred under the agronomy heading.
- Route Corridor Option 3 is preferred over all other options under the heading of ecology
- Route Corridor Option 3 is also preferred over all other options under the heading of Archaeology, Built Heritage and Cultural Heritage
- Route Corridor Option 3 is also preferred over all other options under the heading of hydrogeology
- Route Corridor Option 3 is preferred over Route Corridor Option 2 under the heading of hydrology as option 3 passes through a considerably reduced length of possible flood zone as compared to option 2.
- Both Route Corridor Options 2 and 3 are preferred over Route Corridor Options 1 and 4 under the heading of soils, geology and waste as options 1 and 4 incur a considerable additional requirement for imported fill; furthermore, Route Corridor Option 4 would generate a requirement for extensive soft ground treatment in the flood plain of the River Maigue.
- Under the headings of economy and safety, Route Corridor Option 3, jointly with Route Corridor Option 2, offers the best overall benefits in terms of addressing the objectives of the Foynes to Limerick Road Improvement Scheme while simultaneously addressing the strategic objective of bypassing Adare. The fact that these options provide a greater length of improved road on the N21 corridor extending to a point west of Rathkeale, with increased overall benefits in terms of safety and time savings, render these options superior to Route Corridor Options 4 which offers a similar benefit to cost ratio (BCR). Under the TEN-T Regulations there is requirement to provide a high quality road between Foynes and Limerick by 2030 and along with an upgrade to the N21 corridor by 2050. Route Corridor Option 3 also offers the advantage over Route Corridor Option 2 of utilizing part of the existing N21 Rathkeale Bypass.

The preferred route corridor is shown in Figure 6.15 below and detailed in Drawing Nos. RS-016 to RS-025 in Volume 2 of this report.

Figure 6.15 Preferred Route Corridor



6.18 Public Display

Following on from the public consultation and the route selection process which identified the preferred route corridor, a public display was held on the 1st and 2nd of December 2015. The objectives of this display were to:

- Present the preferred route corridor to the public;
- Invite comments/feedback on the preferred route corridor;
- Further inform the public of the process and the programme for the project;
- Gather local information, including on land ownership;
- Answer questions from the public and address concerns where possible

This section details the display process and presents an analysis of the comments and feedback received.

6.18.1 Methodology

A publicity campaign was undertaken by the Mid West National Road Design Office (MWNRDO) and Limerick City and County Council prior to the Public Display. The display was advertised in the following papers on the 21st and 28th November 2015.

- Limerick Leader; and
- Limerick Post.

In addition, advertisements were broadcast on Limerick 95FM, together Limerick City & County Council's Twitter site and website.

6.18.2 Dates and Venues

The public display events were held at two venues, the South Court Hotel in Limerick on the 1st December 2015 and the Flying Boat & Maritime Museum in Foynes on the 2nd December 2015.

The display information on the scheme consisted of the following:

- Aerial Photography for the scheme showing the Preferred Route Corridor;
- Ordnance Survey Mapping showing the Route Corridor Options as shown at the Public Consultation; and,
- Plans showing the Preferred Route Corridor.

Drawings showing the Preferred Route Corridor were available for inspection at the consultation. The events on both days were attended by a number of staff from the Mid West National Roads Design Office, Limerick City and County Council, and ROD-AECOM.

6.18.3 Attendance

Approximately 600 people attended the public display events over the 2 days.

All attendees were invited to sign a register and were offered copies of the information brochure. Copies of the brochure and maps are included in Appendix A of Volume 3 of this Report. Additional copies of the brochure and maps were made available to the public at the MWNRDO offices at Lissanalta House.

6.18.4 Feedback

During the display events dialogue between staff engaged on the project and members of the public was encouraged. Many of these conversations provided useful local information that is not always apparent from available mapping. This process also yielded vital information on agricultural holdings and other matters such as boundaries, water courses, habitats and other landscape features.

Anybody wishing to make written comments was invited to do so by the closing date, which was extended from 15th January 2016 to 29th January 2016. Approximately 370 individual sets of comments were received.

All individual comments received were evaluated and the information they contained was recorded. Any comment with information relating to any specialist area was copied to the relevant specialist or design team member, e.g. agronomy, archaeology, noise, flora and fauna, etc. The main issues raised included the following:

- Impacts on residences and quality of life
- Severance and accessibility impacts to land and farms;
- Flooding Concerns;
- Impacts to archaeology, protected structures and ecology;
- Gas pipeline in the route of corridor;
- Impacts to equine businesses;
- Noise and visual;
- Vibrations due to rock blasting;
- Community severance and the indirect economic and social impacts;
- Impacts to community facilities; and
- Sentimental value of land which has been in a family for generations.

Concerns about the high quality of land being used for the scheme and impacts due to perceived increases in crime were additional concerns raised in the feedback. Amendments made to the route corridors in certain locations since the four route corridor options were previously published were also of concern.

Suggestions were made for junction locations. In addition, alternative routes were proposed and requests were made to maximise the distance from dwelling houses. These issues are discussed in more detail in section 6.19 below.

Immediately before the Public Display event took place (December 2015) the Mid West National Road Design Office issued a letter to all known property owners within the preferred route corridor. The contact details for those recipients were extracted from property registration documents along with contact details received from the prior public consultation period.

This letter advised of the upcoming public display events. It also offered private meetings with the property owners to allow for adequate explanation of the scheme proposals and discuss concerns the property owners may have. Notes taken at these meetings were circulated to the project team and relevant specialists for further appraisal.

6.19 Summary of Feedback on the Preferred Route Corridor

The 300m wide corridor allows for deviations in the road alignment centreline and elevation as the design emerges. The 300m corridor width at this stage has the effect of exaggerating the number and extent of property impacts. In reality the final road alignment width will, in general, be considerably less than the 300m corridor as presented at the route selection stage. Therefore, the impacts on properties will in many cases be significantly reduced and in some cases eliminated altogether.

The themes of the comments received on the preferred route corridor were very varied. However, they were often reflective of the submissions received previously following the Public Consultation in March 2015 after the announcement of the four route corridor options. On examination of the comments received from individuals and community groups the following subjects were predominant.

Comments were received from both dairy and beef enterprises. The central theme of these comments was the effect of severance upon their respective operations together with land loss. Inherent in these was the desire for the alignment to be located such that severance would be minimised. In the event of severance many comments suggest an overpass or underpass as necessary to allow the enterprise continue into the future. Some of the feedback from farm enterprises also included detailed proposals to alter the route as currently shown, thus minimising disruption to their operations. A number of equine enterprises also made comments. Amongst other items raised these comments focused particularly on the sensitivity of horses to noise and their tendency to react unpredictably to same.

Many cultural heritage sites including ringforts, historical features and built heritage that fall within or close to the preferred route corridor were raised. The cultural attachment to these features is clearly evident.

Comments received from community groups and business interests in the vicinity of Croagh Village included requests for consideration of a junction on the proposed road to provide access to the village and its facilities.

Businesses located near the preferred route corridor expressed concern over the possible limitations placed upon their customers in their catchment area and their ability to continue to support their business. This fear was based upon the presumption that roads may be closed or diverted in their area thus limiting access or altering current passing trade patterns.

Similarly, much concern was expressed regarding the treatment of local roads at intersections with the proposed road. These concerns focussed predominantly on possible local road closures and the effects of any closures upon the community in the surrounding neighbourhood.

The possible effects of a new road on the living environment were a common worry expressed with particular emphasis on the perceived negative air and noise impacts on health.

The strong attachment to family property in some cases passed down over several generations permeated through many submissions. This attachment was expressed regarding family homes, farms and the general layout of their farmyards etc. which in some cases remain physically reflective of previous generations. Some of these comments also proposed alternative routes in the vicinity of their property.

Many comments received mentioned wildlife with various species, both protected and non-protected, living on their lands or gardens. These included various terrestrial and aquatic species and numerous species of birds. Some locations were described as ecological sanctuaries located both on farmland and in gardens. Whilst many of the sanctuaries referred to are located outside of officially designated sites their potential for people's enjoyment of the natural world was emphasised together with their ecological value for maintaining bird and other populations.

The comments and feedback were reviewed by the project team and relevant specialists in advance of finalizing their assessment. The information received will greatly assist in the development of the scheme through the subsequent design phase and will allow appropriate mitigation strategies to be devised.

6.20 Conclusion and Recommendation

The route selection process concluded that the preferred route corridor is Route Corridor Option 3 (Orange).

It is recommended that Route Corridor Option 3 (Orange) be adopted as the preferred route corridor and that this route corridor is taken forward to the design stage of the project (Phase 3).