



M11/N11 Corridor Study

(J4 M50 – J14 Coyne's Cross)

Needs Assessment Report

April 2017



Made: Liam O'Brien / Conor de Courcy

Reviewed: Philip Shiels

Approved: Colin Acton

Executive Summary

Context

This Needs Assessment Report has been commissioned by Transport Infrastructure Ireland in support of the M11/N11 Corridor Study. The Study was initiated to assess the needs of the M11/N11 National Road corridor between Junction 4 (M50/M11) and Junction 14 (Coyne's Cross) against the backdrop of the following policy documents:

- *Strategic Investment Framework for Land Transport (SIFLT)*, published by the Department of Transport Tourism and Sport (DTTAS) in August 2015;
- The *Transport Strategy for the Greater Dublin Area 2016-2035*, published by the National Transport Authority (NTA) in April 2016; and
- The Wicklow and Dún Laoghaire – Rathdown County Development Plans.

The report also considers the needs of the regional and local road network required to support and complement the M11/N11 corridor; and the safe daily operation of the M11/N11 National Road corridor in relation to incidents. The report has been undertaken in consultation with other key stakeholders namely Wicklow County Council (WCC), Dún Laoghaire – Rathdown County Council (DLRCC) and the National Transport Authority (NTA).

The *Transport Strategy for the Greater Dublin Area 2016-2035* provides a framework for the planning and delivery of transport infrastructure within the region surrounding and including Dublin over the next 20 years. Among the suite of public transport, demand management, walking and cycling measures put forward, the *Transport Strategy* identified and appraised the need for a number of measures along the M11/N11 south eastern corridor to address deficiencies and related congestion, specifically: '*Capacity enhancement and reconfiguration of the M11/N11 from Junction 4 (M50) to Junction 14 (Ashford) inclusive of ancillary and associated roads schemes, to provide additional lanes and upgraded junctions, plus service roads and linkages to cater for local traffic movements*'.

The function of this study is to outline the nature of measures which would address the need recognised by the NTA along the M11/N11 road corridor; and present an overall strategy in terms of delivery and implementation; while aligning with the objectives set out in SIFLT.

The section of the M11/N11 between the Junction 4 (M50) and Junction 8 (Kilmacanogue) is a strategic two lane dual carriageway, which has for the most part been in service since 1991, with limited interventions or upgrade since then south of Junction 5 (see Figure A overleaf for context). As such, some sections of this portion of the M11/N11 corridor fall short in terms of current road design standards. In addition, this section of the N11 is situated between two sections of recently upgraded high quality motorway, which tends to emphasise the issues along the subject section. These deficiencies impact on traffic flow conditions and result in significant congestion during the weekday morning and evening peaks and ineffective levels of service.

The M11/N11 is of strategic importance nationally and this is reflected in its inclusion within the Trans-European Transport Network (TEN-T) comprehensive road network. Therefore it is imperative that it begins to operate more efficiently.

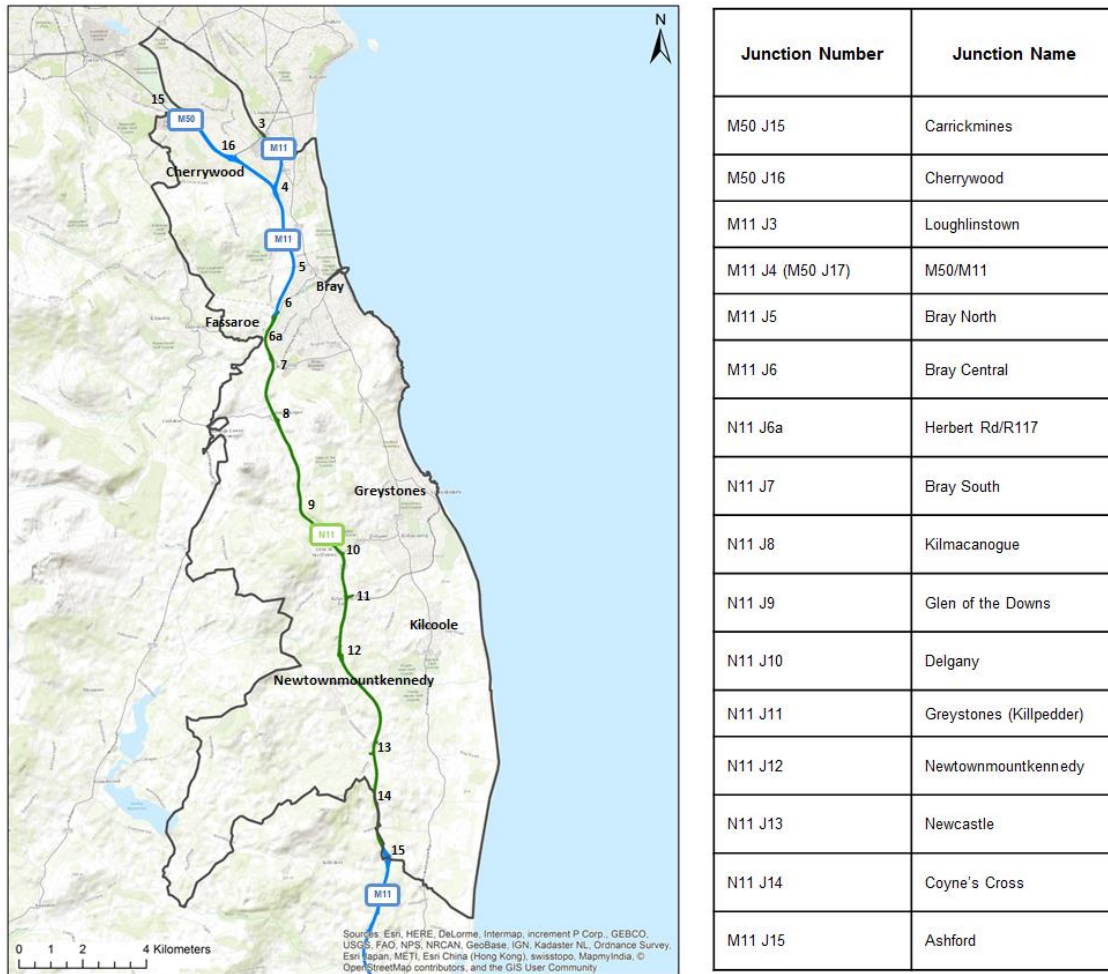


Figure A: M11/N11 Corridor Study Area

Study Objectives

In light of the above, the key objectives of the study are to:

1. Identify the improvements required to:
 - Bring the section of the corridor (M11/N11 mainline and junctions) up to the appropriate standard;
 - Develop the regional and local road network to support local access and complement the corridor strategy, including the closure of all direct accesses; and
 - Ensure the safe daily operation of the M11/N11 mainline and junctions in the event of the occurrence of incidents.
2. Identify a phased implementation of the improvements such that operational benefits on the corridor can be realised at an early stage without compromising the long term strategy.

Findings of the Study

This study has used the projections for employment and population contained within the TII National Transport Model (NTpM). These projections have been compared against those contained in the Wicklow County Development Plan and those used in development of the NTA *Transport Strategy for the Greater Dublin Area*. It is noted that in some cases TII projections are lower than those contained within the other documents. However for the purposes of identifying issues along the corridor they are considered acceptable.

This study has considered the needs and requirements of the National Road network along the N11 corridor between the M50 and Ashford. At present, road users are currently experiencing significant queuing and delay during the peak periods and various sections and junctions along the route are not in accordance with current design standards. This study has considered the impact of the range of complementary public transport and demand management measures along the corridor as outlined in the NTA *Transport Strategy* in determining the scale of road measures required. In developing the proposals of this study further consideration should be given to the interaction between the roads proposals and the complementary public transport and demand management measures to ensure that the measures are compatible.

The needs assessment of the M11/N11 corridor demonstrated the following:

- There is a shortfall in the existing capacity of the M11/N11 mainline corridor and capacity will need to be increased as far south as Junction 8 (Kilmacanogue) in order to cater for the current and projected traffic demands;
- There is no immediate need for additional mainline or junction capacity improvements on the N11 between Junction 8 (Kilmacanogue) and Junction 14 (Coynes Cross) based on current operation and the most current traffic growth projections. However, to bring this section of the corridor up to the required standard existing direct accesses and left on / left off junctions should be closed or reconfigured;
- The capacity/operation of the existing M11/N11 mainline junctions (6, 6a and 7) needs to be improved as there are existing issues at these locations which can manifest on the mainline; and
- Upgrades will need to be made to the regional/local road network to provide improved access between the existing M11/N11 mainline junctions and the regional/local road network. These will improve the connectivity to areas east and west of the M11/N11 corridor, as well as north and south of the Dargle River. These will strengthen provision for public transport and walking and cycling trips and also provide alternative route options for short trips and in the event of incidents occurring on the M11/N11.

Conclusions

Based on the needs assessment a number of measures were considered, modelled and assessed in order to identify a strategy for the M11/N11 corridor between Junctions 4 and 14. A phased implementation of the strategy was then considered which seeks to generate benefits for the M11/N11 corridor as early as possible and is structured around four key phases. The approach to phasing focused on sections of the strategy which do not require land acquisition now and could be implemented in the short term i.e. Phases 1 and 2. The phased implementation of the strategy shown below is one potential version of the strategy, some phases and indeed the proposals contained therein may be interchangeable with others:

Phase 1 – Construction of parallel one-way service roads north of Junction 8 (Kilmacanogue). These improvements do not require land acquisition and address the issues of direct access and can be implemented in the short term;

Phase 2 – Upgrading of the M11 to 3 lanes to Junction 6 (Bray Central) within the existing road reservation and upgrading of Junction 6 (increased capacity of existing roundabout and upgraded merges/diverges);

Phase 3 – Upgrade of the N11 to 3 lanes to Junction 8 (Kilmacanogue), service roads between Junction 6 and 7 inclusive of the closure of direct access at Junction 6a (east and west), major upgrade of Junction 7 (Bray South) and local link road improvements for network resilience; and

Phase 4 – Junction 8 (Kilmacanogue) to Junction 14 (Coynes Cross) direct access/junction improvements.

The assessment also recognised a need for an additional bridge across the River Dargle (link road between Upper Dargle Road and Herbert Link Road) providing further connectivity between the M11/N11 and Bray. The location for an additional bridge crossing of the River Dargle will require further

consideration. In addition to any benefit to the M11/N11 corridor, the location of the crossing will be influenced by the requirements of public transport, walking and cycling and local trips and the technical feasibility of crossing the river.

The proposals outlined above are indicative at this stage and, depending on availability of funds, will be subject to further detailed future investigations including engineering design and appraisal in order to determine their exact form.

The study demonstrates that investment in this section of the M11/N11 would address urban congestion and maximise the value of the existing M11/N11 corridor. Any further delay in investment in this section of the M11/N11 will lead to further increases in congestion along the corridor and indeed within the wider area; and will further constrain growth in the north and east of Wicklow and the Dún Laoghaire Rathdown area, as a result of reduced competitiveness and productivity.

M11/N11 Corridor Study
Needs Assessment Report

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Chapter 1 Introduction

1.1 Overview

This Needs Assessment Report has been commissioned by Transport Infrastructure Ireland in support of the M11/N11 Corridor Study. The Study was initiated to assess the needs of the M11/N11 National Road corridor between Junction 4 (M50/M11) and Junction 14 (Coyne's Cross) against the backdrop of the following policy documents:

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1.2 Context

TII is responsible for securing the provision of a safe and efficient network of National Roads in accordance with Section 17 of the Roads Act, 1993. The National Roads network in the vicinity of larger urban areas support high volumes of traffic engaging in local activities such as commuting, retail and other activities, they are nevertheless required to continue to support more strategic roles in parallel, such as access to ports, inter-urban trade, freight movement and logistics. In order to support such functionality, TII works with local authorities to develop co-ordinated plans for investment in road infrastructure which seek to protect the strategic function of the National Roads, whilst supporting population and employment growth in the areas served by them.

1.3 Overview of the M11/N11 Corridor

The M11/N11 corridor between Dublin and Wexford forms part of the Trans-European Transport Network (TEN-T). There are two designations in the TEN-T network; 'core' and 'comprehensive'. The comprehensive network feeds into the core network at a regional and national level. The aim of the TEN-T network is to contribute to enhancing internal markets, strengthening territorial, economic and social cohesion and reducing greenhouse gas emissions.

The M11/N11 corridor provides one of the primary north-south means of access to the south east of the country, in addition to providing access to international markets for freight and tourist traffic through Rosslare Euro-port.

Over the last two decades, there has been significant development in the towns served by the M11/N11 corridor, most notably in Bray, Greystones, southeast Wicklow and north Wexford. The corresponding improvement to public transport has been limited, with only minor enhancements of rail services, and the sporadic introduction of bus routes which have relied mostly on the response of private operators to a partially regulated market.

More recently, an examination of the TII Traffic Monitoring Units (TMU) between Junction 4 (M11/M50) and Junction 5 (Bray North) reveals a 3% growth in traffic volumes between 2014 and 2015 and between 2015 and 2016. This underlines the steady and consistent growth in traffic on the M11 in the period 2014 - 2016 and it is expected that such growth will continue as the economy continues to grow.

The M11 carries a high proportion of its daily traffic during the AM Peak Period. For example, the M11 between Junction 4 and Junction 5 carried approximately 16% of the daily traffic on the route during the AM peak period (07:00 – 09:00)⁴. By comparison, two other major commuter routes into Dublin, the N4 and N7 carried 14% and 15% respectively during the same period. The M11 however carries lower volumes of Heavy Goods Vehicles (HGV) with the daily proportion of HGVs on the M11 at Fassaroe standing at 2.8% in 2015. This compares to the M7 at Naas which stood at 7.9%⁴.

Figure 1.1 shows the full extents of the M11/N11 corridor.

From Junction 4 (M11/M50) to Junction 5 (Bray North) there is an existing three lane section of motorway with two lanes of motorway thereafter until the M11 becomes the N11 again at Junction 6 (Bray Central). From N11 Junction 6 (Bray Central) until N11 Junction 14 (Coyne's Cross) the road is a two lane dual carriageway. This section of dual carriageway is characterised by many local direct access points, at-grade junctions, reduced standard junction layouts and inadequate weaving lengths between merges and diverges. This is complicated further by the presence of minor junctions between the main junctions, in particular between Junctions 6 (Bray Central) and Junction 8 (Kilmacanogue), with the further addition of speed limit restrictions in the vicinity of Junction 8.

Beyond Junction 8 the distance between the main junction's increases and over this section there are nine local left on or left off junctions, twelve private / commercial accesses and a small number of field accesses. The proliferation of direct accesses is not compatible with a safe and operationally effective strategic road.

From Junction 14 (Coyne's Cross) to south of Gorey the road is a two-lane motorway standard. The proposed M11 south of Gorey to south of Enniscorthy at Oilgate is currently under construction, which extends the length of motorway by a further 26km.

⁴ Source: TII November 2015 TMU Data for: TMU No. M11 010.0N 01113 (M11 between M50/M11 and Bray North Junction, Bray); TMU N04 000.0W (N4 between Jn01 N4/M50 and Jn02 Liffey Valley, Liffey Valley, Co. Dublin); TMU N07 000.0W (N07 between Jn01a Newlands Cross and Jn02 Kingswood, Co. Dublin)

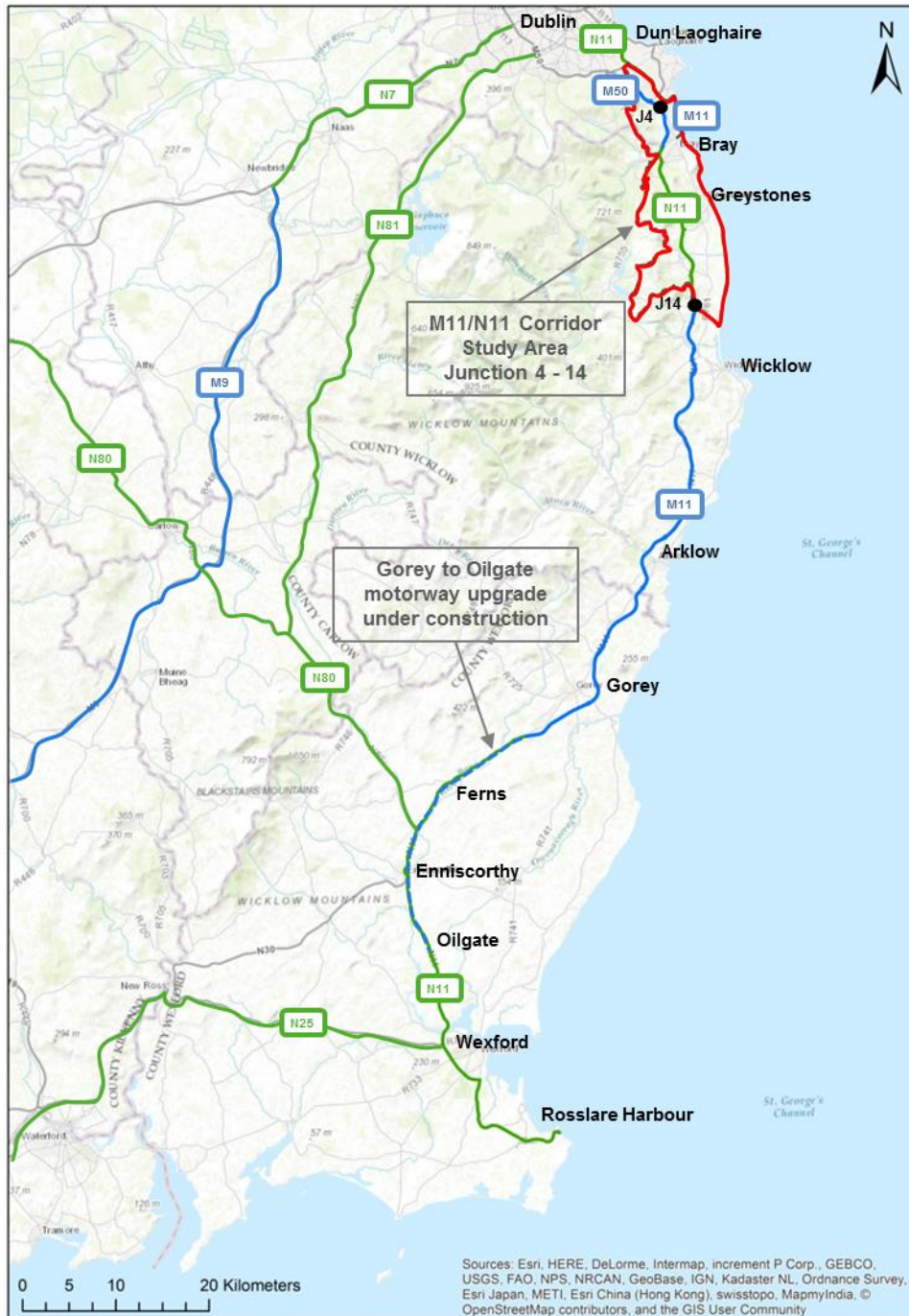


Figure 1.1: M11/N11 TEN-T Corridor

1.4 Study Area

The study area for the M11/N11 Corridor Study has been defined by the characteristics of the corridor and is illustrated in Figure 1.2. The section of the M11/N11 under consideration is approximately 22km in length and encompasses the following:

- M11 from Junction 4 (M50/M11) to Junction 6 (Bray Central); and
- N11 from Junction 6 (Bray Central) to Junction 14 (Coynes Cross).

To the east, the study area is physically constrained by the Irish Sea and to the west by the Wicklow Mountains. As a result there is no comparative north-south alternative to the M11/N11 corridor while east-west crossings are also limited. The study area lies within the functional areas of two local

authorities:

- Dún Laoghaire – Rathdown County Council (DLRCC); and
- Wicklow County Council (WCC).

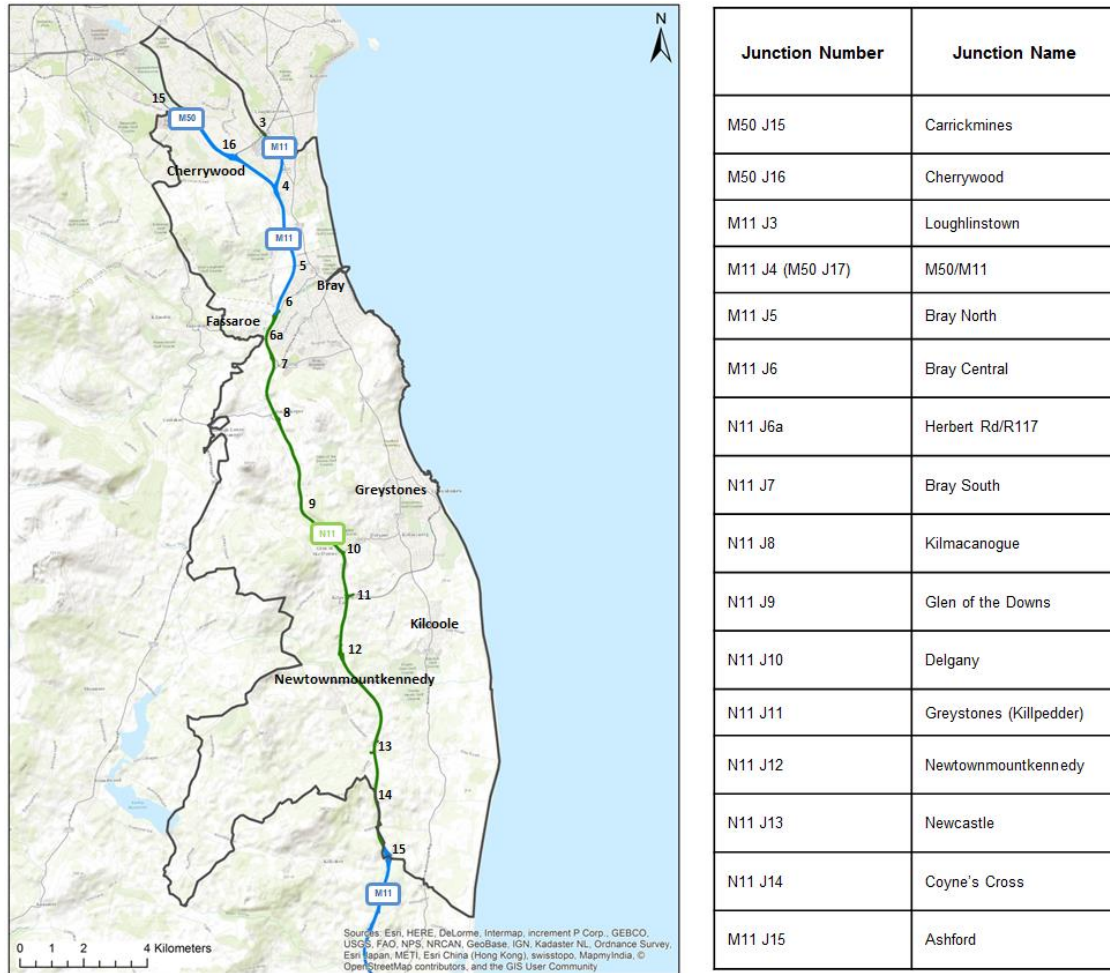


Figure 1.2: M11/N11 Corridor Study Area

Given the on-going issues during the PM periods, the section between the M50 and Junction 5 has been included as part of the needs assessment in order to assess its performance from an operational and capacity perspective.

The following touches briefly on the sequence of delivery of the various elements that make up the M11/N11 corridor between Junction 3 (Loughlinstown) and Junction 14 (Coyne's Cross) in a north to south direction:

- The section of the M11/N11 between Junction 3 (Loughlinstown) and Junction 6 (Fassaroe) was originally constructed in 1991 and was referred to as the Shankill-Bray Bypass. A portion of this was then further upgraded in 2005, between the M50 and Junction 5 (Bray North), as part of the Southeastern Motorway and presently has motorway status.
- The section between Junction 6 (Fassaroe) and Junction 8 (Kilmacanogue) was originally constructed in the 1970s, long before any contemporary design standards were available.
- The section to the south of Kilmacanogue, through the Glen of the Downs was opened in 2003.
- The Newtownmountkennedy Bypass further south was opened in 1990.

Therefore, it would appear that the N11 between Junction 6 (Fassaroe) and Junction 8 (Kilmacanogue) has for the most part been in service since 1991 (at a minimum). Limited interventions or upgrade has taken place on this section of the N11 since the early 1990s, aside from the construction of Junction 6

(Fassaroe) and Junction 7 (Killarney Road) grade separated interchanges and some minor works. The bulk of these infrastructural elements were opened prior to the formation of the National Roads Authority. As such this section of the M11/N11 corridor does not reflect the current design standards applied to other more recently constructed parts of the network. When first designed, it is unlikely that the projections used included such large volumes of traffic both on the mainline and using the junctions. As such, the designs cannot adequately cater for the current demands.

In addition to the points above, the subject section of the N11 between Junction 5 and Junction 14 is located between two sections of recently upgraded high quality motorway, which tends to emphasise the deficiencies of the subject section. These deficiencies impact on traffic flow conditions and result in significant congestion during the weekday morning and evening peaks and inefficient levels of service.

TII has collated traffic data along this stretch of the M11/N11 since 1998, which provides some context to the needs of the corridor. In that time, the AADT on the subject section of the M11/N11 has more than doubled. In 1998, the M11/N11 at Fassaroe was carrying 33,000 AADT, whereas in 2016 the AADT was recorded at approximately 69,000. A plot of the AADTs on the M11 at Fassaroe since 1998 is presented in Figure 1.3.

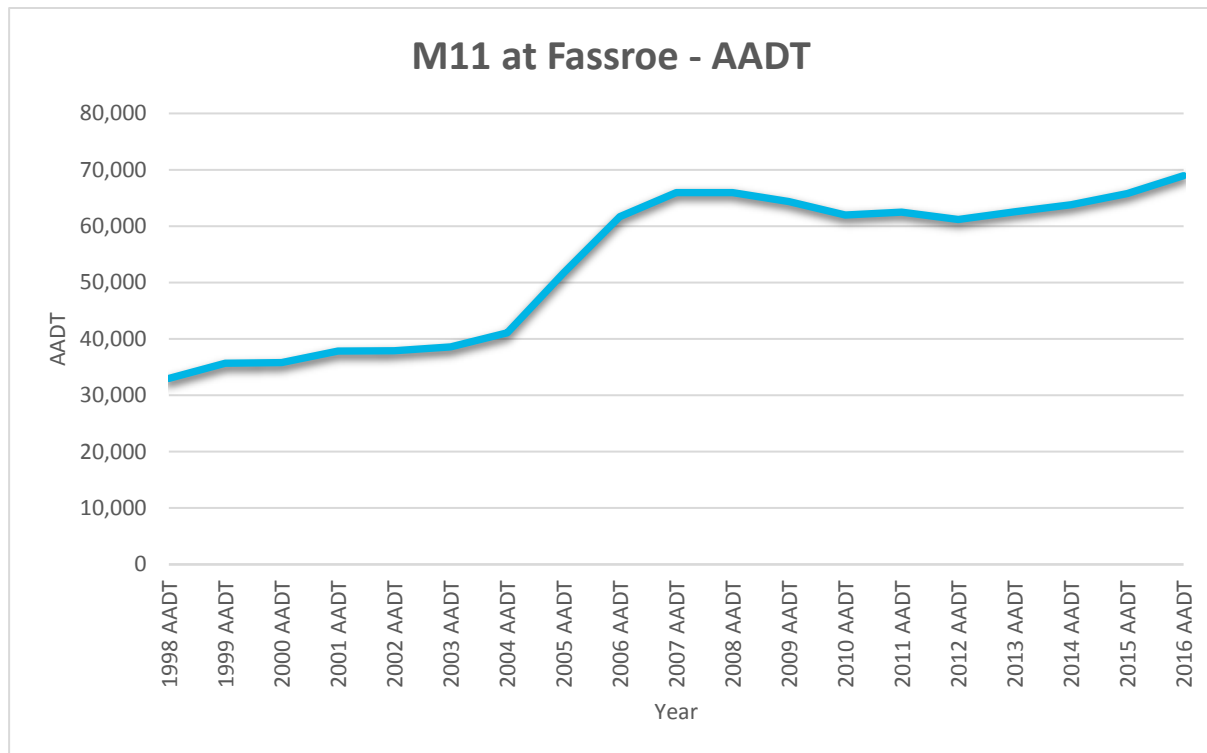


Figure 1.3: AADT at Fassaroe (1998 – 2016)

As shown above, the impact of the opening of the M50 Southeastern Motorway (Junction 13 to Junction 17) had a significant impact on the M11/N11 corridor. The result of the opening of this motorway appears to have manifested itself over time between 2005 and 2007. Despite this jump in demand, the road layout between Junction 5 and Junction 8 remained unchanged with little intervention to address the significant increases in use of the mainline and junctions. The impact of the economic downturn can also be seen in Figure 1.3; between 2008 and 2012 there was drop off in AADT volumes to the order of 7%. However, a return to growth in recent years has taken the AADT on the N11 above the previously recorded maximum.

Chapter 2 Study Objective and Policy

2.1 Overall Aim of Study / Study Objectives

This study seeks to achieve the following:

1. Identify the improvements required to:
 - Bring the section of the corridor (M11/N11 mainline and junctions) up to the appropriate standard;
 - Develop the regional and local road network to support local access and complement the corridor strategy, including the closure of all direct accesses; and
 - Ensure the safe daily operation of the M11/N11 mainline and junctions in the event of the occurrence of incidents.
2. Identify a phased implementation of the improvements such that operational benefits on the corridor can be realised at an early stage without compromising the long term strategy.

2.2 Policy Review

2.2.1 Trans-European Transport Network (TEN-T)

The M11/N11 corridor forms part of the TEN-T comprehensive network. The TEN-T networks are a set of road, rail, air and water transport networks in Europe. Regulation (EU) No 1315/2013 sets out the requirements for high quality roads that shall form part of the TEN-T road network, both Core (2030)⁵ and Comprehensive (2050)⁶, and states under Article 17(3), the following:

“High-quality roads shall be specially designed and built for motor traffic, and shall be 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 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.

In addition, Article 4 of the directive sets out the objectives of the TEN-T network including demonstrating European added value through (a) cohesion, (b) efficiency, (c) sustainability, and (d) increasing the benefits for its users. In particular, the following sub-articles are relevant to this study:

Cohesion through:

- (a) (iii) For both passenger and freight traffic, interconnection between transport infrastructure for,*

⁵ The TEN-T Core network is targeted for completion by 2030

⁶ The TEN-T Comprehensive network is targeted for completion by 2050

on the one hand, long-distance traffic and, on the other, regional and local traffic;

Efficiency through:

- (b) (i) the removal of bottlenecks and the bridging of missing links, both within transport infrastructures and at connecting points between these, within Member States' territories and between them;*
- (iv) the promotion of economically efficient, high-quality transport contributing to further economic growth and competitiveness;*

Increasing the benefits for users through:

- (d) (ii) Ensuring safe, secure and high-quality standards, for both passenger and freight transport.*

Article 10 of the directive sets out the general priorities in the development of the comprehensive network and in particular states:

In the development of the comprehensive network, general priority shall be given to measures that are necessary for:

- (b) ensuring optimal integration of the transport modes and interoperability within transport modes;*
- (c) Bridging missing links and removing bottlenecks, particularly in cross-border sections;*
- (d) Promoting the efficient and sustainable use of the infrastructure and, where necessary, increasing capacity.*

2.2.2 Strategic Investment Framework for Land Transport

In 2015 the Department of Transport, Tourism and Sport (DTTas) published 'Investing in our Transport Future - Strategic Investment Framework for Land Transport (SIFLT)'. The document recognises that an effective transport network is central to the functioning of society and the economy. This framework provides a number of principles and priorities as criteria against which land based transport programmes will be drawn up and assessed. Rather than setting out a list of projects to be prioritised, SIFLT forms a filter for transport investment projects prior to their appraisal for suitability for inclusion in national/regional programmes. These priorities include:

- Priority 1: Achieve Steady State Maintenance;
- Priority 2: Address Urban Congestion;
- Priority 3: Maximise the Value of Existing Land Transport Networks.

As mentioned previously, the subject section of the M11/N11 between the Junction 4 (M50) and Junction 14 is a strategic two lane dual carriageway; some sections of which has been in service since the early 1990's (at a minimum in cases). South of Junction 5 there has been limited interventions to take these sections to a current design standard. Furthermore, the subject section of the M11/N11 is nestled between two sections of high quality motorway (following recent upgrade) which tends to emphasise its issues. These issues impact on traffic flow conditions and result in significant congestion during the weekday morning and evening peaks, leading to significant queuing which can extend into urban areas. The subject section of the M11/N11 corridor is performing inefficiently and provides poor levels of service during peak periods.

In that sense, investment in the subject section of the M11/N11 corridor is supported by a number of the priorities set out within SIFLT, in that: upgrade would likely address some urban congestion. Furthermore, the third priority of the SIFLT is particularly relevant in the context of proposals to upgrade the M11/N11. The underlying principles of this priority are that any further investment should be targeted to maximise the contribution of the land transport networks by enhancing the efficiency of the existing network, particularly:

- Through increased use of ITS applications;

- Through investments that improve connections to key seaports and airports or support other identified national and regional spatial planning priorities;
- In the case of roads, investment should provide access to poorly served regions, access for large-scale employment proposals, complete missing links or address critical safety issues.

In the context of the M11/N11 corridor investment would ensure access to large scale employment proposals such as the future developments envisaged for Fassaroe and Cherrywood, removal of local accesses along the corridor thereby improving safety and completion of the corridor to a standard consistent with its northern and southern most sections (the M11).

2.2.3 Infrastructure and Capital Investment 2016-2021

The national capital plan '*Building on Recovery: Infrastructure and Capital Investment 2016-2021*' published by the Department of Public Expenditure and Reform (DPER) in September 2015 sets out a framework for transport infrastructure investment over a seven year period. It identifies the need for further development of the road, rail and public transport networks and sets out transport implementation priorities for the period of the plan. Under Roads Programmes this document mentions three major projects which will be delivered one of which is the M11 (Gorey to Enniscorthy) which forms part of the M11/N11 TEN-T corridor.

2.2.4 National Transport Authority Transport Strategy for the Greater Dublin Area 2016 -2035

In April 2016 the NTA adopted its "Transport Strategy for the Greater Dublin Area 2016 – 2035". This provides a planning framework for the delivery of transport infrastructure and services across the GDA, based on the principles of effective, efficient and sustainable travel. The Strategy outlines a suite of transportation objectives for the GDA including the provision of additional public transport (heavy rail, light rail, bus and bus rapid transit facilities), cycling and walking infrastructure and road network measures up to 2035.

The NTA Strategy considers the study area as part of South East Corridor F which encompasses; Arklow, Wicklow, Greystones, Bray, Cherrywood, Dundrum, Dún Laoghaire and Dublin City Centre. The strategy outlines that within this corridor, car mode share for all trip purposes is 70% with public transport representing 11% of trips. The NTA Strategy further notes that there are significant capacity constraints along the corridor which affect expansion of the radial road network while congestion on the N11/M11 route is increasing and travel demand is expected to increase by 28%. Stating that:

'Capacity on this route will need to be protected through appropriate demand management, in order to safeguard its strategic function. As such, the Strategy will seek to achieve an appropriate balance with the competing demands of strategic movement of high economic value and more locally based commuter traffic.'

The NTA Strategy also aims to identify public transport options that could effectively meet the growth in travel demand along this corridor, proposing the following for this study area:

- Increased capacity for the South Eastern rail line through enhancements to the existing rail line, incorporating city centre resignalling and extra rolling stock while DART Underground will also enable increases in capacity along this corridor. This will facilitate faster and more frequent intercity, regional and DART services to be provided on this line. The NTA strategy also notes the potential to increase line capacity on the DART north of Bray and the scope for enhanced bus services along the entire corridor.
- Upgrade of the Luas Green Line to Metro standard from the city centre, where it will link into the new Metro North, as far as its current terminus at Bride's Glen. From this point to Bray, a new Luas line is proposed. This will provide a north-south inland rail axis from Swords to Bray.

- Bus Rapid Transit (BRT) on the N11 from UCD to Blanchardstown.
- Core Radial Bus Corridor travelling from Bray/N11 through UCD to Donnybrook, linking with the proposed Orbital Bus Network route passing through Dún Laoghaire, Dundrum, UCD and Tallaght.
- Core Regional Bus Network routes along the M11/N11 corridor, serving Wexford, Wicklow and Arklow.
- Development of strategic rail-based park and ride facilities at points where rail services intersect with the national road network, listing proposed sites at Greystones and Woodbrook.

Alongside these public transport measures, the NTA Strategy also sets out various road schemes and upgrade proposals considered necessary in the south east study area. In relation to National Roads the Strategy sets out the following proposals:

- Widening of the M50 to three lanes in each direction between Junction 14 (Sandyford) and Junction 17 (M11) plus related junction and other changes.
- Capacity enhancement and reconfiguration of the M11/N11 from Junction 4 (M50) to Junction 14 (Ashford) inclusive of ancillary and associated roads schemes, to provide additional lanes and upgraded junctions, plus service roads and linkages to cater for local traffic movements.

The NTA Strategy also sets out demand management measures for a number of road corridors within the Greater Dublin Area including the N11, as follows:

- Demand management measures on radial routes such as the M11 to safeguard sufficient capacity to ensure they retain their strategic function for travel and freight movements.

2.2.5 Wicklow County Development Plan 2016 - 2022⁹

The County Development Plan (CDP) for Wicklow County contains a number of objectives to support development of the N11/M11 corridor over the coming years. Within the CDP, Wicklow County Council have set population targets for 2031 of 185,000 inhabitants, an increase of approximately 35% on the 2011 population recorded within the Census. Furthermore, the CDP sets a target job ratio of 65% of the labour force by 2028. This results in a target of 55,300 jobs within the Council jurisdiction which represents almost 100% increase upon the current job provision within the County.

These objectives include supporting a number of upgrading works to address the existing growth in population and employment within the County. WCC support objectives to upgrade the N11 to motorway status and the upgrading of substandard junctions, particularly to improve junction safety, and to improve the merging of the M11 with the M50. These objectives of WCC are in accordance with Policies TR17 to TR24 in relation to National Roads and have been considered as part of this study.

2.2.6 Dún Laoghaire-Rathdown County Development Plan 2016 – 2022¹⁰

The Dún Laoghaire-Rathdown County Development Plan sets out the framework for the future development of the area. The CDP sets population targets for 2022 of 240,300 based on the Regional Planning Guidelines, an increase of approximately of 24% on the 2006 population recorded within the Census. Furthermore, the CDP also sets a target for jobs within the Council jurisdiction of 36,700 jobs

⁹ Wicklow County Development Plan 2016 – 2022 (Chapter 9 – Infrastructure), Wicklow County Council (November 2015)
<http://www.wicklow.ie/sites/default/files/Chapter%209%20-%20Infrastructure.pdf>

¹⁰ Dún Laoghaire-Rathdown County Development Plan 2016 – 2022 (Section 2 – Sustainable Communities Strategy), Dún Laoghaire-Rathdown County Council (March 2016)
http://www.dlrccoco.ie/sites/default/files/atoms/files/cdp2016_section2.pdf

by 2022.

The CDP also contains a number of road objectives within Policy ST25: Roads. There are two objectives which support improvement to the N11/M11 corridor:

- Upgrade of the N11 to motorway status as far as Fassaroe; and
- Junction 3 at Loughlinstown Roundabout to be upgraded to a grade separated junction in the longer term.

2.3 Previous Studies

A number of previous studies have been carried out in the last ten years which are relevant to this study. These are listed in Table 2.1. The work undertaken, along with the findings and recommendations, has been taken into consideration in the current study.

Table 2.1: Summary of Previous Studies

Study	Description
M11/N11 Merging Study (AECOM-ROD for TII, 2010)	Traffic study of southbound flow breakdown in the peak period using micro-simulation model from Junction 4 to Junction 8. A number of contributory causes identified including issues at sub-standard junctions along the M11/N11 corridor.
N11 Corridor Review Fassaroe to Kilmacanogue (AECOM-ROD for TII, 2010)	Complementary study of potential engineering measures for the section between Junction 6 and Junction 8 to help ease flow breakdown. Preliminary design completed of parallel service roads.
M11/N11 Traffic Management Measures Wilford Interchange Improvements (AECOM-ROD for NRA, 2010) – Part VIII Application by DLRCC	Design of merge improvements and ramp metering of Junction 5 (Bray North). Design submitted for Part VIII planning and approved by DLRCC.
M11/N11 Traffic Management Measures Killarney Road & Fassaroe Interchange Improvements (AECOM-ROD for TII, 2010) – Part VIII Application by WCC	Design of diverge and merge improvements and ramp metering of Junction 6 (Bray Central). Design completed for replacement of eastern roundabout at Junction 7 (Bray South) with conventional four arm traffic signals, signalisation of western roundabout and queue detectors on both southbound and northbound diverges. Design submitted for Part VIII planning by WCC but opposed by Bray TC. Part VIII approval not granted by WCC.
N11 Kilcrouney Interchange Traffic Management Improvement Options Report (AECOM-ROD for TII, 2010)	Study and report describing the options considered that led to the Part VIII proposals at Junction 7 (Bray South).
M50/M11/N11 Corridor Study (AECOM-ROD for TII, 2012)	Corridor study from M50 Junction 14 (Sandyford) to Junction 8 (Kilmacanogue). Modelling developed to include build out of 100% of all zoned lands in DLRCC and WCC along the corridor. Ambitious car mode share of 45% assumed for all new development. Even with this the traffic modelling identified the need for a large number of road proposals and junction upgrades to cater for the additional traffic generated across the whole network.

Study	Description
Assessment of N11 Corridor (Atkins for Bray Town Council, 2013)	Study of potential engineering measures on the M11/N11, including junction upgrades. Preliminary design completed, including alternative designs for parallel service roads and signalisation of the eastern roundabout at Junction 7 (Bray South).
N11/M11 Kilmacanogue to M50 Merge: Wilford to Kilmacanogue Technical Assessment of Work to Date (Tramore House RDO for TII, 2014)	Review of previous studies listed above and summary report of the various findings.
Transport Strategy for the Greater Dublin Area 2016-2035: South East Corridor Study Report (Jacobs-Systra for NTA, 2015)	Study to examine the future transport needs, including the strategic road network and public transport provision, of the south east GDA corridor (from city canal cordon to Greystones, including Sandyford area). Measures identified to cater for existing public transport use, demand growth to Dublin city centre and existing car based demand.

Chapter 3 Existing Situation

3.1 Overview

This section of the report provides a description of the existing situation of the M11/N11 corridor in relation to the demand for travel. Population and employment data from the 2011 CSO Census is presented alongside traffic flow data. The traffic flow data has been extracted from TII permanent Traffic Monitoring Units (TMU's) in the Study Area; and from the 2015 base year M11/N11 traffic model developed as part of this study. Details of the development of the traffic model can be found in Appendix A (Traffic Modelling Report).

3.1.1 Population & Employment (2011 Census Data)

In order to understand the demand for travel on the road network, a review of the population densities and employment levels in the study area was undertaken. Figure 3.1 shows a plot of population densities taken from the 2011 CSO Census at small area level.

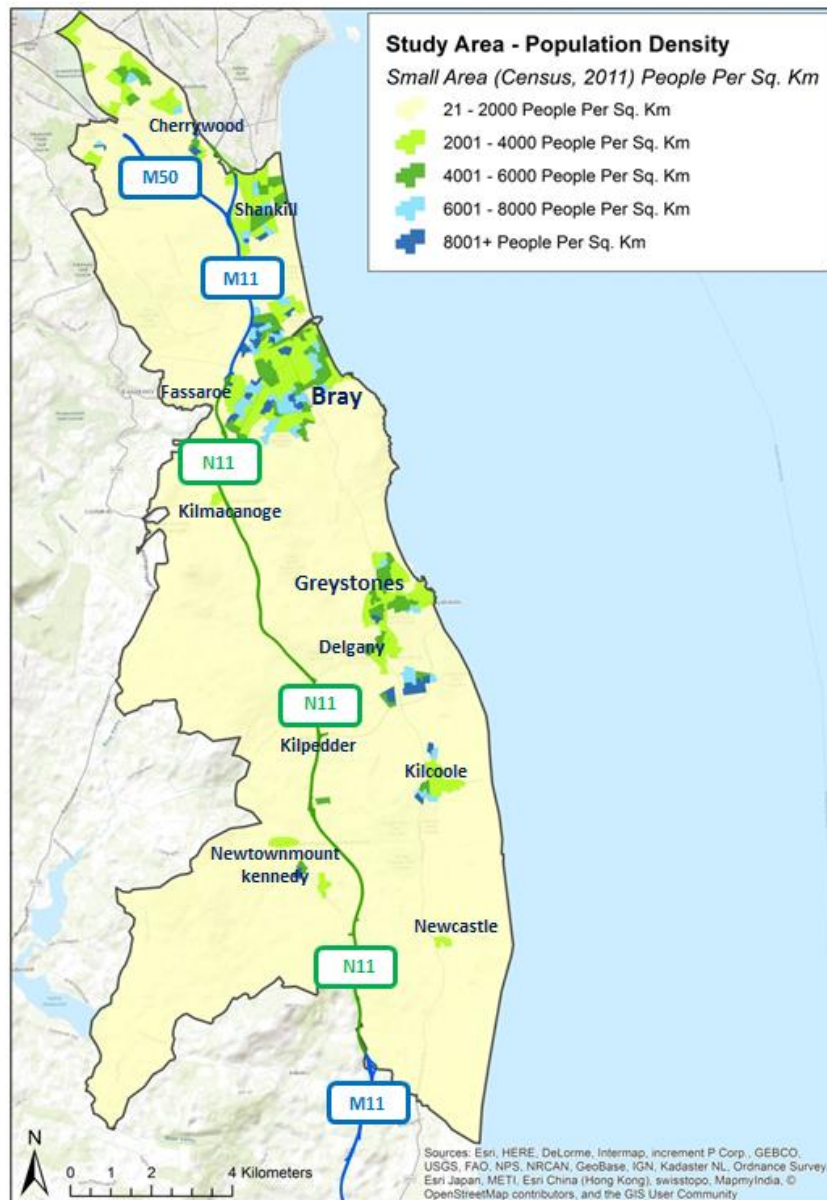


Figure 3.1: Population Densities in the Study Area from 2011 Census

The population density map highlights the main urban areas in the study area, most notably the areas in south Dublin (Shankill/Loughlinstown), Bray and Greystones/Delgany. Smaller urban areas such as Kilpedder, Kilcoole, Newtownmountkennedy and Newcastle are also noted. The 2011 Census showed a population of 84,485 persons. Over 60% of the population of County Wicklow live within study area indicated in Figure 3.1.

The plot emphasises the proximity of these main population areas to the M11/N11 corridor. Thus, a significant portion of traffic demand on these sections of the M11/N11 is associated with trips between these areas and destinations either in Dublin city centre or in other areas such as accessed via the M50 and Dublin city centre.

The M11/N11 Corridor Study Area is characterised by a relatively high residential population north of Junction 10 (Delgany) with smaller towns and villages to the south surrounded by mainly agricultural uses.

A similar plot of the employment density in each CSO small area in the study area, taken from the 2011 Census is presented in Figure 3.2. Employment density records the number of jobs present in each small area relative to the size of the small area. As CSO small area boundaries are developed according to the number of households within them (50-200 units), larger small areas outside towns would be recorded as significant employment centres if geographic size was not accounted for.

The 2011 Census showed 20,093 jobs and 35,001 employed persons living within the study area. Bray town and environs have the highest densities of employment in the study area including town centre retail, jobs in the film industry, pharmaceutical, IT, and cosmetic industries located mostly on the southern periphery of the town. These high tech businesses employ a large number of graduates and professional staff.

As set out in the Wicklow County Development Plan (2016-2022), further expansion of the town is severely constrained on all sides by the administrative boundary of Dún Laoghaire - Rathdown and the coast to the north and east, Bray Head/Sugarloaf Mountain to the south and the M11/N11 to the west. Bray forms part of the Bray/Cherrywood/Greystones Core Economic Area. Analysis of the TII National Transport Model (NTpM) identifies strong desire lines between Bray and Dublin indicating that a significant number of the town's residents commute to Dublin for employment. This is also referred to in 'Chapter 3: Settlement Strategy' of the Wicklow County Development Plan (2016-2022).

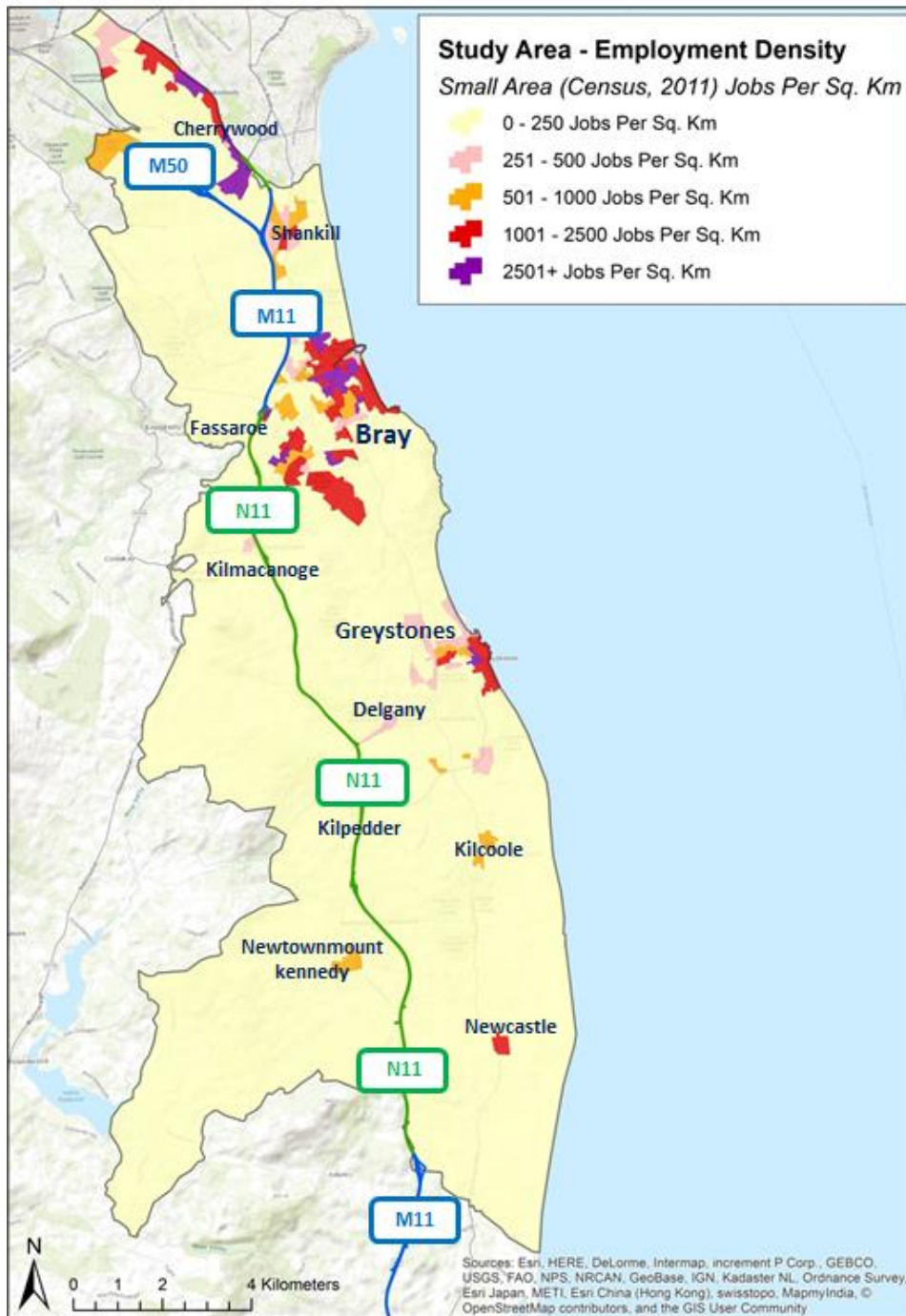


Figure 3.2: Employment (Number of Jobs) Density in the Study Area from the 2011 Census¹³

The situation in Bray with limited local employment opportunities is replicated throughout the study area with far fewer job opportunities present in the region than residents. Figure 3.3 shows a ratio of the number of jobs per person in the study area at CSO small area level, based on the 2011 Census. This data indicates that the potential for jobs in close proximity to residences is limited and that many residents will have to leave the study area to pursue work in larger urban centres in Dublin or those accessed via the M50.

¹³ Employment density is a representative figure for the number of jobs which would be present in a small area they were each one square kilometre in size. Most urban small areas are smaller and this creates values which may appear disproportionately large. For example, in Newcastle there are 198 jobs within a 0.152 square kilometre small area and so the map records 1,306 jobs per square kilometre. There are not 1,306 jobs in this location, but the representative value highlights that it is an urban centre compared to the rural surrounds.

In the case of Kilcoole, low population densities have created a situation where the number of jobs in the local area is proportionally larger than the number of residents located in the CSO small area e.g. 568 jobs for the 310 people located within a 4.6 square kilometre region.

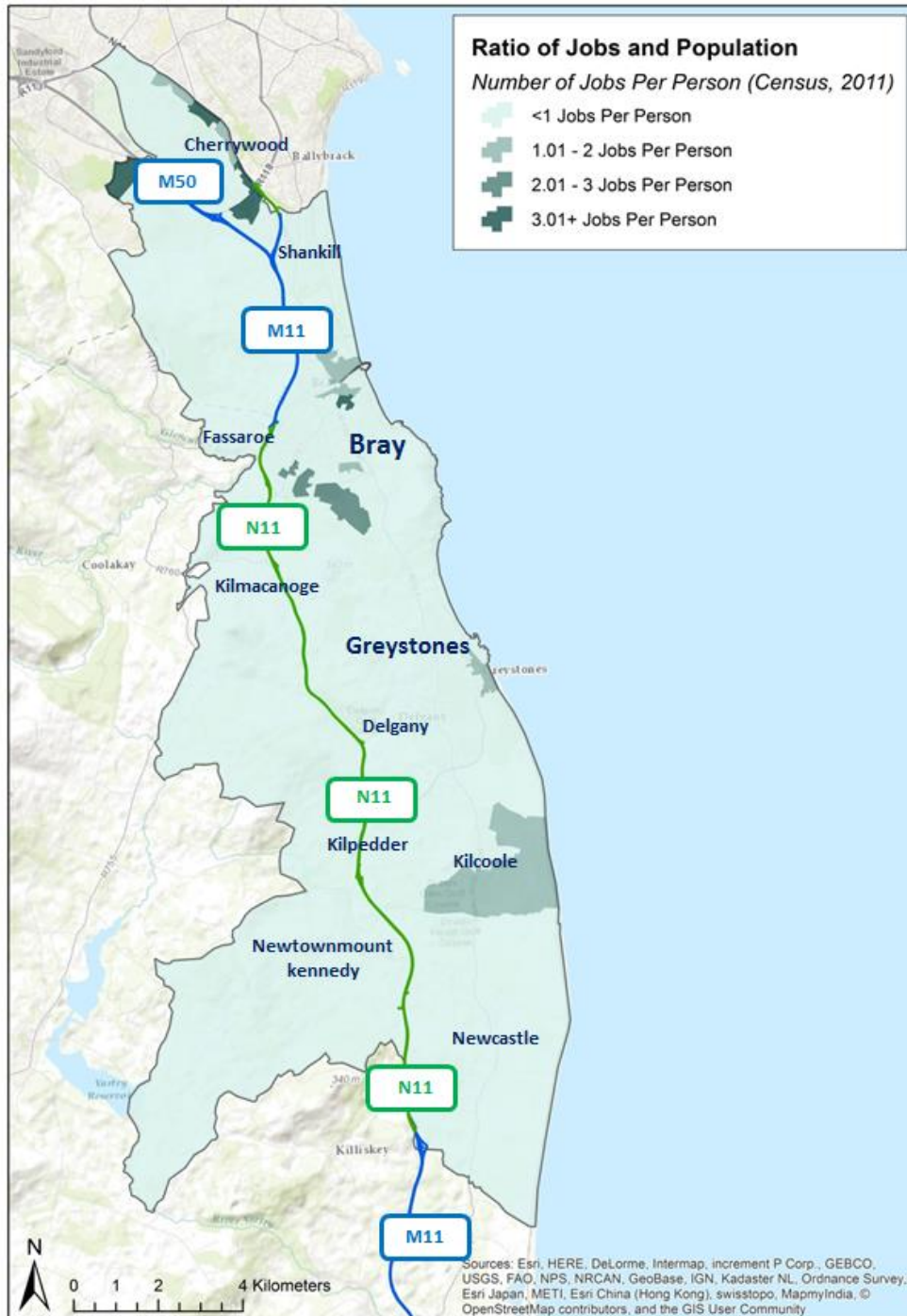


Figure 3.3: Ratio of Jobs and Population

3.2 Strategic Travel Patterns

Strategic travel patterns were assessed using the 2015 base year M11/N11 traffic model and are presented in Figure 3.4.

The desire line graphic below is a schematic plot of traffic volumes between key areas of the network in the AM peak period including the M11/N11 and M50 corridors, the area south of Dún Laoghaire to the

North, and the main urban areas of Bray and Greystones.

The desire lines emanating from each of the key locations represent the cumulative traffic volumes to and from each of the other key locations in the Study Area. For example, the desire lines emanating from the N11 South location show the cumulative volume of traffic between that location and other key locations. It can be seen that there is a significant volume of trips between Bray and the M50 North and the area south of Dún Laoghaire to the M50 North. Outbound trips to Bray from the M50 North location are also reasonably high underlining its importance as an urban area with employment and also as a commuter town for Dublin.

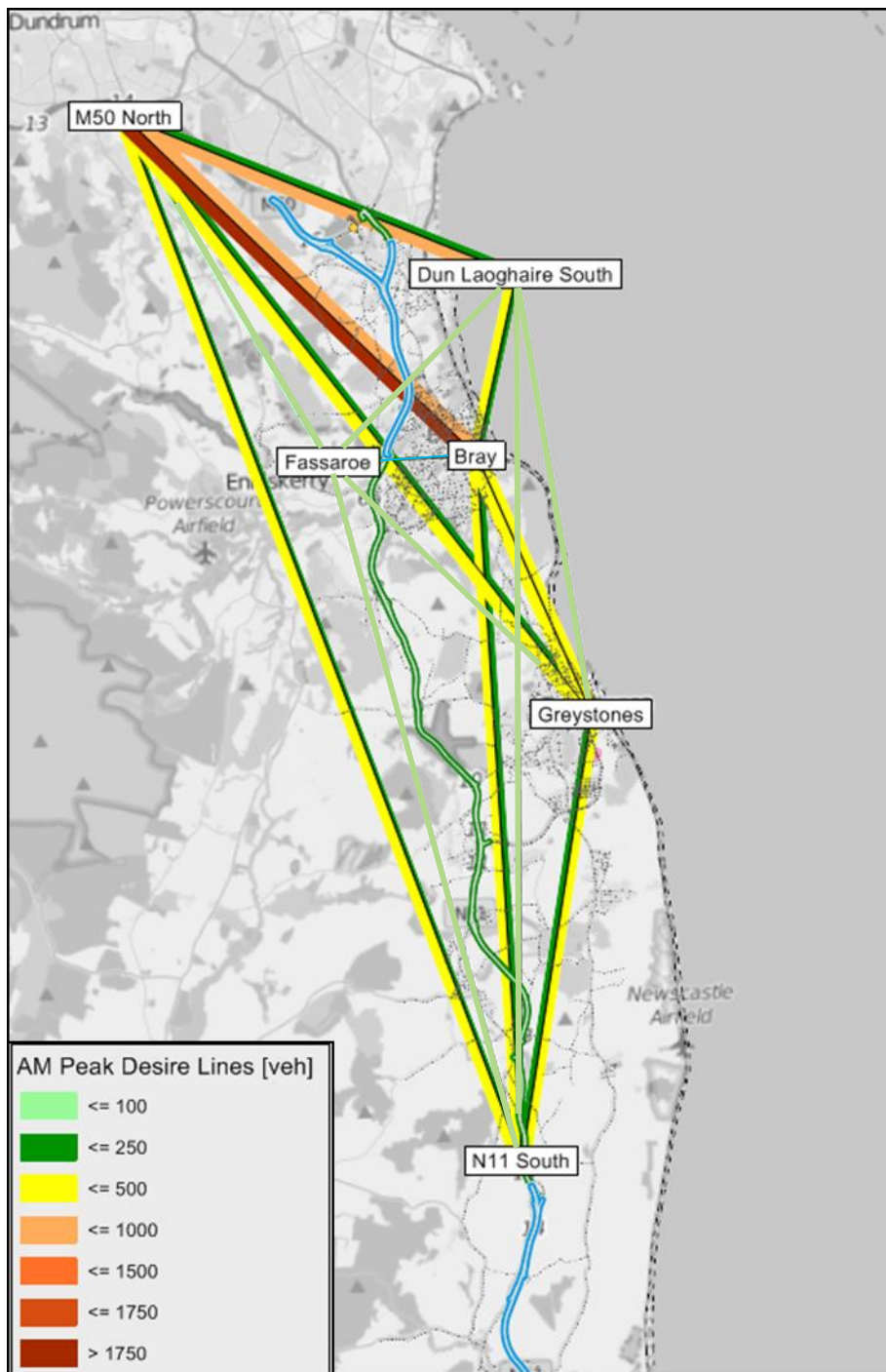


Figure 3.4: AM Peak strategic desire lines in the Study Area (units: vehicles)
- Source: 2015 M11/N11 Local Area Model

3.3 Traffic Growth on the National Road Network

In order to ascertain the pattern of traffic growth on the National Road network a review of TII's Traffic Indices was undertaken and is summarised in Table 3.1.¹⁴

Table 3.1: Traffic Growth on the National Road Network 2013 to 2016

Road Network	Year on Year Growth % (Quarter 3)		
	2013 - 2014	2014 - 2015	2015 - 2016
National Roads	4.1	4.3	3.9
M50	6.0	6.2	4.5
Dublin National Road Radials	4.7	5.5	3.8

The Traffic Indices show that, in general, traffic growth on the National Road network has followed a steady upwards trajectory since 2013. The growth on the Dublin National Road radials and the M50 has followed a similar trajectory but with more extensive growth in traffic noted, particularly on the M50. The M11/N11 corridor is no different with a growth 3% between 2014 and 2015 and between 2015 and 2016. The trajectory observed is plotted in Figure 3.5 below.

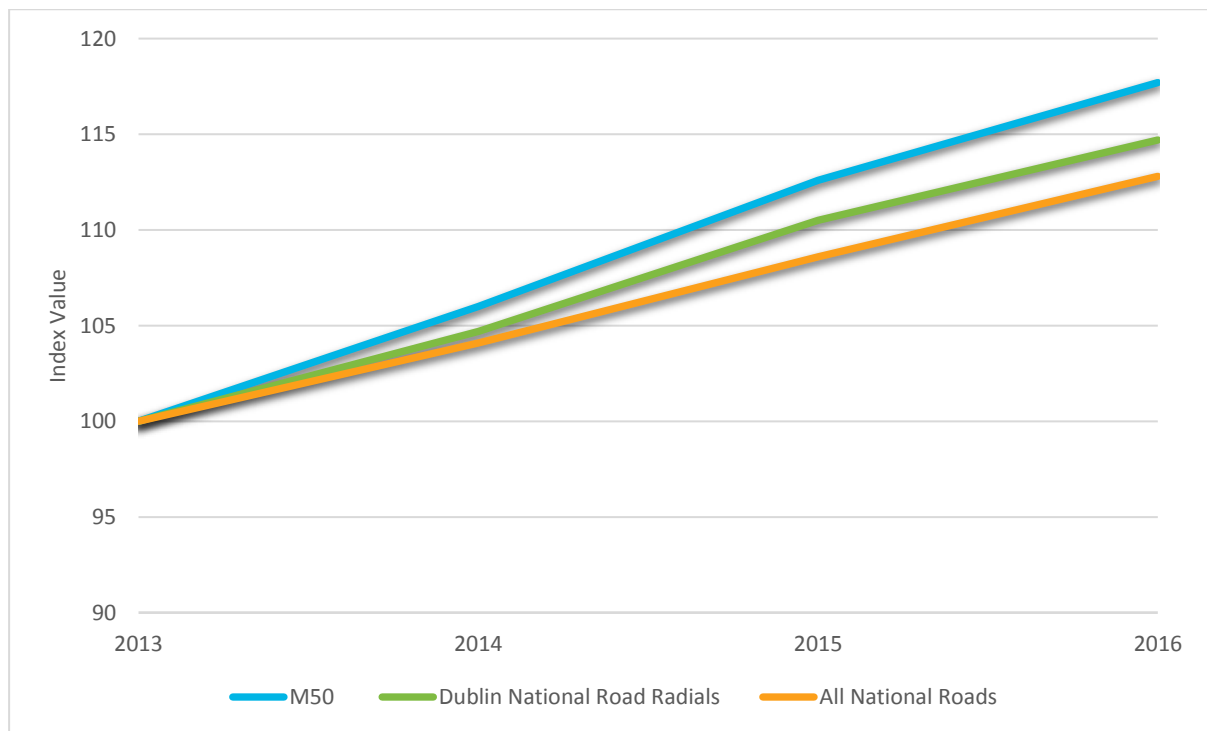


Figure 3.5 – Quarter 3 Traffic Growth - All National Roads, Dublin Radials and M50 Indices: All Vehicles

Source: TII Traffic Indices, 2013-2016

¹⁴ Data summarised within the TII National Road Indicators Reports downloadable at: <http://www.tii.ie/tii-library/strategic-planning/>

3.4 Traffic Volumes on National Roads in the M11/N11 Corridor Study Area

Annual Average Daily Traffic (AADT) flow volumes from the TII Traffic Monitoring Units located on the M11/N11 corridor within the study area are presented in Figure 3.6.

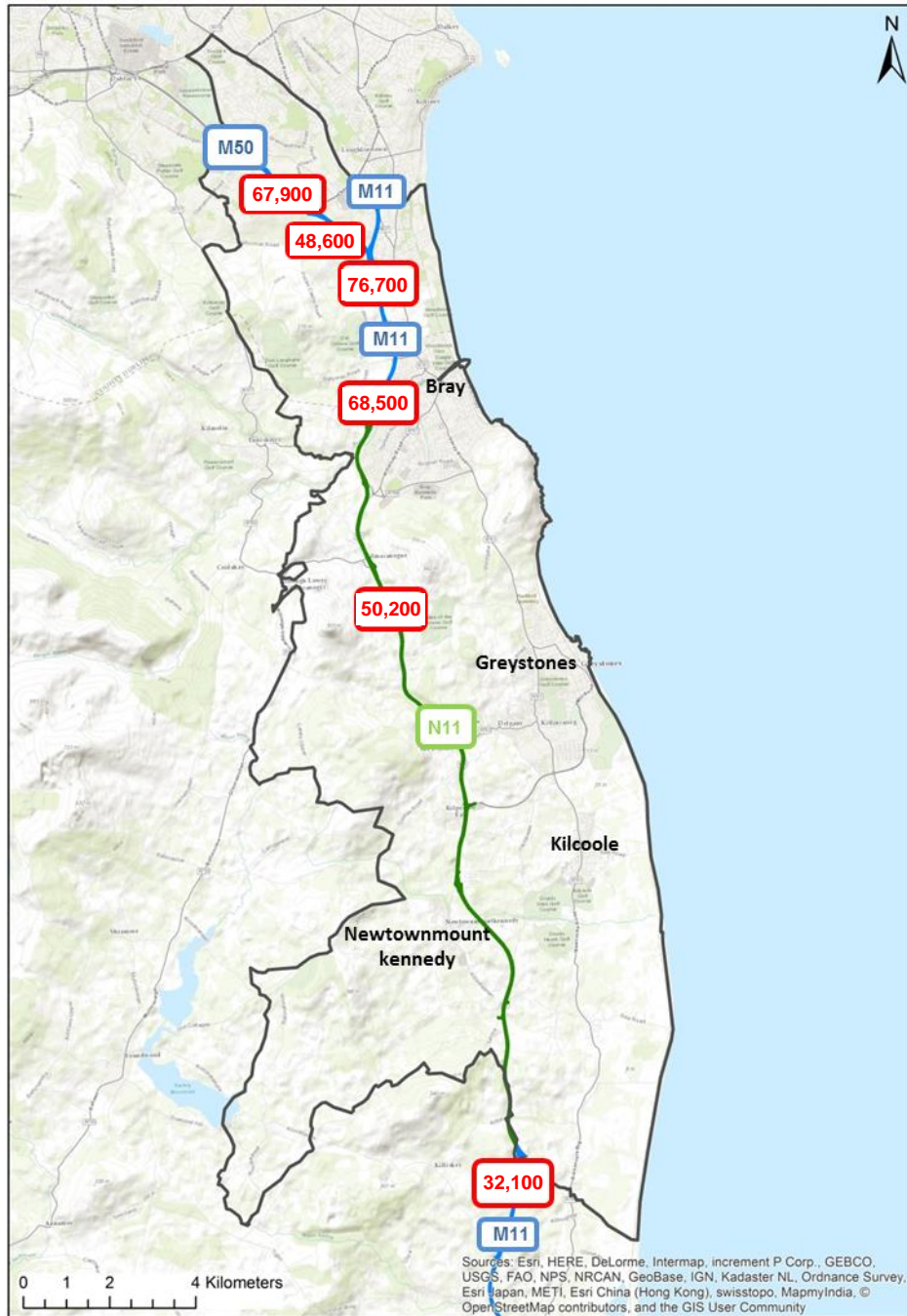


Figure 3.6: Annual Average Traffic Volumes (AADT) on National Road Network 2016

- Source: TII, TMU Data 2016

In order to obtain a clearer picture of the traffic flow profile on the busiest sections of the M11/N11 national route and the associated impacts on levels of service, an examination of weekday hourly traffic volumes per 5 minute interval alongside mean spot speeds (also recorded by the TMU) was undertaken. The results are presented in Figures 3.7 and 3.8 below for the southbound and northbound directions respectively.

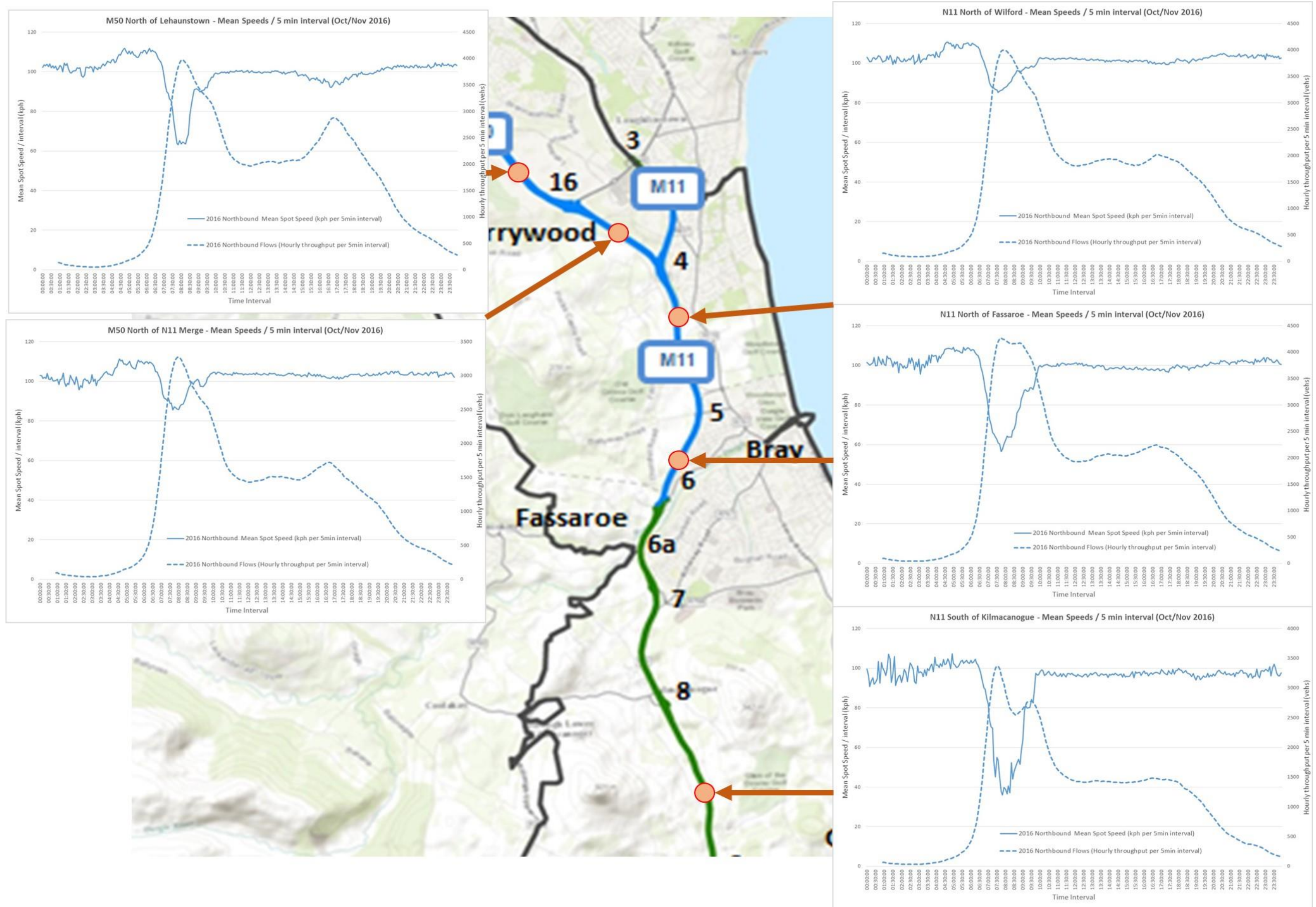


Figure 3.7: Weekday Profile of Northbound Traffic Volumes & Mean Spot Speeds M11/N11 (Source: TII, TMU Data 2016)

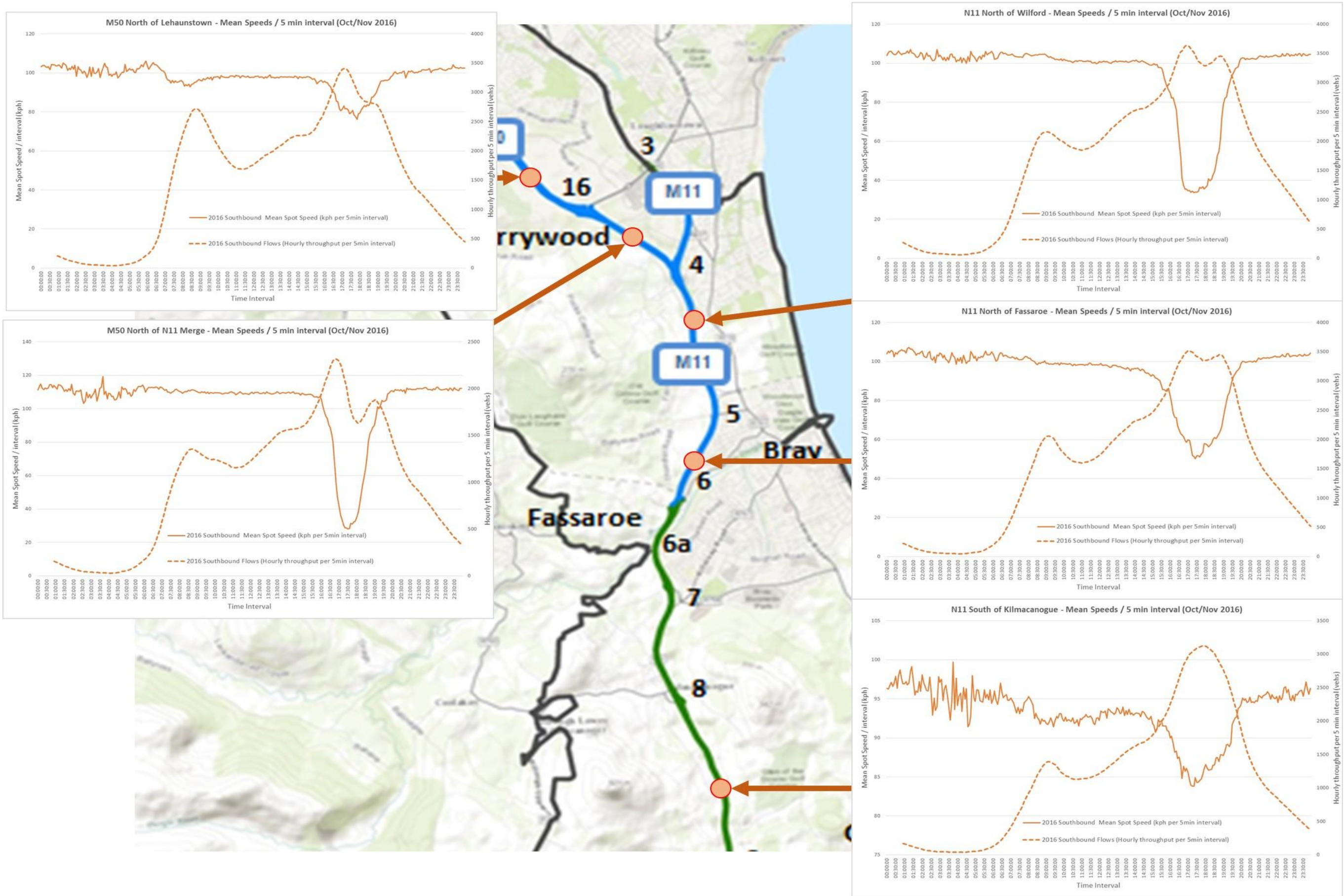


Figure 3.8: Weekday Profile of Southbound Traffic Volumes & Mean Spot Speeds M11/N11 (Source: TII, TMU Data 2016)

3.4.1 Northbound Flow Profiles & Conditions

As shown in the plots in Figure 3.7, the peak northbound movements occur during the AM period.

Commencing at the TMU in the vicinity of Kilmacanogue, flow breakdown¹⁵ is evident during the AM period. Northbound throughput, albeit somewhat suppressed, is to the order of 3,500 vehicles northbound during the AM peak hour. The combination of: high traffic volumes, direct accesses, the speed limit restriction further north in Kilmacanogue, and the high volumes of northbound merging/diverging activity in the vicinity of Junction 7, results in a significant reduction in Level of Service at this point with the spot speeds reducing to approximately 40kph during the AM period.

Once traffic passes Junction 7, the mean spot speeds (measured at 5 minute intervals) increases in the area of Fassaroe to around 60kph. Although this represents an improvement on the Level of Service compared to further south, the low spot speeds at this location is likely a function of the high traffic volumes, to the order of 4,200 vehicles northbound during the AM peak. This may also indicate a mainline capacity issue along this section.

The mean spot speeds stabilise north of Junction 5 (where a section of 3 lane motorway commences). This section is recorded as carrying in excess of 4,000 vehicles northbound during the AM peak.

The above demonstrates the extent of the impacts of the various issues during the AM peak which are present in the road network to the south of Junction 5 and north of Junction 9.

3.4.2 Southbound Flow Profiles & Conditions

As shown in Figure 3.8, the peak southbound movements occur during the PM period.

Commencing at the TMU in the vicinity of Kilmacanogue and working northwards, it is shown that the volume of traffic, approximately 3,200 vehicles southbound during the PM peak, has a modest impact on the spot speeds which drop to 85kph. Generally, conditions are relatively stable at this point (south of Kilmacanogue), traffic having navigated through the speed restriction within the village of Kilmacanogue.

Further north at Junction 6, some flow breakdown is evident and spot speeds drop to approximately 50kph. Although flows are clearly suppressed, throughput is to the order of 3,500 vehicles southbound in the PM peak. Clearly issues, including: mainline capacity; weaving conditions; direct accesses; and sub-standard junction arrangements (Junction 7), are key factors in the congestion and delay experienced at this point of the network.

Flow breakdown exacerbates further north of Junction 6 as the arrival rate, from the M50 for instance, is greater than the discharge rate of the N11 mainline at this point. This 'knock-on' or 'shock wave' effect can be seen in the TMU north of Junction 5 where the mean spot speeds drop rapidly to approximately 35kph during the PM peak. Throughput at this point is also suppressed at 3,500 vehicles southbound in the peak. This in turn has a similar impact on the operation of the M50/M11 merge further north. As shown in the left of Figure 3.8, the mean spot speeds drop to approximately 25kph at this location between approximately 17:00 and 18:15 with flow breakdown also evident. This demonstrates the extent of the impacts of the various issues which are present in the road network to the south of Junction 5 and north of Junction 9 during the PM peak.

3.5 Traffic Incidents along the M11/N11 Corridor Study Area

Traffic incidents, which contributes to congestion, are also a regular occurrence along the M11 / N11 corridor with a large proportion occurring during peak periods. Network issues, as described previously, combined with high traffic volumes are likely to influence the number of incidents observed along the

¹⁵ Flow breakdown occurs at a Level of Service range E to F and results in queues forming behind breakdown points.

M11/N11 corridor.

All incidents on the M11/N11 between Junction 4 (M50) and Junction 18 (Wicklow South) are recorded within the TII Incident Management System (IMS). The incidents recorded within this system ranges from serious collisions to other minor incidents such as; breakdowns, debris, oil spills, weather events, etc. Whether the incident is serious or minor in nature, an incident along this sensitive corridor during peak periods will compound congestion significantly. The recording of all incidents is therefore a valuable insight to assist in identifying the issues along this section of the M11/N11 corridor.

In 2016 there were a total of 195 incidents recorded on the M11/N11 by the IMS. This number included some 71 instances which involved an obstruction resulting from debris or a spillage. Taking these sort of incidents out of the dataset results in 124 incidents per annum, roughly an incident every third day. A screenshot of the TII IMS is shown in Figure 3.9 and provides an overview of the incident data collated for the M11/N11 corridor in 2016.

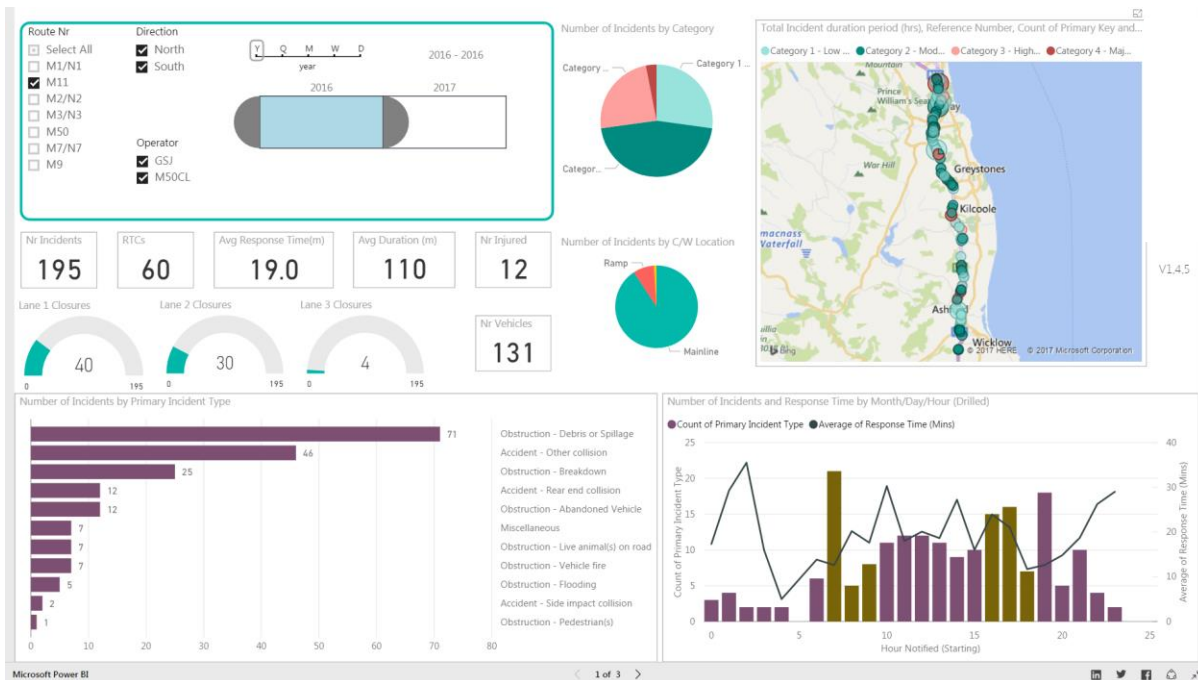


Figure 3.9: Overview of TII Incident Management System database.

As can be seen above, of the 195 incidents recorded in 2016, 60 were categorised as road traffic collisions. The average response time across the year was approximately 19 minutes, whilst the average duration was approximately 110 minutes. 40 incidents involved the closure of Lane 1; 3 incidents involved the closure of lane 2; and Lane 3 was closed on 4 occasions. An incident during peak periods (potentially requiring a lane closure) along the M11/N11, has a detrimental effect on traffic flow.

Looking further into incident type along the M11/N11, aside from debris and breakdown, one of the more prevalent incident types on the M11/N11 involves rear end collisions. These sort of incidents are most prominent during the peaks when traffic volumes are particularly heavy along the corridor. Abandoned vehicles also are a common occurrence during peak periods. A breakdown of the collision types are shown in Figure 3.10 below.

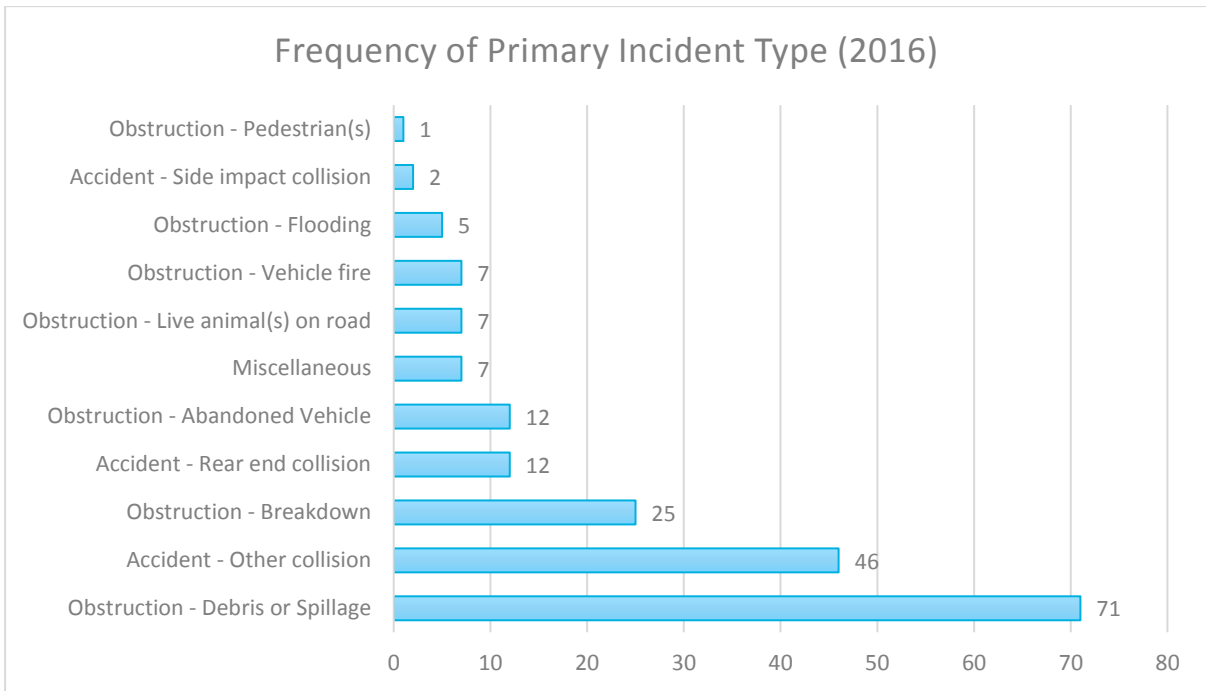


Figure 3.10: Overview of TII Incident Management System database.

Considering the data in more detail, the distribution of incidents on the M11/N11 closely matches the typical profile of traffic along the corridor with a spike in frequency during the AM and PM peak periods. The higher rate of incidents during these periods, indicates a strong connection between volumes and incidents, see Figure 3.11.

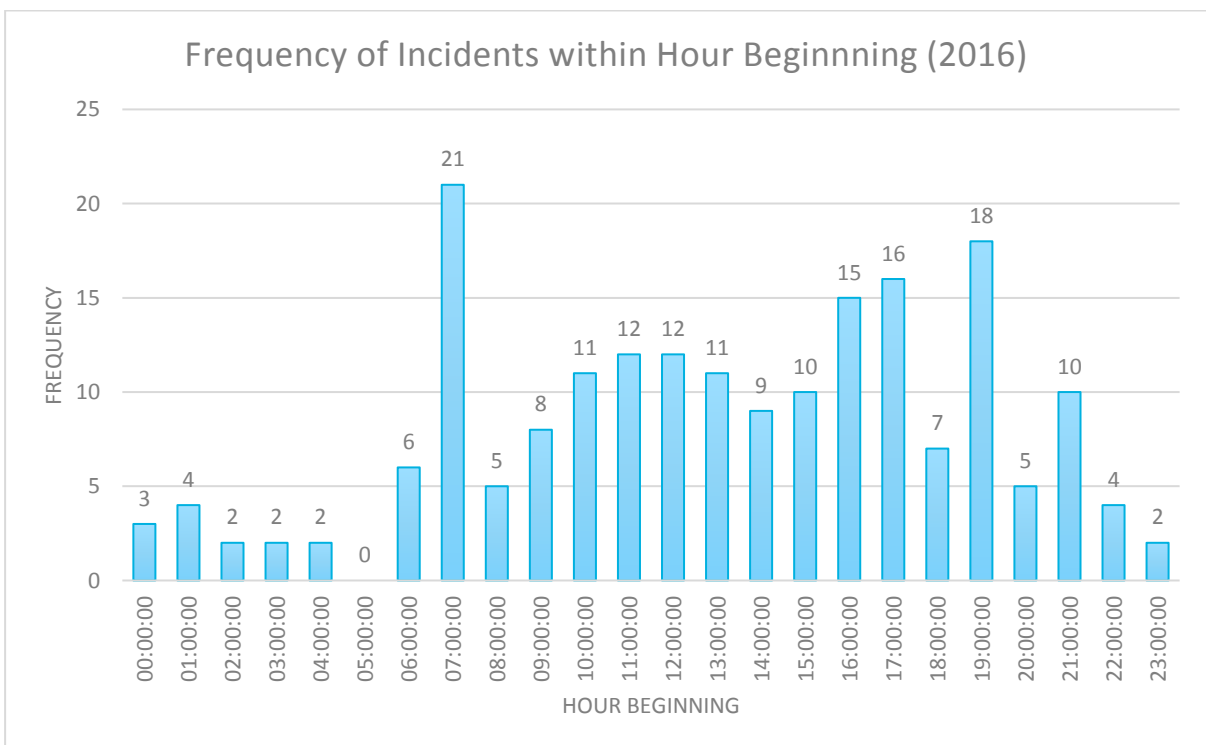


Figure 3.11: Frequency of Incidents by hour along M11/N11

The TII IMS also allows the data to be broken down by direction. To this end Figure 3.11 has been split into the northbound and southbound directions, shown in Figure 3.12. Figure 3.12 also demonstrates that the directional distribution of incidents along the M11/N11 also closely matches the directional traffic flow profiles along the corridor with a highest demand for northbound movement during the AM period

and southbound movement during the PM period.

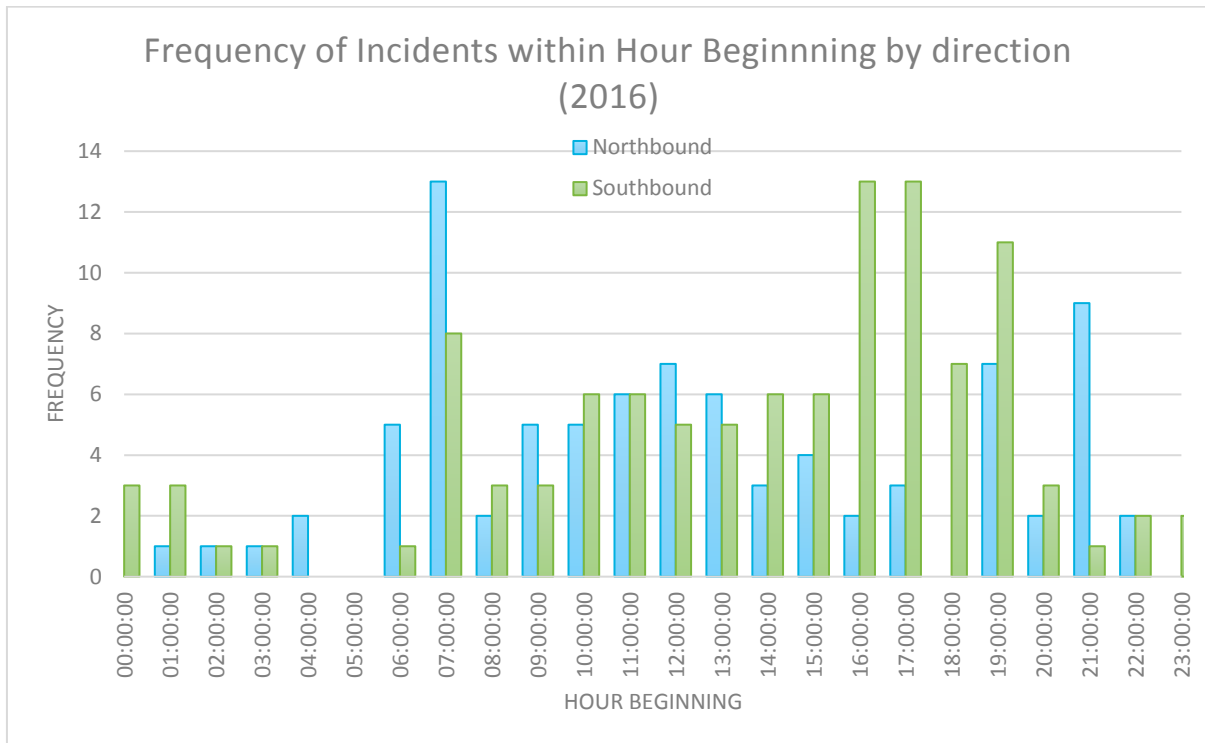


Figure 3.12: Frequency of Incidents by hour along M11/N11 per direction

3.6 Practical Capacity of the Existing Corridor Mainline Lanes

In view of the tidal nature of the peak period traffic volumes this Needs Assessment of the M11/N11 corridor is based on the assessment of peak hour flows and not AADT. Therefore in order to identify the extent of additional mainline lanes required it is essential to know the practical capacity of the various sections of the M11/N11 mainline corridor.

'A Study of Lane Capacity in the Greater Dublin Area'¹⁶ published by TII found that the practical capacity of an unmanaged lane in a traffic stream can be defined at approximately 1,700 vehicles/lane/hour. Practical capacity in this context refers to the point at which flow breakdown events are likely to start to occur within the traffic stream.

However, this research was primarily based on data from several M50 sites, although data from one site each on the M1 and M11 were also included.¹⁷

Therefore in order to more accurately represent the existing practical capacity of different sections of the M11/N11 corridor further local analysis has been undertaken. This will ensure that the assessment undertaken will accurately reflect the needs of the corridor. The results of this assessment are set out Appendix D to this report.

Based on this analysis, an estimation of the practical capacity of the various sections along the M11/N11 corridor was computed and is summarised in Table 3.2.

¹⁶ A Study of Lane Capacity in the Greater Dublin Area, TII, (February, 2012)

[http://www.tii.ie/tii-library/strategic-planning/transport-research-and-information-notes\(trins\)/A-Study-of-Lane-Capacity-in-the-Greater-Dublin-Area.pdf](http://www.tii.ie/tii-library/strategic-planning/transport-research-and-information-notes(trins)/A-Study-of-Lane-Capacity-in-the-Greater-Dublin-Area.pdf)

¹⁷ Table 5.2 Observed Practical Capacity of Lanes (vehicles/hour) – A Study of Lane Capacity in the Greater Dublin Area, TII, (February, 2012)

Table 3.2: Practical Capacity M11/N11 Sections

Road	Junction No.	Junction Name	No. of Lanes	Practical Capacity (vehicles/lane/hour)	
				Northbound	Southbound
M50	16 – 17	Cherrywood – M11	2	4,600	4,600
M11	3 – 4	Loughlinstown – M50	2	3,400	3,400
	4 – 5	M50/M11 – Bray North	2+1	6,300	6,300
	5 – 6	Bray North – Bray Central	2	4,600	3,850
N11	6 – 6a	Bray Central – Herbert Road/R117	2	3,550	3,200
	6a – 7	Herbert Rd/R117 – Bray South	2	3,550	3,200
	7 – 8	Bray South - Kilmacanogue	2	3,550	3,200
	8 – 9	Kilmacanogue – Glen of the Downs	2	3,550	3,550
	9 – 10	Glen of the Downs - Delgany	2	3,550	3,550
	10 – 11	Delgany – Greystones (Kilpedder)	2	3,550	3,550
	11 – 12	Greystones (Kilpedder)–Newtown	2	3,550	3,550
	12 – 13	Newtown MK - Newcastle	2	3,550	3,550
M11	13 – 14	Newcastle – Coyne's Cross	2	3,550	3,550
	14 – 15	Coyne's Cross - Ashford	2	4,600	4,600

3.7 Base Year (2015) Model Outputs

Tables 3.3 presents the AM Peak (northbound) and PM Peak (southbound) hour flows on the mainline sections of the M11/N11 corridor taken from the 2015 traffic models. The number of lanes for each section is also provided alongside the practical capacity.

The traffic flow volumes highlighted in red show the links that are operating at or above 95% of the link specific practical capacity in the base year. In particular, in the AM peak, it is evident that the M11/N11 northbound and southbound flows are operating at or above capacity between Junction 6 (Bray Central) and Junction 7 (Bray South).

Table 3.3: 2015 M11/N11 Peak Hour Flows (Source: 2015 M11/N11 Local Area Model)

Road	Junction No.	Junction Name	No. of Lanes	AM Peak (08:00 – 09:00) – Northbound (vehicles/hour)		PM Peak (17:00 – 18:00) – Southbound (vehicles/hour)	
				2015 Flow	Link Practical Capacity	2015 Flow	Link Practical Capacity
M50	16 – 17	Cherrywood – M11	2	2,811	4,600	2,339	4,600
M11	3 – 4	Loughlinstown – M50	2	1,826	3,400	1,362	3,400
	4 – 5	M50/M11 – Bray North	2+1	4,640	6,300	3,701	6,300
	5 – 6	Bray North – Bray Central	2	3,902	4,600	3,273	3,850
N11	6 – 6a	Bray Central – Herbert Road/R117	2	3,985	3,550	3,497	3,200
	6a – 7	Herbert Rd/R117 – Bray South	2	3,979	3,550	3,159	3,200
	7 – 8	Bray South - Kilmacanogue	2	2,905	3,550	2,855	3,200
	8 – 9	Kilmacanogue – Glen of the Downs	2	2,425	3,550	2,496	3,550
	9 – 10	Glen of the Downs - Delgany	2	2,392	3,550	2,464	3,550
	10 – 11	Delgany – Greystones (Kilpedder)	2	2,092	3,550	2,294	3,550
	11 – 12	Greystones (Kilpedder)–Newtown	2	2,013	3,550	2,118	3,550
	12 – 13	Newtown MK - Newcastle	2	1,613	3,550	1,703	3,550
	13 – 14	Newcastle – Coyne's Cross	2	1,710	3,550	1,831	3,550
M11	14 – 15	Coyne's Cross - Ashford	2	1,698	4,600	1,920	4,600

Figures shown in **red** indicate links operating at or in excess of 95% of the link specific practical capacity in the peak hour.

3.8 Operational Issues

Table 3.3 provides an overview of the mainline flows on the M11/N11 corridor and a high level assessment of the capacity of the corridor in relation to practical capacity. However there are a number of additional issues to be noted which impact upon the operation of the corridor. These issues which have been highlighted by surveys, site visits, models and previous studies, are summarised in the following sections:

3.8.1 Northbound AM Peak Operational Issues

Flow breakdown leading to queues and delays from N11 Junction 6 (Bray Central/Fassaroe) back to N11 Junction 11 (Kilpedder) as a result of:

- High traffic volumes exceeding lane capacity between Junctions 6 and 7;
- Roundabouts at Junction 7 (Bray South/Kilcrone) are currently operating over capacity leading to queues on slip roads extending to mainline;
- N11 direct accesses (Junction 6a and others);
- Speed restrictions at Kilmacanogue; and
- Merging/Weaving issues as traffic seeks to access the various junctions serving Bray.

3.8.2 Southbound PM Peak Operational Issues

Flow breakdown leading to queues and delays from N11 Junction 7 (Bray South/Kilcrone) back to M50

Junction 16 (Cherrywood) as a result of:

- High traffic volumes exceeding lane capacity between Junctions 6 and 7;
- Roundabouts at Junction 7 (Bray South/Kilcroney) are currently operating over capacity leading to queues on slip roads extending to mainline;
- Merging/Weaving issues as traffic seeks to access the various junctions serving Bray;
- Speed restrictions at Kilmacanogue;
- N11 direct accesses (Junction 6a and others); and
- Gradient of the N11 corridor.

3.8.3 Junction 6a (Herbert Road/Enniskerry Road) Operational Issues

A number of specific issues occur at Junction 6a (Herbert Road/Enniskerry Road) due to its current operation which have a direct impact upon the capacity of the M11/N11 and Junctions 6 & 7. Junction 6a operates as a left in/out only junction and therefore limits access to both Enniskerry and Bray for particular movements to/from the M11/N11 and between Enniskerry and Bray, these include:

Bray

- Vehicles travelling from Bray (Herbert Road area) to the N11 northbound via Junction 6a must travel south to Junction 7 and take a U-turn to access the N11 northbound; and
- Vehicles travelling from the N11 northbound to Bray (Herbert Road area) via Junction 6a must travel north to Junction 6 and take a U-turn to access the N11 southbound and Junction 6a.

Enniskerry

- Vehicles travelling from the N11 southbound to Enniskerry must travel south to Junction 7 and take a U-turn to access the N11 northbound and Junction 6a; and
- Vehicles travelling from Enniskerry to the N11 southbound via Junction 6a must travel north to Junction 6 and take a U-turn to access the N11 southbound.

As a result of these movements additional traffic passes through both Junction 6 (Bray Central/Fassaroe) and Junction 7 (Bray South/Kilcroney) and also along the N11 between these two junctions.

In addition it should be noted that apart from the N11 there is only one other crossing of the Dargle River being the R761 (Main St.) bridge in Bray Town. Existing queues and delays due to congestion within Bray Town at peak times make the N11 crossing a more attractive route for drivers accessing Bray and therefore drivers utilise Junction 5 (Bray Central) and Junction 6a (Herbert Road).

3.9 Summary of Existing Situation

In summary, the TMU data and modelled flow volumes highlight the high ratio of traffic volumes compared to the capacity of the M11/N11 corridor in the base year 2015 particularly on the northbound links in the AM peak and southbound links in the PM peak along the M11/N11 from Kilmacanogue to the M50. The operation of the M11/N11 corridor is directly impacted upon by the capacity of the various junctions, direct accesses, road gradient and weaving/merging movements which in combination lead to flow breakdown during peak periods.

Chapter 4 Future Year Baseline Modelling

4.1 Overview

Chapter 3 demonstrated that there are numerous existing issues along the M11/N11 corridor which requires speedy attention in terms of investment. However, there is a need to ensure that any transport infrastructure proposed is also suitable to meet future demands. Therefore, this section of the report summarises the development of the baseline scenario (Do-Minimum) future year Local Area Model (LAM) used to inform the needs assessment of the M11/N11 corridor. For full details of the model development process refer to Appendix A (Traffic Modelling Report).

4.1.1 Future Year Demand

Two future years have been used as part of the needs assessment, 2030 and 2050. These years represent the forecast years built into the NTpM; and also the planned completion dates of the core and comprehensive TEN-T networks respectively. The projected growth in demand on the National Road network in both 2030 and 2050 is based on the TII National Transport Model (NTpM) 'Central' growth scenario. Full details of the projection of traffic in the NTpM are provided in the *National Transport Model Demographic and Economic Forecasting Report – September 2014*²³.

4.2 Demographic Projections

The total population and employment projections for the study area used in the development of the LAM for 2030 and 2050 are summarised in Table 4.1. A population growth of approximately 0.95% per annum is projected up to 2030 reducing to 0.3% per annum between 2030 and 2050. Employment grows at 1.2% up to 2030 and reduces significantly to 0.1% per annum beyond 2030.

Table 4.1: NTpM Population & Employment Projections

Demographic	Year			Percentage Growth	
	2015	2030	2050	2015 - 2030	2015 - 2050
Population	85,595	98,522	104,288	15%	21%
Employment	34,869	41,346	41,913	19%	20%

4.3 Travel Demand Projections

The NTpM converts the projected demographics presented in Table 4.1 into peak hour vehicular trips for the study area. Table 4.2 and 4.3 provide a summary of the trip matrix total for the base and future year scenarios in the AM and PM peak hour respectively.

Table 4.2: AM Peak Final Trip Demand Matrix Totals

Demand	Year			Percentage Growth	
	2015	2030	2050	2015 - 2030	2015 - 2050
Cars	17,154	20,464	21,980	19%	28%
HGV	567	820	1,146	45%	102%

²³ <http://www.tii.ie/tii-library/strategic-planning/>

Table 4.3: PM Peak Final Trip Demand Matrix Totals

Demand	Year			Percentage Growth	
	2015	2030	2050	2015 - 2030	2015 - 2050
Cars	17,257	20,573	21,745	19%	26%
HGV	450	650	910	44%	102%

4.4 2030 Do-Minimum

The 2030 Do-Minimum traffic volumes for the AM and PM peak periods are provided in Table 4.4. The number of lanes for each section and the practical capacity is also shown.

Table 4.4: 2030 Do-Minimum M11/N11 Peak Hour Demand Flows (Source: 2030 Do-Minimum M11/N11 LAM)

Road	Junction No.	Junction Name	No. of Lanes	AM Peak (08:00 – 09:00) – Northbound (vehicles/hour)		PM Peak (17:00 – 18:00) – Southbound (vehicles/hour)	
				Demand Flow	Link Practical Capacity	Demand Flow	Link Practical Capacity
M50	16 – 17	Cherrywood – M11	2	3,390	4,600	2,968	4,600
M11	3 – 4	Loughlinstown – M50	2	2,021	3,400	1,617	3,400
	4 – 5	M50/M11 – Bray North	2+1	5,411	6,300	4,584	6,300
	5 – 6	Bray North – Bray Central	2	4,714	4,600	4,085	3,850
N11	6 – 6a	Bray Central – Herbert Road/R117	2	4,855	3,550	4,143	3,200
	6a – 7	Herbert Rd/R117 – Bray South	2	4,866	3,550	4,054	3,200
	7 – 8	Bray South - Kilmacanogue	2	3,978	3,550	3,564	3,200
	8 – 9	Kilmacanogue – Glen of the Downs	2	3,270	3,550	3,103	3,550
	9 – 10	Glen of the Downs - Delgany	2	3,232	3,550	3,068	3,550
	10 – 11	Delgany – Greystones (Kilpedder)	2	2,796	3,550	2,888	3,550
	11 – 12	Greystones (Kilpedder)–Newtown	2	2,653	3,550	2,679	3,550
	12 – 13	Newtown MK - Newcastle	2	2,040	3,550	2,160	3,550
M11	13 – 14	Newcastle – Coyne's Cross	2	2,125	3,550	2,366	3,550
M11	14 – 15	Coyne's Cross - Ashford	2	2,227	4,600	2,465	4,600

Figures shown in **red** indicate links operating at or in excess of 95% of the link specific practical capacity in the peak hour.

The traffic flow volumes highlighted in red represent the links that are operating at or above 95% of the link specific practical capacity in the 2030 Do-Minimum scenario. The key issues are as follows:

AM Peak Hour

- Volumes on the M11/N11 northbound carriageway exceed capacity from Junction 8 (Kilmacanogue) to Junction 5 (Bray North/Wilford).

PM Peak Hour

- Volumes on the M11/N11 southbound carriageway exceed capacity from Junction 5 (Bray North/Wilford) to Junction 8 (Kilmacanogue).

4.5 2050 Do-Minimum

A 2050 Do-Minimum model was also developed for the AM and PM peak periods. The 2050 Do Minimum traffic volumes were also assessed against the practical capacities. The findings of this assessment were compatible with those outlined in Section 4.4 above. No additional sections in 2050 beyond those highlighted in the 2030 assessment operate above practical capacity.

4.6 Network Statistics

Table 4.5 outlines a comparison of the modelled network statistics for the 2015 Base Models and the 2030 and 2050 Do-Minimum models for the AM and PM peak periods. As can be seen from the network statistics, by 2030, in the AM peak the network will experience an increase in vehicle kilometres (23%), travel time (23%) and network delay (34%). In the 2050 AM peak the network will experience a significant increase in vehicle kilometres (34%), travel time (39%) and most significantly network delay (66%).

Similarly, in the 2030 PM peak the network will experience an increase in vehicle kilometres (22%), travel time (23%) but most significantly in network delay (37%). In the 2050 PM peak the network will experience a significant increase in vehicle kilometres (27%), travel time (32%) and most significantly network delay (63%).

Table 4.5: AM & PM Peak Hour Modelled Network Statistics

Scenario	Total Trips (Vehs/hr)	Total Travel Time (hrs)	Travel Time per Vehicle (mins)	Total Distance (km)	Total Delay (hrs)
2015 AM	17,721	4,648	15.74	201,602	997
2030 AM Do-Min	21,284	5,740	16.18	248,432	1,333
2050 AM Do-Min	23,125	6,444	16.72	270,556	1,656
2015 PM	17,706	4,445	15.06	200,448	807
2030 PM Do-Min	21,223	5,451	15.41	244,970	1,102
2050 PM Do-Min	22,655	5,873	15.55	254,009	1,318

4.7 National Transport Authority – Regional Modelling System

The National Transport Authority operates and maintains a Regional Modelling System (RMS) in support of its transport planning functions. The Eastern Regional Model (ERM) forms part of this modelling system and encompasses the M11/N11 study area. The ERM was used by the NTA in support of the development of the *Transport Strategy for the Greater Dublin Area 2016-2035* which identified the need for improvements within the study area specifically:

'Capacity enhancement and reconfiguration of the M11/N11 from Junction 4 (M50) to Junction 14 (Ashford) inclusive of ancillary and associated roads schemes, to provide additional lanes and upgraded junctions, plus service roads and linkages to cater for local traffic movements'.

The ERM contains two 2035 scenarios namely: the Do Minimum; and Do Strategy (including all of the proposals incorporated within the *Transport Strategy* including public transport, road interventions, demand management, walking and cycling interventions). One of the key inputs in deriving the demand for travel within the ERM is the planning data sheet which is ran through the National Demand Forecasting Model (NDFM). The projections incorporated within the planning data sheet were developed by a combination of a 'bottom-up' and 'top-down' approach; in that all local authorities within the Greater Dublin Area provided the NTA with projections for their jurisdiction (bottom-up). These projections were subsequently then constrained to CSO projections (top-down). As such, the aspirations of Dún Laoghaire Rathdown, Wicklow and Wexford County Councils as set out in their respective County Development Plans are incorporated within the NTA forecasts.

The M11/N11 Do Minimum LAM is broadly compatible with the NTA ERM Do-Minimum scenario, in that it takes account of the impact of schemes such as:

- Major completed transport schemes delivered between 2012-2015;
- Luas Cross City;
- Phoenix Park Tunnel; and
- DART frequency increases on the Northern and South Eastern lines.

To ensure compatibility of this Study with the proposals outlined within the NTA Strategy, the highway flows within the NTA 2035 Do Minimum and Do Strategy scenarios have also been assessed against the M11/N11 practical capacities established within this study. The Do Minimum scenario indicated that anticipated traffic volumes would exceed practical capacities between Junction 5 and Junction 8 in both the north and southbound directions. The Do Strategy scenarios also indicated that traffic volumes would exceed practical capacities between Junction 5 and Junction 8 in the northbound direction and Junction 7 to Junction 8 in the southbound direction. The range of measures included along the M11/N11 corridor are presented in Section 2.2 of this report. These include the upgrade of the existing inter-city rail service, provision of a core bus corridor and regional bus corridor and fiscal demand management measures on the M50 and M11.

This analysis identifies that while the employment and population projections differ across the various horizon years for the various studies / strategies, the provision of a roads only, public transport only and or demand management solution does not adequately address the current and future needs along the corridor.

4.8 Summary of Future 'Do-Minimum' Needs Assessment

The needs assessment of the M11/N11 corridor, which took cognisance of the provisions within the NTA Strategy has demonstrated the following:

- The existing capacity of the M11/N11 mainline corridor will need to be increased as far south as Junction 8 (Kilmacanogue) in order to cater for the projected demand in 2030 based on current traffic growth projections;
- There is no need for additional mainline or junction capacity on the N11 between Junction 8 (Kilmacanogue) and Junction 14 (Coyne's Cross) based on current traffic growth projections. However, to bring this section of the corridor up to the required standard existing direct accesses and left on / left off junctions should be closed or reconfigured; and
- Upgrades will need to be made to the regional/local road network to provide improved access between the existing M11/N11 mainline junctions and the regional/local road network.

This study also highlighted that the isolated detailed analysis of individual junctions on / accessing the corridor (e.g. 6, 6a, 7, 8) should be revisited to ensure they address existing issues and the causes of the same in the context of the entire corridor. This is discussed in more detail in the following section of this report.

Chapter 5 Do-Something Modelling

5.1 Overview

Following the identification of the mainline needs of the M11/N11 corridor based in the 2030 and 2050 Do-Minimum scenarios, and the input of the NTA Strategy measures on the corridor; a number of additional Do-Something measures were developed and tested using the M11/N11 LAM. These measures may resolve issues at junctions, support local access and complement the operation of the mainline improvements. The measures identified and tested were structured around the three key objectives of the study:

- To bring the section of the corridor (M11/N11 mainline and junctions) up to the appropriate standard;
- To develop the regional and local road network to support local access and complement the corridor strategy, including the closure of all direct accesses; and
- To ensure the safe daily operation of the M11/N11 mainline and junctions in the event of the occurrence of incidents.

5.2 M11/N11 Mainline Upgrade

The modelling undertaken has identified the need to consider an increase in the capacity of the M11/N11 corridor to Junction 8 (Kilmacanogue). Based on this need the Do-Something scenario presented in Table 5.1 was tested in the LAM.

Table 5.1: Do-Something Scenario 1

Scenario	Description
DS 1	3 lanes plus an auxiliary lane on the M11 between Junction 4 (M50/M11) and Junction 5 (Bray North) and 3 lanes on the M11/N11 between Junctions 5 and Junction 8 (Kilmacanogue), in both directions.

It should be noted that while future year modelled flows indicate a need for 3 mainline lanes between Junctions 7 and 8, the merge and diverge flows at Junction 7 are such that this is best achieved by the provision of lane gains and lane drops northbound and southbound at Junction 7 such that the third lane between Junctions 7 and 8 is a continuous auxiliary lane.

Considerations should be given at preliminary design stage to ensure that the possibility of maintaining three mainline lanes through Junction 7 is not precluded.

5.2.1 2030/2050 Do-Something 1

A summary of the 2030 demand flows on the M11/N11 corridor in Do-Something Scenario 1 is provided in Table 5.2 for the AM Peak (northbound) and PM Peak (southbound) directions. The table also provides the practical capacity for each section of the corridor based on the applicable cross-section.

In order to have a reliable value of the future practical capacity for the 3 lane section of the N11 between Junctions 6 and 8, data from the TII TMU on the N7 (3 lane dual carriageway) between Junctions 5 and 6 has been interrogated as this represents a direct comparable section of existing road. The speed/flow graphs of each lane of the N7 are provided in Appendix B (Figures B7 to B9) and these indicate a practical capacity of 5,450 vehicles/hour). However for the N11 southbound direction the practical capacity has been reduced to reflect the uphill gradient issue which would still apply regardless of the widening of the carriageway. The practical capacity of the upgraded 3 lane section of the M11 between Junctions 5 and 6 is based on a proportionate increase in capacity from the existing assessment undertaken in Section 3.5.2.1 (i.e. 4,600 to 6,900).

The table illustrates that the capacity increase provided as part of this scenario meets the mainline needs of the M11/N11 corridor with all sections operating below the practical capacity range. However, a number of residual issues remain and are discussed in Section 5.3 of this report, including: sub-standard junctions; numerous direct accesses; at grade junctions; inadequate weaving lengths; and speed limit restrictions.

Table 5.2: 2030 Do-Something Scenario 1 - M11/N11 Northbound Peak Hour Flows

Road	Junction No.	Junction Name	No. of Lanes	AM Peak Northbound (vehicles/hour)		PM Peak Southbound (vehicles/hour)		Do-Something Practical Capacity (vehicles/hour)	
				Demand Flow		Demand Flow			
				DM	DS 1	DM	DS 1	Link Specific	
								North	South
M50	16 – 17	Cherrywood – M11	2	3,390	3,394	2,968	2,970	4,600	4,600
M11	3 – 4	Loughlinstown – M50	2	2,021	2,017	1,617	1,617	3,400	3,400
	4 – 5	M50/M11 – Bray North	3+1	5,411	5,411	4,584	4,587	8,600	8,600
	5 – 6	Bray North – Bray Central	3	4,714	4,729	4,085	4,085	6,900	6,900
N11	6 – 6a	Bray Central – Herbert Road/R117	3	4,855	4,856	4,143	4,141	5,450	5,450
	6a – 7	Herbert Rd/R117 – Bray South	3	4,866	4,867	4,054	4,057	5,450	5,000 ²⁴
	7 – 8	Bray South - Kilmacanogue	3	3,978	3,984	3,564	3,556	5,450	5,450
	8 – 9	Kilmacanogue – Glen of the Downs	2	3,270	3,274	3,103	3,094	3,550	3,550
	9 – 10	Glen of the Downs - Delgany	2	3,232	3,237	3,068	3,059	3,550	3,550
	10 – 11	Delgany – Greystones (Kilpedder)	2	2,796	2,797	2,888	2,888	3,550	3,550
	11 – 12	Greystones (Kilpedder)–Newtown	2	2,653	2,653	2,679	2,679	3,550	3,550
	12 – 13	Newtown MK - Newcastle	2	2,040	2,040	2,160	2,159	3,550	3,550
M11	13 – 14	Newcastle – Coyne's Cross	2	2,125	2,125	2,366	2,365	3,550	3,550
	14 – 15	Coyne's Cross - Ashford	2	2,227	2,227	2,465	2,464	4,600	4,600

Figures highlighted in red indicate that the section is operating at or above 95% of the link specific practical capacity in the peak hour.

²⁴ Lower southbound link specific practical capacity between Junctions 6a & 7 due to downstream issues

Table 5.3: 2050 Do-Something Scenario 1 - M11/N11 Northbound Peak Hour Flows

Road	Junction No.	Junction Name	No. of Lanes	AM Peak Northbound (vehicles/hour)		PM Peak Southbound (vehicles/hour)		Do-Something Practical Capacity (vehicles/hour)	
				Demand Flow		Demand Flow			
				DM	DS 1	DM	DS 1	Link Specific	
								North	South
M50	16 – 17	Cherrywood – M11	2	3,678	3,696	3,218	3,255	4,600	4,600
M11	3 – 4	Loughlinstown – M50	2	2,168	2,042	1,693	1,795	3,400	3,400
	4 – 5	M50/M11 – Bray North	3+1	5,846	5,738	4,910	5,050	8,600	8,600
	5 – 6	Bray North – Bray Central	3	5,013	5,096	4,300	4,333	6,900	6,900
N11	6 – 6a	Bray Central – Herbert Road/R117	3	5,038	5,308	4,468	4,640	5,450	5,450
	6a – 7	Herbert Rd/R117 – Bray South	3	5,077	5,389	4,379	4,066	5,450	5,000 ²⁵
	7 – 8	Bray South - Kilmacanogue	3	3,959	4,506	3,811	3,776	5,450	5,450
	8 – 9	Kilmacanogue – Glen of the Downs	2	3,326	3,543	3,292	3,255	3,550	3,550
	9 – 10	Glen of the Downs - Delgany	2	3,273	3,503	3,255	3,221	3,550	3,550
	10 – 11	Delgany – Greystones (Kilpedder)	2	2,915	2,967	3,089	3,074	3,550	3,550
	11 – 12	Greystones (Kilpedder)–Newtown	2	2,785	2,808	2,844	2,832	3,550	3,550
	12 – 13	Newtown MK - Newcastle	2	2,084	2,095	2,261	2,259	3,550	3,550
	13 – 14	Newcastle – Coyne's Cross	2	2,209	2,210	2,488	2,488	3,550	3,550
M11	14 – 15	Coyne's Cross - Ashford	2	2,319	2,320	2,585	2,585	4,600	4,600

Figures highlighted in red indicate that the section is operating at or above 95% of the link specific practical capacity in the peak hour.

5.3 M11/N11 Mainline Junctions

The findings on mainline junctions, discussed below, has been supported by analysis and modelling summarised within the Technical Note in Appendix D of this report.

5.3.1 Junction 5 (Bray North)

At present there are no significant congestion/operational issues associated with Junction 5 Bray North (Wilford). However, occasionally there are issues with: tailbacks from the Dublin Road/Old Connaught Avenue junction; and the unusual layout of the northbound slip. Short term measures may have the potential to address these issues. The future year Do-Minimum models also demonstrated that the current capacity/operation of Junction 5 can cater for the projected demand. However, future public transport proposals (i.e. Luas extension to Bray) and local area plan proposals are likely to require the upgrading of the junction. As such two potential options for increasing the capacity of the junction were considered and assessed:

- Scenario J5a – Upgrade based on a gyratory design developed by Atkins²⁷; and
- Scenario J5b – Upgrade based on a dumbbell design as per M50/M11/N11 Corridor Study (2012).

5.3.2 Junction 6 (Bray Central)

The existing merges/diverges at Junction 6 are sub-standard and have a direct impact upon the capacity

²⁵ Lower southbound link specific practical capacity between Junctions 6a & 7 due to downstream issues

²⁷ Assessment of N11 Corridor (Atkins for Bray Town Council, 2013);

and operation of M11/N11 mainline. As such it is necessary to bring the existing merges/diverges at this location up to standard and also increase the capacity of the two existing roundabouts. The following scenario was tested and assessed:

- Scenario J6 – Increased capacity of roundabouts and upgrade the merges/diverges to standard.

5.3.3 Junction 6a (Herbert Road / Enniskerry Road)

The existing left on / left off junctions at Herbert Road (southbound) and Enniskerry Road (northbound) are substandard and have a direct impact upon the capacity and operation of the N11 mainline. As the interventions proposed at Junction 6a mainly deals with regional and local roads and do not include a junction test, this proposal forms part of Do-Something L7. Full details of which are provided in Section 5.4.7.

5.3.4 Junction 7 (Bray South)

The capacity/operation of Junction 7 Bray South (Kilcronney) and the Killarney Road roundabout have a direct impact upon the capacity/operation of the N11 mainline. There are several potential options for increasing the capacity of this junction but for the purpose of this study the following scenario was tested and assessed:

- Scenario J7 – Closure of the existing on/off ramps and the implementation of a dumbbell interchange or similar. As indicated earlier, the 2030 and 2050 Do-Something mainline and merge/diverge flows at Junction 7 indicate that a lane drop/lane gain arrangement would be appropriate at Junction 7. This would be provided in both northbound and southbound directions such that between Junctions 7 and 8 there would be 3 lanes.

Considerations should be given at preliminary design stage to ensure that the possibility of maintaining three mainline lanes through the junction is not precluded.

5.3.5 Junction 8 (Kilmacanogue)

The speed limit reduction and operational arrangements of the southbound diverge and northbound merges have a direct impact upon the capacity and operation of the N11 mainline. The following scenario is proposed.

- Scenario J8 – New southbound lane drop to appropriate standard to incorporate service road and all accesses. New single northbound lane gain to appropriate standard to incorporate service road, local junctions and all accesses. These will facilitate the increase of the speed limit to 100km/hr in both directions.

A summary of the M11/N11 mainline junction upgrades tested as part of this study are presented in Table 5.4.

Table 5.4: Do-Something Scenarios (Junctions)

Junction	Scenarios	Description
J5 - Bray North (Wilford)	DS J5a	Increased capacity (Gyratory layout)
	DS J5b	Increased capacity (Dumbbell layout)
J6 - Bray Central (Fassaroe)	DS J6	Increased capacity (roundabouts and merges/diverges)
J6a – Herbert Road / Enniskerry Road	DS J6a	Closure of direct access between N11 and Herbert Road/Enniskerry Road. This proposal forms part of Do—Something L7. Refer to Do-Something L7 in Section 5.4.7 for full details
J7 - Bray South (Kilcrouney)	DS J7	Increased capacity (Dumbbell layout), with potentially southbound lane drop and lane gain south of J7, and potentially northbound lane drop and lane gain north of J7.
J8 – Kilmacanogue	DS J8	Introduction of single southbound lane drop/service road and single northbound lane gain/service road with associated increase in speed limit of 100km/hr

Full details of the assessment of each of the junction options considered are presented in Appendix D. Each option was initially assessed using the 2015 base year AM and PM peak models to evaluate its impact based on current traffic levels and then in the 2030 AM and PM peak models.

5.4 Regional/Local Road Options

A number of regional and local road improvements were considered in order to address the need to provide improved access and connectivity to areas east and west of the M11/N11 corridor, as well as north and south of the Dargle River. Improvements were also considered that would provide alternative route options for short trips currently using the N11 and in the event of incidents occurring on the M11/N11. These are outlined in the following sections and summarised in Table 5.5.

It should be noted the focus of the local road measures considered is to reduce the volume of local trips on the M11/N11 corridor and reduce reliance on the national road network to service local trips. Some of the local road schemes considered may serve a number of other functions in the context of the development of Wicklow / Dún Laoghaire Rathdown areas and these functions are not considered as part of this study.

The findings on regional and local road options, discussed below, has been supported by analysis and modelling summarised within the Technical Note in Appendix D of this report.

5.4.1 Do-Something L1

Do-Something L1 (DS L1) which is illustrated indicatively in Figure 5.1 seeks to improve access between the M11/N11 corridor and Bray by providing an additional crossing of the River Dargle in the vicinity of Junction 6 (Bray Central). This proposal would reduce traffic on the N11 corridor between Junctions 6 and 7 as vehicles would be able to access the southern areas of Bray via Junction 6.

The provision of this additional crossing of the River Dargle would also have added advantages to traffic movement within Bray, as well as improving the connectivity between Bray and development proposals at Fassaroe.

The precise location for a bridge crossing of the River Dargle will require further consideration. In addition to any benefit to the M11/N11 corridor, the location of the crossing will be influenced by the requirements of public transport, walking and cycling and local trips and the technical feasibility of crossing the river.

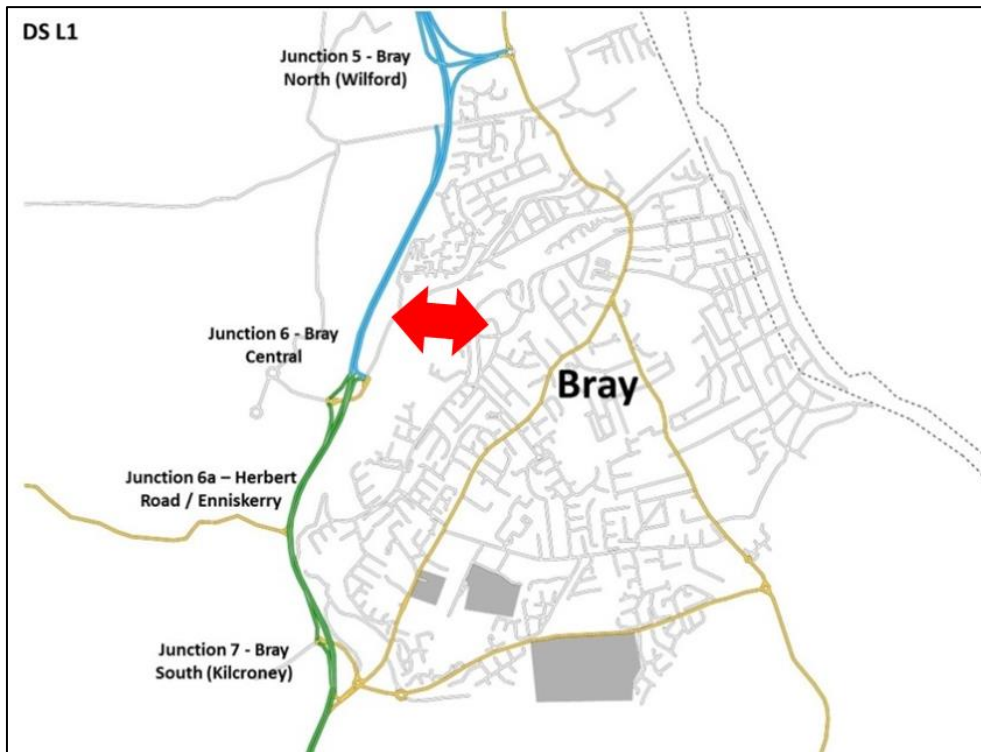


Figure 5.1: Do-Something Scenario L1

5.4.2 Do-Something L2

Do-Something L2 (DS L2) which is illustrated in Figure 5.2 provides for a crossing of the N11 at Junction 6a (Herbert Road/R117). The objective of the scenario is to provide east-west access between Bray and Enniskerry (the junction currently operates as a left in/left out junction east and west of the N11). This proposal would remove the need for traffic to travel through Junctions 6 & 7 in order to make a ‘U-turn’ to access the N11 or Bray/Enniskerry. Access to the N11 via Junction 6a is maintained as part of the proposal.



Figure 5.2: Do-Something Scenario L2

5.4.3 Do-Something L3

Do-Something L3 (DS L3) which is illustrated in Figure 5.3 aims to improve access between Enniskerry and the M11/N11 corridor/Bray by upgrading the existing local road (Berryfield Lane). Berryfield Lane currently provides a connection between Junction 6 (Bray Central/Fassaroe) and the R117 north of Enniskerry, however the route has a poor geometric layout/alignment at present. The objective of the scenario is to provide an alternative route between Enniskerry and the M11/N11 via Junction 6 (Bray Central/Fassaroe).

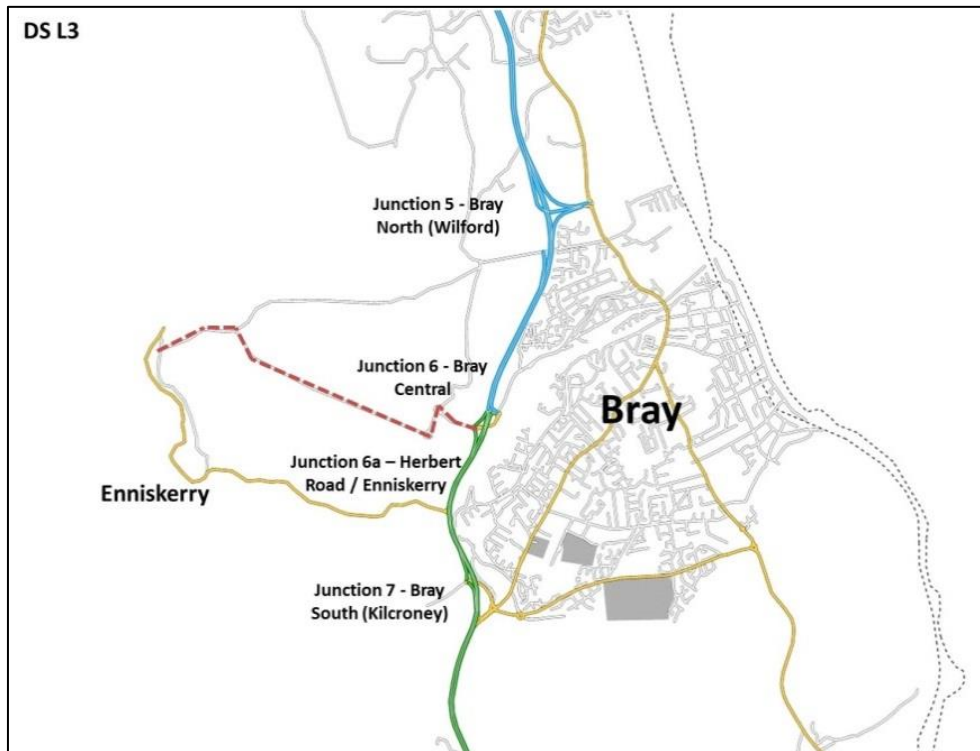


Figure 5.3: Do-Something Scenario L3

5.4.4 Do-Something L4

Do-Something L4 (DS L4) which is illustrated in Figure 5.4 provides for a connection between Junction 8 (Kilmacanogue) and Bray Southern Cross Road (R768).

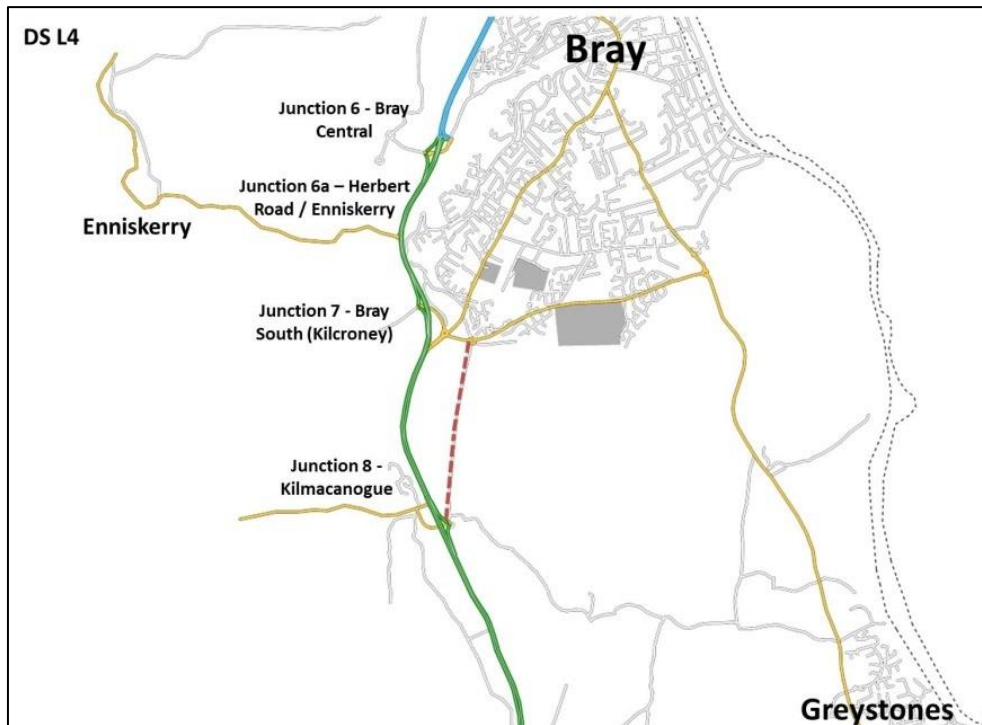


Figure 5.4: Do-Something Scenario L4

The objective of this scenario is to reduce the level of traffic through Junction 7 (Bray South/Kilcronee) and on the N11 between Junction 7 (Bray South/Kilcronee) and Junction 8 (Kilmacanogue) by removing local trips between Bray and Kilmacanogue. This scenario also includes the Do-Something J8 services road proposals at Junction 8 (Kilmacanogue) as discussed in Section 5.3.4.

5.4.5 Do-Something L5

Do-Something L5 which is illustrated in Figure 5.5 provides for a new link road from the R761 at Greystones to Ballydonagh Road (as identified in the 'Greystones-Delgany and Kilcoole Local Area Plan 2013-2019' improving access onwards to the N11 at Junction 9 (Glen of the Downs).



Figure 5.5: Do-Something Scenario L5

5.4.6 Do-Something L6

Do-Something L6 which is illustrated in Figure 5.6 proposes to close access to and from Junction 6a at Herbert Road in the southbound direction as it is a tight radius bend which has a direct impact upon the capacity and operation of the N11 mainline. The objective of this scenario is to improve the operation of the southbound section of the N11 between Junctions 6 and 7.

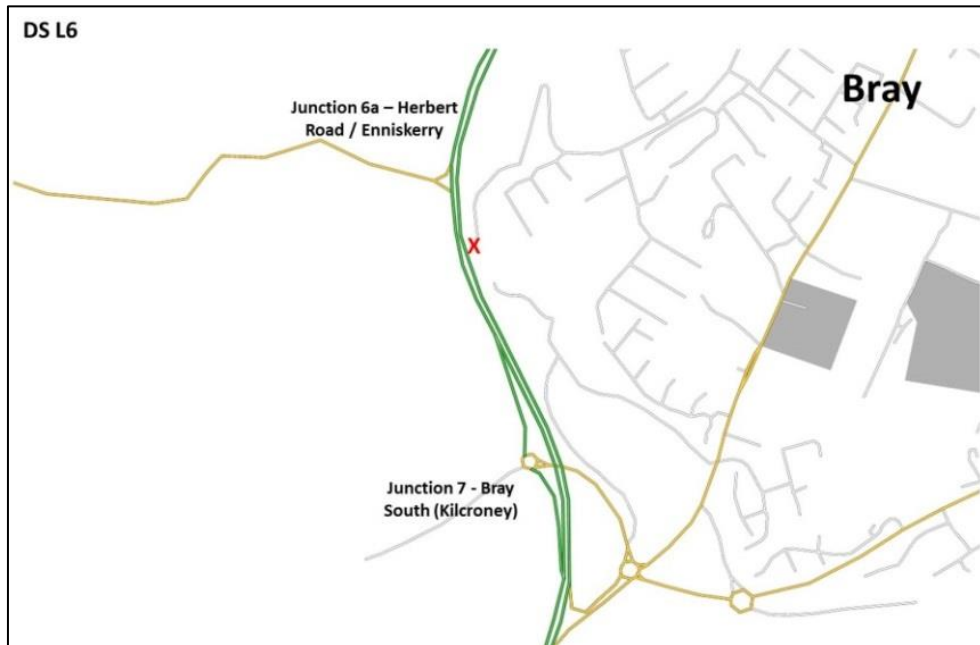


Figure 5.6: Do-Something Scenario L6

5.4.7 Do-Something L7

Do-Something L7 which is illustrated in Figure 5.7 provides for new service roads adjacent to the N11 connecting Junction 6a to both Junction 6 and Junction 7. On the northbound section of the N11, Junction 6a (R117 Enniskerry Road) will be connected to both Junction 6 and 7 via segregated one-way services road and removing direct access to the N11 in line with standards. On the southbound section of the N11, a one-way segregated service road will commence north of Dargle Lane and connect Junction 6a (Herbert Road) to Junction 7. Direct access between the N11 and Junction 6a (Herbert Road) will be closed.

The objective of this scenario is to effectively remove direct access onto the N11 at Junction 6a from both Herbert Road and the R117, to allow traffic to join the N11 at junctions of a higher standard that are in line with TEN-T requirements. This will also have the effect of raising the southbound mainline capacity by removing the weaving movements and slow moving vehicles at this location.

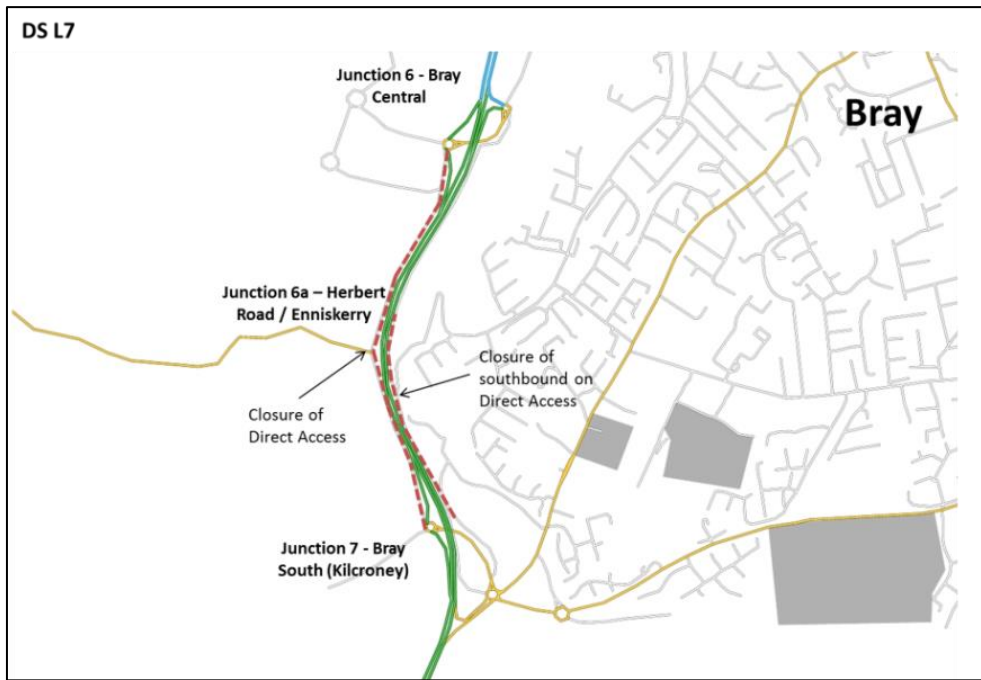


Figure 5.7: Do-Something Scenario L7

5.4.8 Do-Something L8

DS L8 provides for a link road from Rathmichael/Ballycorus Road to M50 Junction 16 (Cherrywood). This option provides an alternative route for users travelling from the Shankill area to the M50 by allowing them a more direct route thereby potentially avoiding travelling to this destination via Junction 5 (Bray North/Wilford).

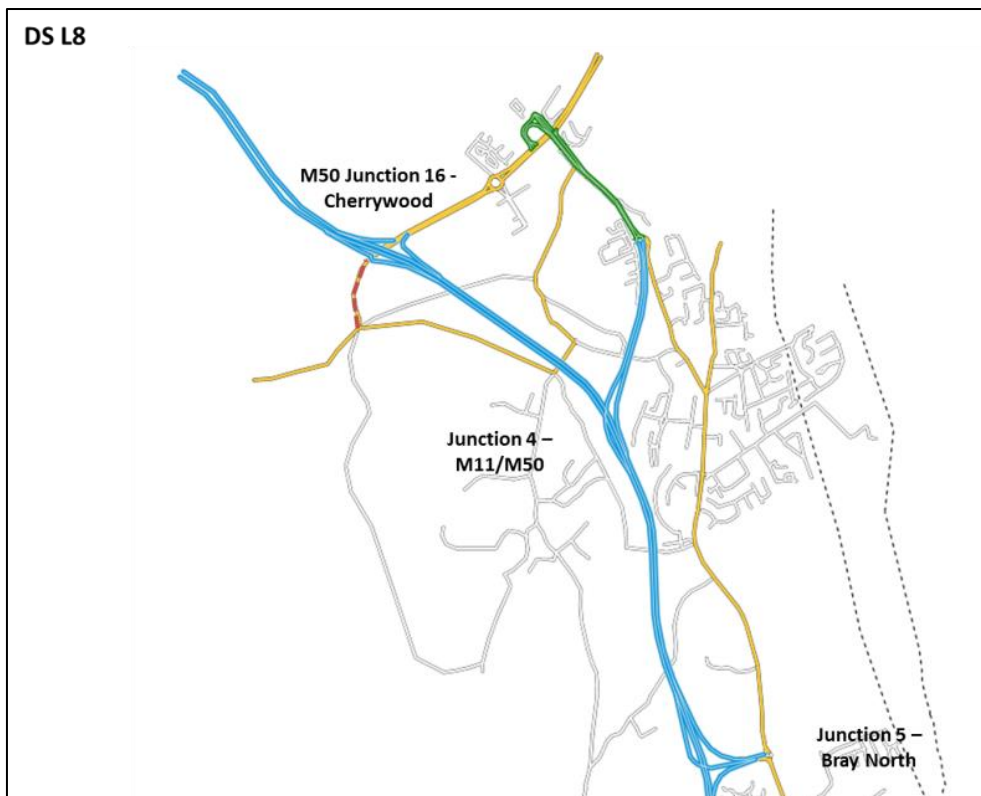


Figure 5.8: Do-Something Scenario L8

5.4.9 Do-Something L9

DS L9 provides for a link road from Old Connaught Avenue to the northbound on-ramp at Junction 5. This option provides an alternative route for users travelling from Old Connaught Avenue, west of the M11/N11, to the M50 by allowing them a more direct route thereby potentially reducing congestion at the Old Connaught Avenue / Dublin Road junction which can occasionally impact upon the operation of the M11/N11 mainline.

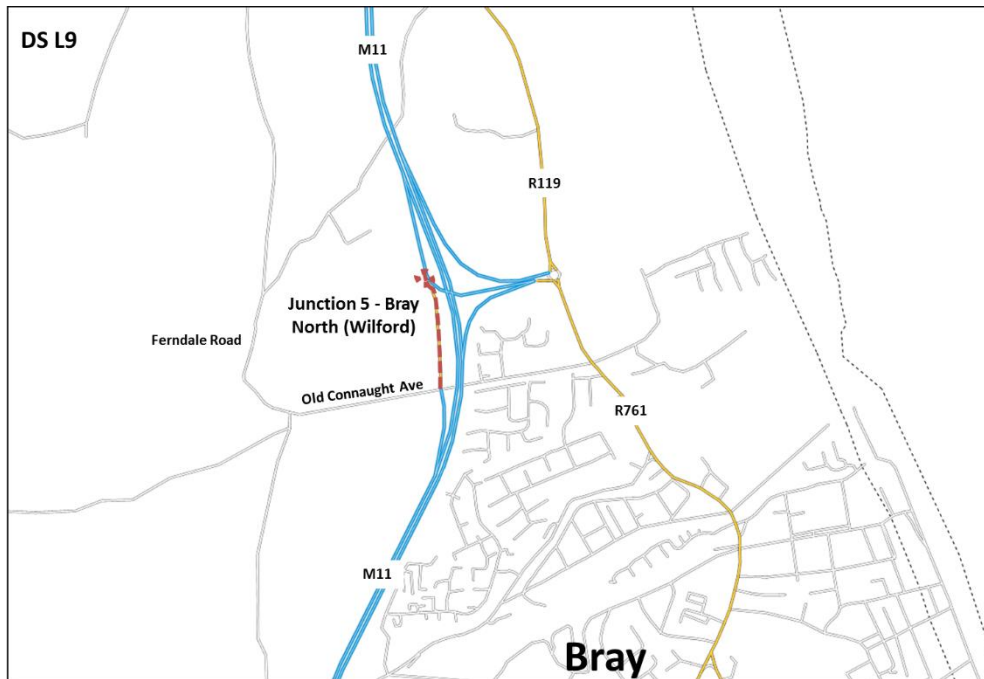


Figure 5.9: Do-Something Scenario L9

5.4.10 Assessment of Proposals

Each option was initially assessed using the 2015 base year AM and PM peak models to evaluate its impact based on current traffic levels and then in the 2030 AM and PM peak models. A summary is provided in Table 5.5 below and full details of the assessment of each of the options considered are presented in Appendix D.

Table 5.5: Do-Something Scenarios (Regional/Local Road Options)

Scenarios	Description	Impact on M11/N11 / Other Comments
L1	Link road between Herbert Road and Upper Dargle Road. Provides a 3 rd crossing of the Dargle River and allows access to Junction 6 (Bray Central/Fassaroe).	Provides benefits to the operation of the N11 as a result of reduced flows between Junctions 6 and 7. Also benefits to Bray Town with reduced traffic levels through the town and improved local network accessibility. The proposal will also lead to improved accessibility/connectivity between Bray and Fassaroe. ✓
L2	Bridge over N11 (Junction 6a) between Herbert Road and Enniskerry Road (R117)	Benefit to N11 between Junction 6a and 7 however three junctions with full turning movements in close proximity (<2km) would not be recommended. X

Scenarios	Description	Impact on M11/N11 / Other Comments
L3	Link road between Junction 6 (Bray Central/Fassaroe) and Enniskerry	It is recognised there is some merit in this option from the point of view of local accessibility but limited benefit to N11. X
L4	Link road between Junction 7 (Bray South/Kilcorney) and Junction 8 (Kilmacanogue)	Limited benefit to the operation of the N11 via reduced flows and considered superfluous with mainline and junction improvements between Junctions 7 and 8. However it is recognised there is still some merit in this option from the point of view of local accessibility. X
L5	North Greystones Link Road.	When considered in isolation there is a small increase of 170 vehicles in 2015 between Junctions 8 and 9 with a subsequent reduction along the Bray Southern Cross Road. This equates to a 4% increase in flows on the N11 between Junctions 8 and 9. However when considered with the Junction 7 upgrade in place traffic continues to use the R761/R768 Bray Southern Cross. This road is of a good standard and the link flow is comfortably below the capacity. As such scenario L5 is discounted. X
L6	Closure of junction between Herbert Road and the N11.	When considered in isolation there is adverse impacts on local traffic. However this junction is dealt with by the J6a proposals described earlier. X
L7	Closure of direct access between Enniskerry Road and the N11. Access maintained through one-way northbound service roads between Junction 7 and 6 connecting to Enniskerry Road. Closure of junction between Herbert Road and the N11. New additional diverge between J6 and J7 to a southbound segregated one-way service road accessing Halting site, Dargle Lane, Herbert Road and private accesses, which then connects to Ballywaltrim Lane and then to J7 via local road network.	When considered in isolation there is adverse impacts on local traffic. However, provision of Scenario L1 will address this. Benefits to N11 mainline. ✓
L8	DS L8 provides for a link road from Rathmichael/Ballycorus Road to M50 Junction 16 (Cherrywood). Alternative route for users travelling from the Shankill area to the M50 by allowing them a more direct route thereby potentially avoiding travelling to this destination via M11 Junction 5 (Bray North/Wilford).	Minor benefits in travel time and delay in the AM peak. Shorter route to the M50 for traffic in Shankill. In the PM peak reduction of the u-turn movement down to Junction 5 (Bray North). Relatively low benefits but strong contribution to network resilience in providing an alternative route and relieving pressure on M11 Junction 5. ✓
L9	DS L9 provides for a link road from Old Connaught Avenue to the northbound on-ramp at Junction 5. This option provides an alternative route for users travelling from Old Connaught Avenue, west of the M11/N11, to the M50.	Benefits in travel time and delay are minor due to the current low levels of development to the west of the M11/N11. The study demonstrates that an upgrade of J5 is not required as the junction can cater for the projected demand. However future public transport proposals and/or local area plan proposals are likely to

Scenarios	Description	Impact on M11/N11 / Other Comments
		require the upgrading of the junction. Therefore, provision of this intervention at this stage may be premature. X

5.5 Alternative Routes for Incident Management

One of the objectives of the needs assessment is to ensure the safe daily operation of the M11/N11 mainline and junctions in the event of the occurrence of incidents. The unexpected closure of a section of the National Road network particularly one which carries a high volume of traffic can lead to significant delays and wider network impacts. In the event of an unexpected closure an alternative route which provides a safe route to the next junction should be available.

Table 5.6: Do-Something Scenarios (Alternative Routes)

Scenario	Description
AR1	Improved local roads to the west of M11 between J4 and J6 (Ferndale Road, part of Thornhill Road plus a new link from Thornhill Road to Fassaroe as per Fassaroe masterplan). ✓
	New link from M50 J16 (Cherrywood) to Rathmichael/Ballycorus Road - Scenario L8 above. ✓
	New local road between Junction 7 & 8 on the east side (Kilmacanogue Link Road) – Scenario L4 above. X

5.6 2030 Do-Something Roads Strategy

Based on the assessment of each of the individual scenarios as described in Appendix C, a 2030 Do-Something strategy was identified and is outlined in Table 5.7.

Table 5.7 - 2030 Do-Something Strategy

Scenario	Description
1	3 lanes plus an auxiliary lane on the M11 between Junction 4 (M50/M11) and Junction 5 (Bray North) and 3 lanes in each direction on the M11/N11 between Junction 5 and Junction 8 (Kilmacanogue). The merge and diverge flows at Junction 7 are such that this is best achieved by the provision of lane gains and lane drops northbound and southbound at Junction 7 such that the third lane between Junctions 7 and 8 is a continuous auxiliary lane. However, considerations should be given at preliminary design stage to ensure that the possibility of maintaining three mainline lanes through Junction 7 is not precluded.
J6	Increased capacity (roundabouts and merges/diverges)
J7	Increased capacity (Dumbbell layout or other layout that provides adequate capacity for future year flows)
L1	Link road between Herbert Road and Upper Dargle Road. Provides another crossing of the Dargle and allows access to Junction 6 (Bray Central/Fassaroe), subject to other measures.
J6a/L7	Junction 6a (West) – Closure of direct access between Enniskerry Road and the N11. Access maintained through one-way northbound service roads between Junction 7 and 6 connecting to Enniskerry Road. Junction 6a (East) - Closure of direct access between Herbert Road and the N11. New additional diverge between J6 and J7 to a southbound segregated one-way service road accessing Halting

Scenario	Description
	site, Dargle Lane, Herbert Road and private accesses, which then connects to Ballywaltrim Lane and then to J7 via local road network.
J8	Junction 8 Kilmacanogue – Service Roads
AR1	<ol style="list-style-type: none"> 1. Improved local roads to the west of M11 between J4 and J6 (Ferndale Road, part of Thornhill Road plus a new link from Thornhill Road as per Fassaroe masterplan). 2. New link from M50 J16 (Cherrywood) to Rathmichael Road (DS L8)

Other measures such as at Junction 5 (Wilford), etc. will be necessary to facilitate the ongoing development of the Wicklow and Dún Laoghaire Rathdown County Council areas. The form and implementation of these measures will depend on the development of adjacent lands and other transport proposals such as public transport, Luas, etc.

5.7 2050 Do-Something Strategy

The summary of the 2050 flows on the M11/N11 corridor provided in Table 5.3 demonstrated that the increase in capacity of the M11/N11 corridor to Junction 8 (Kilmacanogue) included in the 2030 Do-Something strategy above can cater for the projected traffic flows in 2050. As such there is no need for further capacity enhancements in any 2050 Do-Something Strategy.

As with the 2030 strategy there is no need for additional mainline or junction capacity on the N11 between Junction 8 (Kilmacanogue) and Junction 14 (Coyne's Cross) in any 2050 strategy, based on current projections. However, to bring this section of the corridor up to the required standard (being part of the TEN-T comprehensive network) by 2050; existing direct accesses and left on / left off junctions should be closed or reconfigured within this timeframe.

Chapter 6 Phased Implementation of Long Term Strategy

6.1 Overview

The final objective of the study was to “Identify a phased implementation of the interventions such that operational benefits on the corridor can be realised at an early stage without compromising the long term strategy”.

In addressing this objective the focus has been to identify where the most benefits can be realised in the shortest timescale, rather than simply proposing a phased implementation southwards from the M50/M11 merge. Consideration has been given to the engineering feasibility and the deliverability of the improvements needed to implement the various component parts of the full roads strategy.

This identified that there are two sections that could be completed within the existing road corridor reservation:

- Widening of the M11 between J5 (Bray North) and J6 (Bray Central) from 2 lanes to 3 lanes in each direction; and
- Completion of the amended merges and diverges, together with the one-way service roads, between J7 (Bray South) and Junction 8 (Kilmacanogue) in both directions.

Alternatively it has identified that all land acquisition required for the long term improvements would need to be acquired on the western side between Junction 6 Bray Central and Junction 8 Kilmacanogue. It is therefore possible for the full length of the southbound mainline upgrade to be completed within the existing road corridor.

As a consequence the improvements here could be implemented in the short term, whereas all other elements would require some land acquisition and / or would need to be progressed through the Statutory Planning process. Therefore consideration was given to what operational benefits could be achieved by the implementation of these two sections. Following this, consideration was given to how the remaining sections could be phased to provide the increase in mainline capacity that is needed.

6.2 Improvements within Existing Road Corridor Reservation

6.2.1 *Widening to 3 lanes between Junctions 5 and 6*

Based on the available cross section, this widening can be achieved without the need for any land acquisition, making use of the wide central median. The study traffic model was used to assess the operational benefits of undertaking this section in isolation. This has shown that the benefits are limited as the capacity and weaving issues between Junctions 6 (Bray North) and 7 (Bray South) would remain. Effectively in the AM peak period in the northbound direction the capacity of the Junction 6-7 section would still act as constraint to the dominant flow. A similar situation would exist in the PM peak period in the southbound direction.

6.2.2 *Merge, Diverge and Service Roads between Junctions 7 and 8*

Mainline capacity is affected by a number of contributory factors that lead to the southbound congestion in the PM peak period. One of these is the reduction in speed limit from 100km/hr to 60 km/hr between Junctions 7 (Bray South) and 8 (Kilmacanogue), coupled with the number of direct accesses and in particular the petrol filling station at the Junction 8 diverge. There are similar, although less severe, issues northbound in the AM peak period, with a speed limit drop from 100km/hr to 80km/hr, weaving movements and a bus stop at the Junction 8 merge, as well as a separate diverge and merge serving Avoca Hand Weavers and an unnamed local road and another diverge.

The long term strategy for this link in the southbound is to have an early lane drop that acts as the slip

road to Junction 8 as well as a segregated service road for all the accesses and the petrol station. The speed limit on the two mainline lanes that would carry on past Junction 8 southwards could therefore remain at 100km/hr. A similar arrangement is proposed in the northbound direction in the long term; the lane gain at Junction 8 would happen some way north of the junction with a segregated service road for the petrol station, bus stop and local road also acting as the slip road. Again this would mean that there would be no need to reduce the speed limit on the N11 from 100km/hr.

This arrangement could be implemented in the shorter term in advance of the provision of additional mainline lanes between Junction 7 and 8 within the existing road corridor; and instead of having a lane gain / lane drop, a full standard merge and diverge could be constructed from the two mainline lanes that exist between Junctions 7 and 8. This would remove some of the contributory factors to congestion, particularly southbound, and also allow the mainline speed limit to be maintained at 100km/hr for the full length, with associated travel time benefits.

6.2.3 Full Southbound Mainline Improvements between Junction 5 and 8

As referred to above, all land acquisition required for the full strategy would be on the western side of the N11. The wide median of the existing corridor is sufficient to allow for the full southbound scheme to be implemented without impacting the existing northbound carriageway. However the Junction 7 upgrade would not occur as part of these improvements. The desirability of implementing such a strategy is considered questionable and would require additional investigation.

6.3 Phased Implementation Alternatives

Following the assessments referred to above, one alternative for the phased implementation plan for the long term needs of the corridor would be structured around four phases such that operational benefits can be realised as quickly as possible:

- Phase 1 – Construction of parallel one-way service roads north of Junction 8 (Kilmacanogue). These improvements do not require land acquisition and address the issues of direct access and can be implemented in the short term;
- Phase 2 – Upgrading of the M11 to 3 lanes to Junction 6 (Bray Central), upgrading of Junction 6 (increased capacity of existing roundabout and upgraded merges/diverges);
- Phase 3 – Upgrade of the N11 to 3 lanes to Junction 8 (Kilmacanogue), service roads between Junction 6 and 7 inclusive of the closure of direct access at Junction 6a (east and west), major upgrade of Junction 7 (Bray South) and local link road improvements for network resilience; and
- Phase 4 – Junction 8 (Kilmacanogue) to Junction 14 (Coyne's Cross) direct access/junction improvements.

The assessment also recognised a need for an additional bridge across the River Dargle (link road between Upper Dargle Road and Herbert Link Road) providing further connectivity between the M11/N11 and Bray. The location for an additional bridge crossing of the River Dargle will require further consideration. In addition to any benefit to the M/N11 corridor, the location of the crossing will be influenced by the requirements of public transport, walking and cycling and local trips and the technical feasibility of crossing the river.

An alternative approach to implementing the proposed measures, would see Phase 1 include the widening of the M11 in both directions between Junction 4 and Junction 6 and the southbound only widening of the N11 between Junction 6 and 8, as no land take is required to implement these proposals. A description of the potential phased implementation proposals outlined above is provided in Appendix E alongside a graphical summary of the various measures proposed.

Chapter 7 Summary & Conclusions

SIFLT has effectively framed how Exchequer capital will be directed within the transport sector in the near future. This document recognises that an effective transport network is central to the functioning of society and the economy. Rather than setting out a list of projects to be prioritised, SIFLT forms a filter for transport investment projects prior to their appraisal for suitability for inclusion in national/regional programmes. These priorities include:

- Priority 1: Achieve Steady State Maintenance;
- Priority 2: Address Urban Congestion;
- Priority 3: Maximise the Value of Existing Land Transport Networks.

The *Transport Strategy for the Greater Dublin Area 2016-2035* provides a framework for the planning and delivery of transport infrastructure within the region surrounding and including Dublin over the next 20 years. Among a suite of public transport, road proposals, demand management, walking and cycling measures put forward, the Transport Strategy identified and appraised the need for a number of measures along the M11/N11 south eastern corridor to address deficiencies and related congestion, specifically a: *'Capacity enhancement and reconfiguration of the M11/N11 from Junction 4 (M50) to Junction 14 (Ashford) inclusive of ancillary and associated roads schemes, to provide additional lanes and upgraded junctions, plus service roads and linkages to cater for local traffic movements'*.

The subject study has been undertaken to outline the nature of measures which would address the need recognised by the NTA along the M11/N11 road corridor; and present an overall strategy in terms of delivery and implementation; while aligning with the objectives set out in SIFLT.

The study has been undertaken in consultation with other key stakeholders namely Wicklow County Council (WCC), Dún Laoghaire – Rathdown County Council (DLRCC) and the National Transport Authority (NTA); and has considered the needs and requirements of the National Road network along the M11/N11 corridor between the M50 and Ashford. At present, road users are currently experiencing significant queuing and delay during the peak periods and various sections and junctions along the route are not in accordance with current design standards. This study has considered the impact of the range of complementary public transport and demand management measures along the corridor as outlined in the NTA Transport Strategy in determining the scale of road measures required. In developing the proposals of this study further, consideration should be given the interaction between roads proposals and the complementary public transport and demand management measures to ensure that the measures are compatible.

The section of the M11/N11 between the Junction 3 (Loughlinstown) and Junction 8 (Kilmacanogue) is a strategic two lane dual carriageway, which has for the most part been in service since 1991, with limited interventions or upgrade since then south of Junction 5. As such, some sections of this portion of the M11/N11 corridor fall short in terms of current road design standards. In addition, this section of the N11 is situated between two sections of recently upgraded high quality motorway, which tends to emphasise the issues along the subject section. These deficiencies impact on traffic flow conditions and result in significant congestion during the weekday morning and evening peaks and ineffective levels of service.

Furthermore, the M11/N11 is of strategic importance nationally and this is reflected in its inclusion within the Trans-European Transport Network (TEN-T) comprehensive road network.

This study has used the population and employment projections contained within the TII National Transport Model. These projections have been compared against those contained in the Wicklow County Development Plan and those used in development of the NTA Transport Strategy for the Greater Dublin Area. It is noted that in some cases TII projections are lower than those contained within the other documents. However for the purposes of identifying issues along the corridor they are considered

acceptable.

To this end, the study has identified improvements necessary to take the mainline, junctions and local road network within the study area up to standard (Chapter 5). The study also outlined a number of strategies for implementation of the improvements in order that operational benefits on the corridor can be realised at an early stage without compromising the long term strategy (Chapter 6). The approach to phasing focused on sections of the strategy which do not require land acquisition now and could be implemented in the short term i.e. Phases 1 and 2. The phased implementation of the strategy shown below is one potential version of the strategy, some phases and the proposals contained therein may be inter-changeable with others:

Phase 1 – Construction of parallel one-way service roads north of Junction 8 (Kilmacanogue). These improvements do not require land acquisition and address the issues of direct access and can be implemented in the short term;

Phase 2 – Upgrading of the M11 to 3 lanes to Junction 6 (Bray Central) within the existing road reservation and upgrading of Junction 6 (increased capacity of existing roundabout and upgraded merges/diverges);

Phase 3 – Upgrade of the N11 to 3 lanes to Junction 8 (Kilmacanogue), service roads between Junction 6 and 7 inclusive of the closure of direct access at Junction 6a (east and west), major upgrade of Junction 7 (Bray South) and local link road improvements for network resilience; and

Phase 4 – Junction 8 (Kilmacanogue) to Junction 14 (Coyne's Cross) direct access/junction improvements.

The assessment also recognised a need for an additional bridge across the River Dargle (link road between Upper Dargle Road and Herbert Link Road) providing further connectivity between the M11/N11 and Bray. The location for an additional bridge crossing of the River Dargle will require further consideration. In addition to any benefit to the M11/N11 corridor, the location of the crossing will be influenced by the requirements of public transport, walking and cycling and local trips and the technical feasibility of crossing the river.

The proposals outlined above are indicative at this stage and, depending on availability of funds, will be subject to further detailed future investigations including engineering design and appraisal in order to determine their exact form.

The study demonstrates that investment in this section of the M11/N11 would address urban congestion and maximise the value of the existing M11/N11 corridor. Any further delay in investment in this section of the M11/N11 will lead to further increases in congestion along the corridor and indeed within the wider area; and will further constrain growth in the north and east of Wicklow and the Dún Laoghaire Rathdown area, as a result of reduced competitiveness and productivity.