An Roinn Iompair
Department of Transport

Tionscadal Éireann
Project Ireland
2040

Comhairle Contae Chill Dara
Kildare County Council

MAYNOOTH TO LEIXLIP PROJECT

Maynooth to Leixlip Project

Phase 2 Options Report

Volume A Main Report

April 2024

Comhairle Contae Átha Cliath Theas
South Dublin County Council

NTA
Údarás Náisiúnta Iompair
National Transport Authority

TII
Bonneagar Iompair Éireann
Transport Infrastructure Ireland

KILDARE nro
NATIONAL ROADS OFFICE

ARUP

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Introduction

Kildare County Council is progressing the development of the Maynooth to Leixlip Project in partnership with South Dublin County Council, Transport Infrastructure Ireland and the Department of Transport. The aim of the Maynooth to Leixlip Project is to assess the needs of the M4/N4 mainline corridor and junctions from Maynooth to Leixlip in terms of catering for future demand from a safety and operational efficiency perspective.

The Maynooth to Leixlip Project is being implemented in accordance with Transport Infrastructure Ireland's Project Management Guidelines (PMGs). These guidelines provide a framework for the management, development and delivery of national road and public transport capital projects. The Project Management Guidelines divide the evolution and progression of a project into an eight-phase process (Phase 0 – 7 inclusive) as illustrated in Figure 1 below.

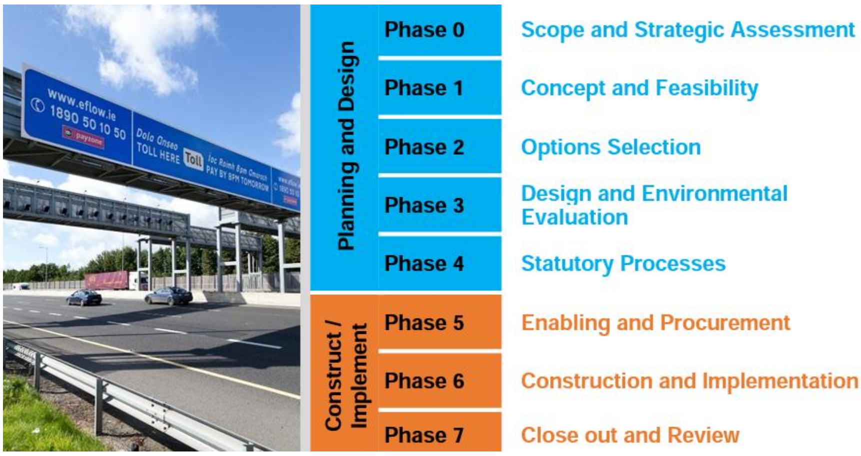

Figure 1: TII PMG Project Phases

The Maynooth to Leixlip Project study area is shown Figure 2.

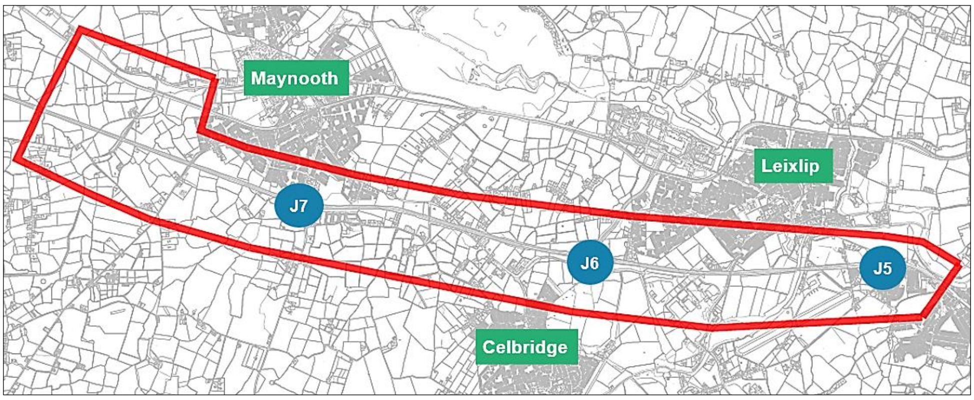

Figure 2: Maynooth to Leixlip Project - Study Area (© Google Map data ©2024 Tele Atlas)

Phase 1 (Concept and Feasibility) was undertaken in 2020 and sought to investigate the feasibility of the Maynooth to Leixlip Project by identifying the cause of the existing problems, identifying potential interventions and establishing the viability and direction of further studies. The outcome of the Phase 1 studies was that a strong justification for the advancement of the Maynooth to Leixlip Project to Phase 2 existed.

Project Objectives

In accordance with the TII Project Appraisal Guidelines and the Common Appraisal Framework (CAF), published by the Department of Transport, the specific objectives of the Maynooth to Leixlip Project are listed in Table 1.

Table 1: Project Objectives

Criteria	Project Specific Objective
Economy	• Provide a more reliable and resilient transport solution. • Manage congestion on the M4/N4 corridor. • Provide the infrastructure to enable transport solutions to move more people more efficiently. • Support the protection of the economic prospects of Maynooth, Leixlip, Celbridge, Kilcock, Enfield and their rural hinterland. • Facilitate effective strategic traffic movement, including from regional centres of Athlone and Sligo. • Facilitate effective freight movement.
Safety	• Enable the provision of a safer travelling environment for all road users, including vulnerable road users.
Environment	• Facilitate an increase in modal shift from private car to public transport and walking/cycling thus supporting a transition towards low carbon and climate resilience.
Accessibility and Social Inclusion	• Provide improved accessibility to the GDA public transport network from regions outside of the GDA. • Support improved connectivity for all road users to public transport. • Enable the successful creation of place making and assist in the generation of vibrant communities.
Integration	• Provide the infrastructure to support an improved balance of transport modes. • Support greater road-based user integration and connectivity with all other transport modes.
Physical Activity	• Improve infrastructure in, across and adjacent to the M4/N4 corridor which may form barriers to physical activity and in particular linkage between key local trip attractors including education, work, residential, leisure and natural environment. • Support the provision for cycle parking and infrastructure at key public transport nodes and destinations. • Support the creation of a healthy environment conducive to active travel.

Need for the Project – Policy Context

The need to deliver the Maynooth to Leixlip Project is supported in terms of policy from European to local level. The objectives of the Maynooth to Leixlip Project are consistent with current government planning and transport policy as set out in the various policy documents listed below.

Table 2: Policy Context

Policy Hierarchy	Policy Plan/Document
European Policy Context	Trans-European Network for Transport ("TEN-T") Regulations
National Policy Context	Project Ireland 2040: National Planning Framework
	Project Ireland 2040: National Development Plan 2021 – 2030
	National Roads 2040
	Climate Action Plan 2024
	Department of Transport Statement of Strategy 2021 – 2023
	National Investment Framework for Transport in Ireland (NIFTI)
	Government of Ireland National Sustainable Mobility Policy
Regional Policy Context	Eastern and Midland Regional Assembly, Regional Spatial and Economic Strategy 2019-2031
	NTA Transport Strategy for the Greater Dublin Area 2022-2042
	BusConnects
	NTA Greater Dublin Area Cycle Network Plan
Local Policy Context	Kildare County Development Plan 2017 – 2023
	South Dublin Draft County Development Plan 2022 – 2028

Project Specific Need

The Maynooth to Leixlip Project is required to provide interventions to a number of transportation issues, which include the following:

- Congestion on the M4/N4, particularly at peak times;
- AADT between J6 and J8 increased by 19% between 2013 and 2019;
- M4/N4 currently serves both strategic traffic and also local Greater Dublin Area traffic, which is impacting on its operational efficiency as a strategic route;
- High dependency on private cars within the study area (approximately 68%);
- Bus services utilising the M4/N4 must negotiate the same traffic volumes as private cars;
- Extensive public transport in the study area, however sufficient modal shift from private car to public transport has not materialised; and

- Junction 7 Maynooth has geometric and safety issues.

Fundamentally, the Maynooth to Leixlip Project is required to address the operational and safety deficiencies along the M4/N4 corridor between Junction 5 Leixlip and Junction 7 Maynooth. The provision of optimised and improved infrastructure seeks to enable the delivery of an overall transport network that moves more people more efficiently and support better user integration with other transport modes, including public transport and active travel.

The Maynooth to Leixlip Project is an integral component required to support investment within the study area and to align the corridor with the wider policies, as noted above. The project objectives provide the basis upon which options were developed and assessed, with the aim of delivering upon the full range of performance targets set out within the Options Report.

Initial Options Assessment Methodology

The methodology for the development of options for the Maynooth to Leixlip Project followed a rigorous and thorough multi-stage process. As outlined in TII Project Appraisal Guidelines Unit 4.0 *(Consideration of Alternatives and Options)*, the initial step focussed on drafting a long list of potential options that may address the need for intervention. A process flow chart was prepared and used for the development and assessment of options. The process flow chart is illustrated in Figure 3.

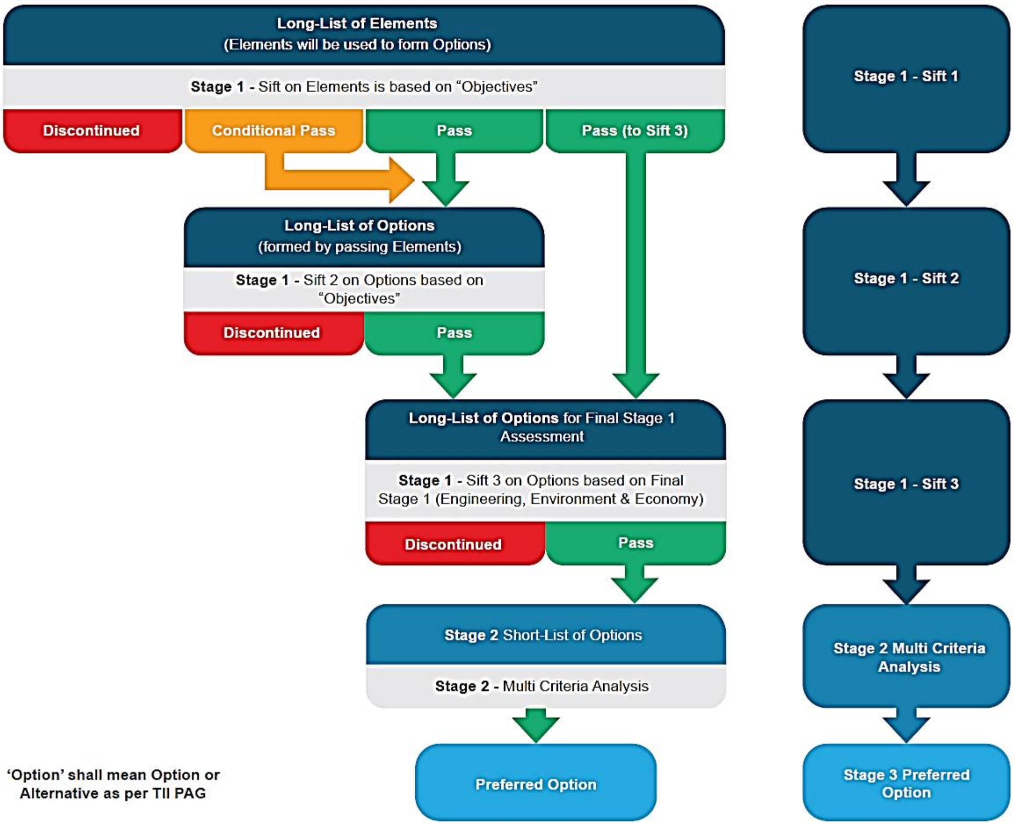

Figure 3: Phase 2 Process Flow Chart

Stage 1 Sift 1 - Long-List of Elements

Elements comprised of different categories, with a number of different elements under each category. These are summarised in Table 3.

Table 3: Element Categories entering Stage 1 Sift 1

Number of Elements	Element Category	Description
6	Bus	These were a combination of the addition of bus priority measures including, eastbound only, westbound only and both directions, together with enhanced bus infrastructure.
10	Park and Ride	These were a combination of strategic park and ride, local mobility hubs and local park and ride elements. Locations included, from west to east, Enfield, Tolling Point, Kilcock, Millfarm, Junction 7 Maynooth, Junction 6 Celbridge, Collinstown and Junction 5 Leixlip.
2	Rail	These were DART+ West benefit analysis and regional rail improvement testing.
6	Active Travel	These were a combination of active travel enhancements at an array of locations including Junction 7 Maynooth on the R406, the R405 Overbridge, Junction 6 on the R449, the R404 Overbridge and Junction 5. A further element was the supporting of cycle parking and infrastructure at key public transport nodes and destinations within the study area.
39	Demand Management	These measures included land use, fiscal, traffic demand management, parking management, behavioural change programs, information awareness and built environment measures.
14	Road	These included offline options, online widening in various directions and ancillary lanes at various locations.
20	Junctions/Bridges	These included elements at the existing M4/N4 junctions and also at each of the existing overbridges within the study area.
97	**Total**	

Elements were qualitatively assessed against the project objectives to establish, at a fundamental level, if these options would respond to the transportation problems identified within the study area and surrounds. A summary of the Stage 1 Sift 1 Long-List of Elements is shown in Table 4.

Table 4: Stage 1 Sift 1 Long-List of Elements Summary

Element Category	Number of Elements	Pass (to Stage 1 Sift 3)	Pass	Conditional Pass	Discontinued
Bus	6	1	2	1	2
Park and Ride	10	6	0	0	4
Rail	2	2	0	0	0
Active Travel	6	6	0	0	0

Element Category	Number of Elements	Pass (to Stage 1 Sift 3)	Pass	Conditional Pass	Discontinued
Demand Management	39	11	0	0	28
Road	14	0	0	3	11
Junctions/Bridges	20	0	0	9	11
Total	**97**	**26**	**2**	**13**	**56**

Stage 1 Sift 2 - Long-List of Options

A total of 77 options were identified under the two different categories, which are summarised in Table 5.

Table 5: Options Categories entering Stage 1 Sift 2 Categories

Number of Options	Option Category
9	Corridor Options
68	Junctions/Bridges Options
77	**Total**

These options were then qualitatively assessed against the project objectives to establish, at a fundamental level, if these options would respond to the transportation problems identified within the study area and surrounds.

A summary of the options that were taken forward to Stage 1 Sift 3 Preliminary Options Assessment (POA), based on Engineering, Environment & Economy, is shown in Table 6.

Table 6: Stage 1 Sift 2 Long-List of Options Summary

Option Category	Final Pass (to Sift 3)
Corridor Options	6
Junctions/Bridges Options	14
Total	**20**

These were then combined with options for other categories to form a list of options which were taken forward into the Stage 1 Sift 3 Preliminary Options Assessment (POA), as follows:

- 6 Corridor options (Corridors contain bus and road-based options);
- 1 Enhanced Bus Infrastructure;
- 14 Junctions/Bridges options;
- 11 Demand Management options;
- 6 Park and Ride options;
- 6 Active Travel options; and
- 2 Test Rail options.

Stage 1 Sift 1 and 2 Summary

A summary of the Stage 1 Sift 1 and Sift 2 process is illustrated in Figure 3.

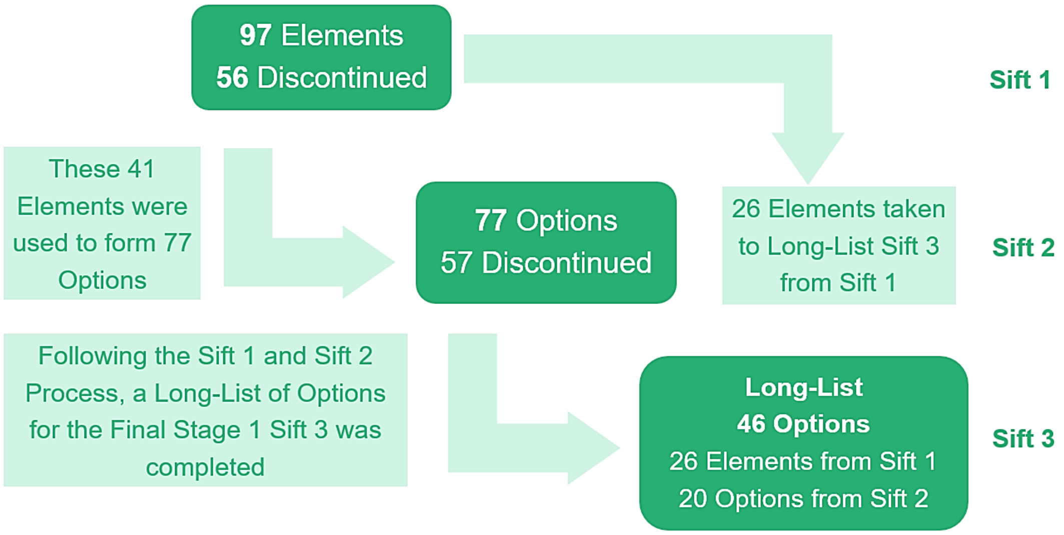

Figure 4: Stage 1 Sift 1 and 2 Summary

Stage 1 Sift 3 - Preliminary Options Assessment

The Stage 1 Preliminary Options Assessment was the third sift in Stage 1. The headline criteria against which each of the options were assessed were:

- Engineering;
- Environment; and
- Economy.

Corridor Options

Corridor Option 1

Corridor Option 1 consists of proposed hard shoulder bus priority measures in both the eastbound and westbound directions between Junction 7 Maynooth and Junction 5 Leixlip.

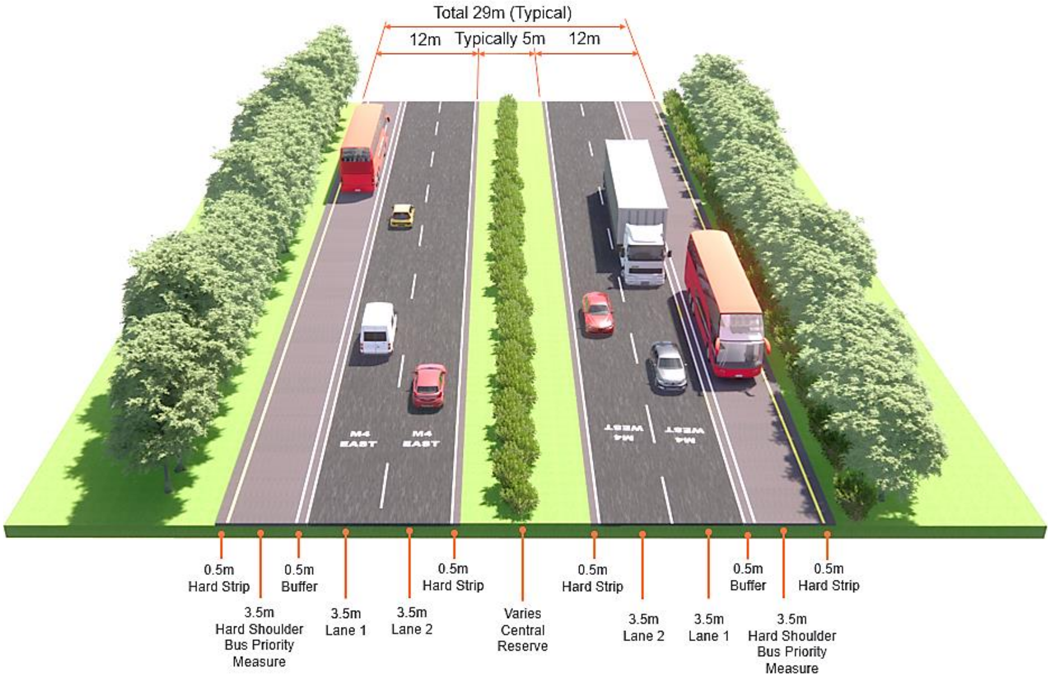

Figure 5: Corridor Option 1 – Cross Section

Corridor Option 2

Similar to Corridor Option 1, Corridor Option 2 consists of proposed hard shoulder bus priority measures in both the eastbound and westbound directions between Junction 7 Maynooth and Junction 5 Leixlip. However, it differs in that it includes an additional third traffic lane in the westbound direction therefore it has a wider extent.

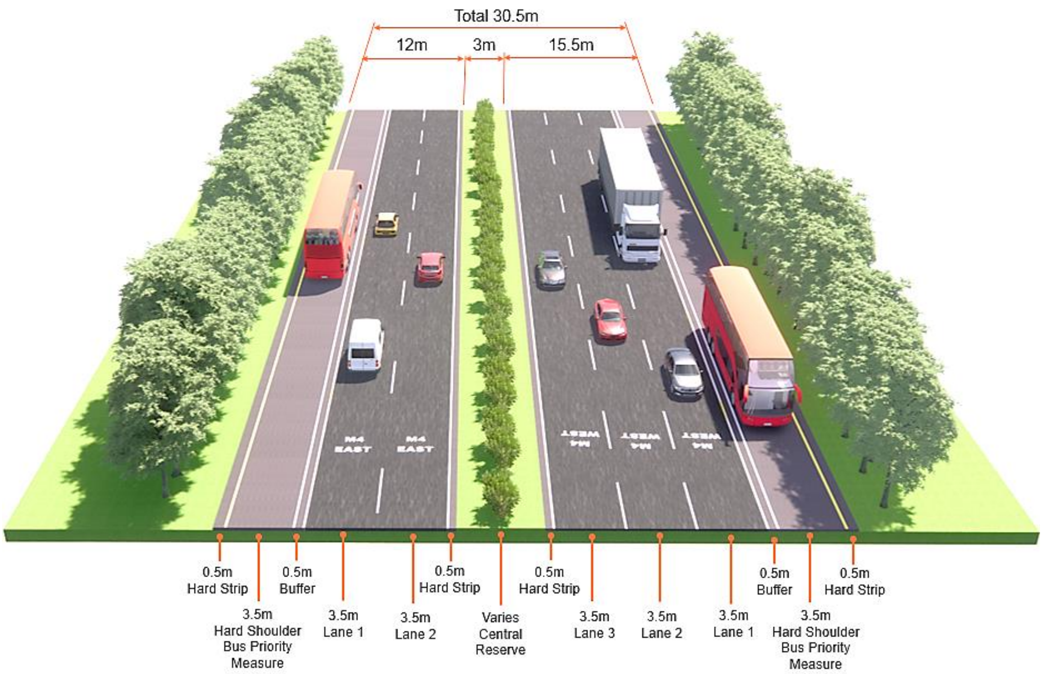

Figure 6: Corridor Option 2 – Cross Section

Corridor Option 3

This Corridor Option differs in that it includes an additional third traffic lane in both the eastbound and westbound directions. Therefore, it has a wider extent than either Corridor Option 1 or Corridor Option 2.

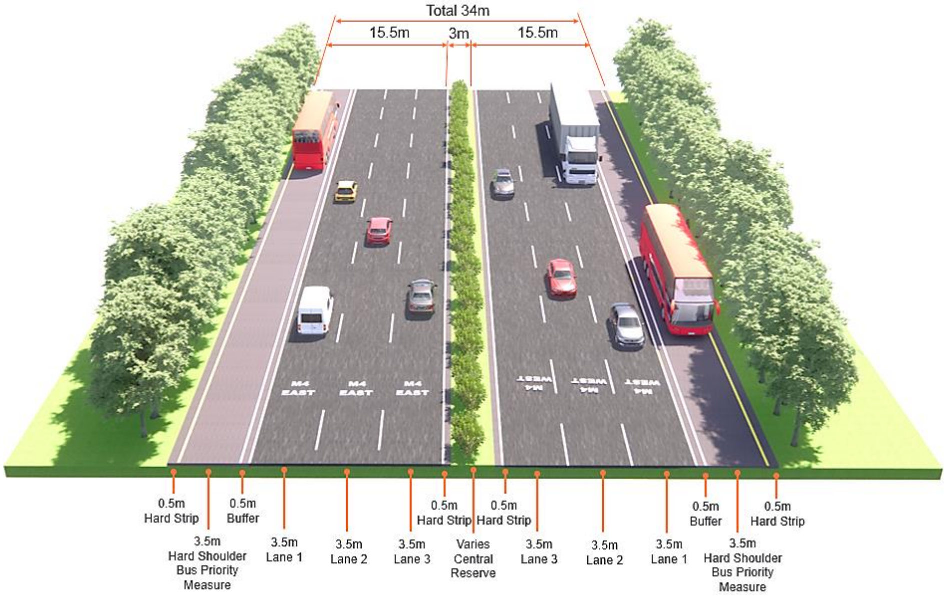

Figure 7: Corridor Option 3 – Cross Section

The summary of the Corridor options Stage 1 Preliminary Options Assessment outcome was as follows:

- Corridor Option 1: Taken forward into Stage 2 Project Appraisal Matrix;
- Corridor Option 2: Taken forward into Stage 2 Project Appraisal Matrix; and
- Corridor Option 3: Excluded, not taken forward.

Junction and Bridges Options

Junction 7 Maynooth

Junction options for Maynooth included both road and active travel-based options. The preferred option in each category was then assessed against each other. A summary of this assessment is as follows:

Option 1 – taken forward to Stage 2 PAM - Multi-Criteria Analysis

Figure 8: Option 1 – Improve Existing Junction (1 Junction Option)

Option 2 – taken forward to Stage 2 PAM - Multi-Criteria Analysis

Figure 9: Option 2 - Provide 1 New Junction and Convert Existing to an Overbridge

Junction 5 Leixlip

Junction options for Leixlip included both road and active travel options. The three options included in the Preliminary Options Assessment were:

- Improve the existing junction;
- New junction located on the R404, and convert the existing to an overbridge; and
- New junction located between the Liffey River Bridge and the existing junction and convert the existing to an overbridge.

The options are shown below.

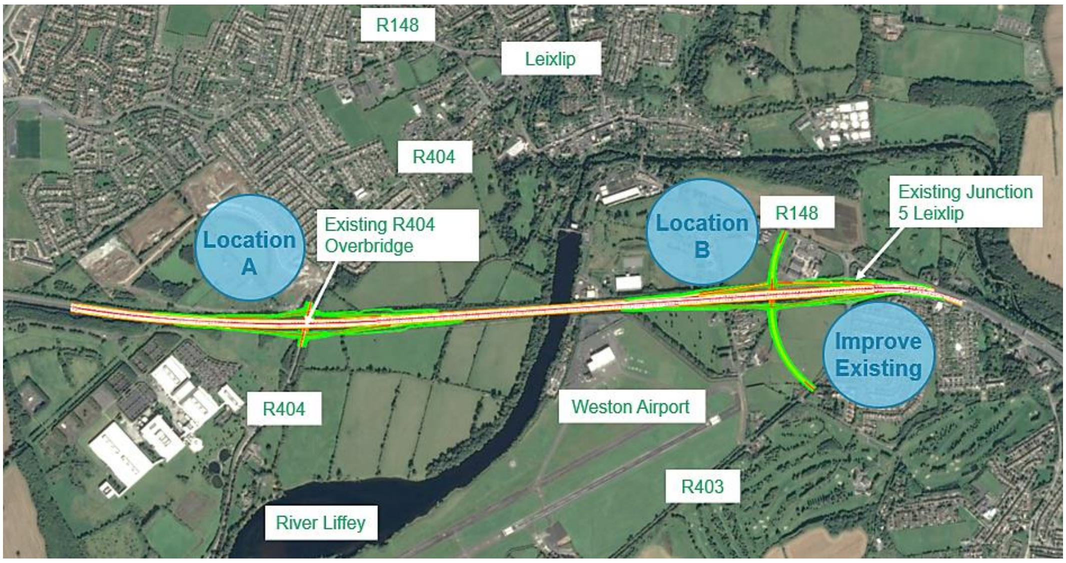

Figure 10: Junction 5 Leixlip Options Overview

The option of improving the existing junction was taken forward into the Stage 2 PAM Multi-Criteria Analysis. Refer to Table 7.

Table 7: Junction 5 Summary

Option	Option Description	Result	Comments
Option 1	Improve Existing Junction	Preferred	Taken forward to Stage 2 PAM
Option 2	Provide 1 New Junction and Convert Existing to an Overbridge	Discounted	Preferred over Location B. Taken forward for assessment against Option 1
		Discounted	Location A preferred to Location B

Stage 2 Project Appraisal Matrix

Overview

A brief summary of the Corridor, Junction and Active Travel options taken forward to Stage 2 Project Appraisal Matrix (PAM) is presented in the tables below.

Table 8: Stage 2 PAM Corridor Options

Corridor Option	Option Description
Corridor Option 1	Bus priority measures within the hard shoulder in both the eastbound and westbound directions
Corridor Option 2	Bus priority measures within the hard shoulder in both the eastbound and westbound directions and an additional traffic lane in the westbound direction

Table 9: Stage 2 PAM Junction Options

Junction	Option Description
Junction 7 Maynooth	Option 1 – Maintain and Optimise/Improve the Existing Junction
	Option 2 - New Junction and Convert the existing Junction to an Overbridge
Junction 6 Celbridge	Optimise/Improve the Existing Junction
Junction 5 Leixlip	Optimise/Improve the Existing Junction

Table 10: Stage 2 PAM Active Travel Options

Location	Option Description
R408 Newtown Road Overbridge	East Option vs West Option
Junction 7 Maynooth	East Option vs West Option
R405 Ballygoran Overbridge	East Option vs West Option
Junction 6 Celbridge	East Option vs West Option
R404 Celbridge Road Overbridge	East Option vs West Option
Junction 5 Leixlip	East Option vs West Option

Corridor Options

A summary of the Stage 2 PAM multi-criteria analysis for the Corridor options is presented below.

Table 11: Corridor Options - Multi-Criteria Analysis (MCA) – CAF Criteria Summary

Criteria	**Corridor Option 1**	**Corridor Option 2**
Safety	Preferred	Least Preferred
Economy	Preferred	Preferred
Environment	Preferred	Least Preferred
Integration	Preferred	Least Preferred
Accessibility and Social Inclusion	Preferred	Preferred
Physical Activity	Preferred	Preferred
Overall Result	**Corridor Option 1 is Preferred**	

Junction 7 Maynooth Options

A summary of the Stage 2 PAM multi-criteria analysis for the Junction 7 Maynooth options is presented below.

Table 12: Junction 7 Options - Multi-Criteria Analysis (MCA) – CAF Criteria Summary

Criteria	**Corridor Option 1**	**Corridor Option 2**
Safety	Least Preferred	Preferred
Economy	Preferred	Least Preferred
Environment	Preferred	Least Preferred
Integration	Preferred	Least Preferred
Accessibility and Social Inclusion	Preferred	Preferred
Physical Activity	Least Preferred	Preferred
Overall Result	**Junction 7 Option 1 is Preferred**	

Active Travel Options

A summary of the Stage 2 PAM multi-criteria analysis for the Active Travel options is presented below.

Table 13: Active Travel Options - Multi-Criteria Analysis (MCA) – Summary

Location	Preferred Option
R408 Newtown Road Overbridge	New Active Travel Structure to the east of the Existing
Junction 7 Maynooth	New Active Travel Structure to the east of the Existing
R405 Ballygoran Road Overbridge	New Active Travel Structure to the west of the existing is marginally Preferred.
Junction 6 Celbridge	New Active Travel Structure to the west of Existing
R404 Celbridge Road Overbridge	An Active Travel Structure is not proposed at the R404 Celbridge Road Overbridge, as a new Active Travel Structure is proposed as part of a separate planning application.
Junction 5 Leixlip	New Active Travel Structure to the west of the existing is marginally Preferred

Preferred Options to Advance to Stage 3

The options that were advanced to Stage 3 (Preferred Options and Preparation of PABS) are presented below.

Table 14: Preferred Options to Advance to Stage 3

Corridors	Preferred Option Description
Corridor Option 1	Bus priority measures within the hard shoulder in both the eastbound and westbound directions between Junction 5 Leixlip and Junction 7 Maynooth
Junctions	**Preferred Option Description**
Junction 5 Leixlip	Improve and Optimise Existing Junction - Signalise northern junction (Eastbound Diverge) - Eastbound Diverge to be amended from 1 lane to 2 lanes
Junction 6 Celbridge	Improve and Optimise Existing Junction - Signalise all approaches to the junction - Improve active travel facilities
Junction 7 Maynooth Option 1	Improve and Optimise Existing Junction - Westbound Diverge to be realigned and signalised - Eastbound Diverge to be realigned and signalised - Maynooth Outer Orbital Route (MOOR) to be incorporated

Active Travel	Preferred Option Description
R408 Newtown Road Overbridge	New Active Travel Structure to the east of the existing. Option 2 (East) is Preferred. However, Option 1 (West) is still a viable option. Further detailed data collection and evaluation should be carried out at the next phase.
Junction 7 Maynooth	New Active Travel Structure to the east of the existing
R405 Ballygoran Road Overbridge	New Active Travel Structure to the west of the existing. Option 1 (West) is marginally Preferred. However, Option 2 (East) is still a viable option. Further detailed data collection and evaluation should be carried out at the next phase.
Junction 6 Celbridge	New Active Travel Structure to the west of the existing
R404 Celbridge Road Overbridge	An active structure is not proposed at the R404 Celbridge Road Overbridge, as a new active travel structure is proposed as part of a separate planning application. Based on this separate planning permission, this new active travel structure will be located in the vicinity of the Wonderful Barn.
Junction 5 Leixlip	New Active Travel Structure to the west of the existing. Option 1 (West) is marginally Preferred. However, Option 2 (East) is still a viable option. Further detailed data collection and evaluation should be carried out at the next phase.

Stage 3 Preferred Options and Compilation of PABS

The overall conclusion and recommendation of the Phase 2 Options Report is to advance the preferred options that meet the project objectives. Table 15 outlines in summary how the preferred options for the Maynooth to Leixlip Project delivers on the project objectives.

Table 15: Preferred Options and Project Objectives

Objective Criteria	Preferred Option
	• The preferred options achieve value for money, with a positive Benefit to Cost Ratio which provide benefits to public transport, active travel and road users alike. • The specific interventions under the headings of corridors, junctions and active travel would improve the operational efficiency and resilience of the overall transport network within the study area. • This would be achieved by improving and optimising the existing road infrastructure at Junction 5 Leixlip, Junction 6 Celbridge and Junction 7 Maynooth. • This would enable the M4/N4 corridor to perform its primary function to facilitate effective strategic traffic movement, including from regional centres of Athlone and Sligo.

Objective Criteria	Preferred Option
	• As the preferred options are multi-modal, inclusive of the provision of bus services and active travel facilities, they prioritise person throughput over vehicle throughput and will ultimately enhance the overall transportation network within the study area and along the M4/N4 corridor.
Safety	• The security of road users would be improved as a result of the proposed options along the corridor and particularly at Junction 5 Leixlip, Junction 6 Celbridge and Junction 7 Maynooth. • The preferred options would achieve an improved level of operational efficiency. • The provision of dedicated active facilities at the R408 Newtown Road, Junction 7 Maynooth, R405 Ballygoran, Junction 6 Celbridge and Junction 5 Leixlip would accommodate vulnerable road users in a safer manner.
Environment	• The preferred options for the Maynooth to Leixlip Project would aim to maximising the value and sustainable use of existing infrastructure. • The provision of bus priority measures on the M4/N4 would support a reduction in private car dependency and improve modal choice. It would support a transition towards low carbon and climate resilience and align with government national, regional and local policy. • Detailed assessments of predicted noise impacts will be undertaken during future phases of the preferred options as they get taken forward as separate dedicated bus priority, active travel and junction optimisation projects. • Opportunities exist along the M4/N4 corridor to incorporate noise mitigation measures as part of the improvement works which have the potential to result in positive impacts to existing properties. • Future phases of the preferred options will determine the precise impact, if any, of theses future projects on designated Nature 2000 sites. • Future phases of the preferred options would determine in detail the anticipated environmental impacts and identify any mitigation measures required to minimise these impacts. • Appropriate Assessment Screening and, if required, Appropriate Assessment, will be undertaken to assess any potential implication of the preferred options on designated ecological sites, including the Rye Water Valley/Carton SAC. • The preferred options would not impact on any heritage sites of national importance.
Accessibility & Social Inclusion	• The components of the preferred options, including bus priority measures, active travel facilities and junction optimisations would improve accessibility to and from the Greater Dublin Area by supporting improved connectivity for all road users to public transport. • The preferred options would improve north-south connectivity across the M4/N4, which currently presents a barrier to inter-community travel. • The provision of improved facilities for active travel in addition to the inclusion of bus service enhancements would encourage more travel independence for vulnerable groups.

Objective Criteria	Preferred Option
	• The preferred options would support the integration of road-based transport with other modes of travel through the provision of bus priority measures. • Further work on the integration of Park and Ride measures within the corridor will be undertaken during future phases of the preferred options, in conjunction with the National Transport Authority. • The enhancements proposed within the preferred options meet the objectives of the TEN-T Network by delivering a more resilient transport corridor by ensuring safe, secure and high-quality standards for both passenger and freight transport. • The project would further strengthen access to Dublin Port in line with the objectives of the Regional Spatial and Economic Strategy. • The preferred options support the objectives of national, regional and local planning policy and be compatible with adopted land-use objectives.
	• Dedicated pedestrian and cyclist facilities would be provided at the following locations: o R408 Newtown Road; o Junction 7 Maynooth; o R405 Ballygoran; o Junction 6 Celbridge; and o Junction 5 Leixlip. • These interventions would eliminate vulnerable road users from interacting with live traffic at the existing overbridge locations and thereby ensure a more comfortable and spacious environment for active travel users. • The active travel strategy for the Maynooth to Leixlip Project aims to provide connectivity between the main communities within the study area and along the corridor. These are Maynooth and Leixlip to the north and Celbridge to the south. • The Maynooth to Leixlip Project active travel proposals align fully with the NTA Greater Dublin Area Draft Cycle Network Plan, which sets out the strategy for the development of an integrated cycle network. • The completion of cycle parking surveys at key locations in Maynooth, Celbridge and Leixlip would also be included, supporting the provision for cycle parking and infrastructure at key public transport nodes and destinations.

1 Introduction and Description

1.1 General

Arup has been appointed by Kildare County Council to provide multi-disciplinary technical consultancy services for the delivery of the Maynooth to Leixlip Project, on behalf of Kildare County Council and South Dublin County Council.

The aim of the Maynooth to Leixlip Project is to assess the needs of the M4/N4 mainline corridor and junctions from Maynooth to Leixlip in terms of catering for future demand from a safety and operational efficiency perspective. This includes assessing the need for and types of interventions to address issues that may be present.

The Maynooth to Leixlip Project is being implemented in accordance with Transport Infrastructure Ireland's Project Management Guidelines (PMGs). These guidelines provide a framework for the management, development and delivery of national road and public transport capital projects. The Project Management Guidelines divide the evolution and progression of a project into an eight-phase process (Phase 0 – 7 inclusive) as illustrated in Figure 1.1 below.

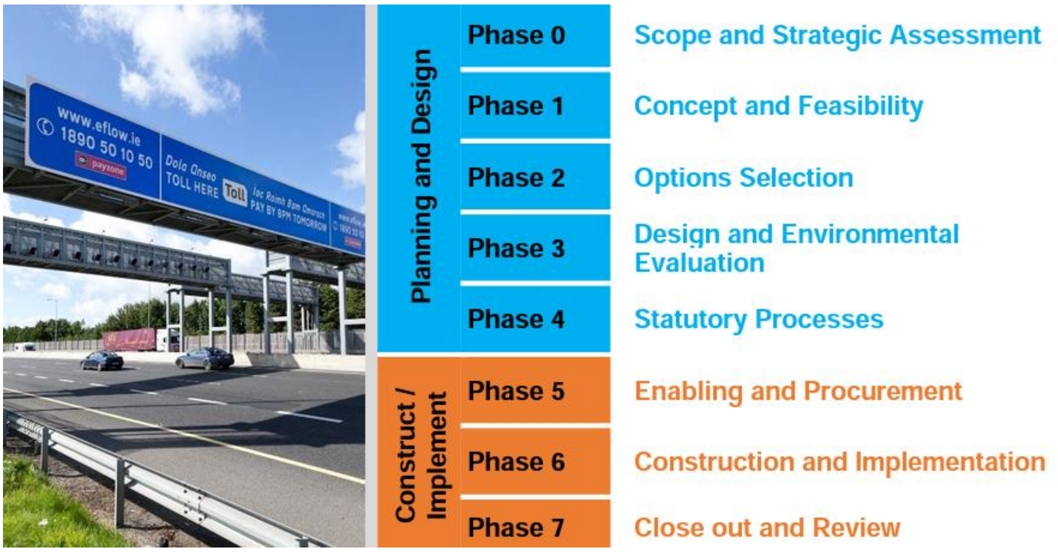

Figure 1.1: TII PMG Project Phases

Arup has been appointed to progress the delivery of the project through Phases 1 to 4 of the Project Management Guidelines. Following the completion of Phase 1 Concept and Feasibility in 2020, Phase 2 of the project was progressed, culminating in the publication of this Options Report.

1.2 Overview of Proposed Project

1.2.1 Context

The planning, design, implementation and safe operation of national roads in Ireland is the responsibility of Transport Infrastructure Ireland (TII), under Section 17 of the Roads Act, 1993. Working in partnership with the Department of Transport, the National Transport Authority and local authorities, TII strives to provide sustainable transport infrastructure and services, delivering a better quality of life, supporting economic growth and respecting the environment.

The M4/N4 national road is the primary artery connecting Dublin to the west and northwest of the country from the M50 in Dublin to Sligo over a length of approximately 200km. It is a dual carriageway standard from the M50 to Junction 5 Leixlip incorporating direct accesses, bus facilities, bus stops, footways, cycleways over a length of approximately 7km. It is motorway standard from Junction 5 Leixlip in County Dublin to Coralstown in County Westmeath over a length of approximately 53km and it is a mixture of single and dual carriageway from Coralstown in County Westmeath to Sligo over a length of approximately 140km.

The section of M4/N4 corridor under consideration includes the M4 mainline carriageway from Maynooth to Leixlip and the associated mainline junctions, Maynooth train line, the surrounding road network and any existing and proposed alternative transport modes or routes that provide suitable alternatives in favour of the M4/N4.

This section traverses two local authority boundaries, Kildare County Council and South Dublin County Council. A Section 85 Agreement has been entered into by both local authorities, which appoints Kildare County Council as the Lead Local Authority and Sponsoring Agency of the project. TII, acting as the Approving Authority, have appointed Kildare National Roads Office to project manage the delivery of the project. The project is being delivered in conjunction with the National Transport Authority.

The existing M4/N4 corridor is predominantly within the boundary of Kildare County Council, with 1.5km of the approximate 11km length within the boundary of South Dublin County Council.

The study area is largely greenfield agricultural land punctuated by the urban centres of Maynooth, Celbridge and Leixlip.

The study area for the project is presented in Figure 1.2.

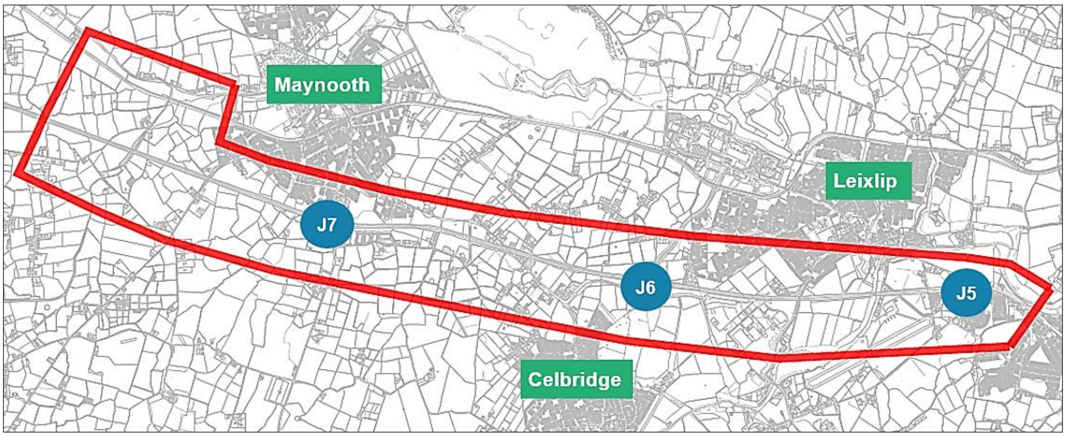

Figure 1.2: Study Area (© Google Map data ©2024 Tele Atlas)

1.2.2 Role of the M4/N4 Corridor

Given the location of the Maynooth to Leixlip Project within the Greater Dublin Area (GDA), this 11km section of the corridor supports high volumes of traffic engaging in local activities such as commuting, retail and amenity, as well as supporting more strategic movements in parallel, such as freight distribution, inter-urban trade and access to key ports and airports.

Moreover, given modern mobility needs in the context of the Greater Dublin Area, the M4/N4 corridor must support accessibility across a variety of transport modes, including public transport and active travel.

Maynooth, which is outlined in the Regional, Spatial and Economic Strategy (RSES) (2019–2031) as a key town within the GDA. These key towns have potential to accommodate commensurate levels of population and employment growth, facilitated by their location on high quality public transport corridors and aligned with requisite investment in services, amenities and sustainable transport. Leixlip is noted for having strategic greenfield lands near Confey Station with capacity for phased development while improving links to Dublin/ Meath lands. Both Leixlip and Celbridge are identified as a Level 3 key service centre and highly urbanised settlements which have strong connections with Dublin City.

Regulation (EU) No. 1315/2013 of the European Parliament and of the Council, Trans-European Network for Transport (the “TEN-T Regulations”) is a European Union policy directed towards the implementation and development of a Europe-wide network of roads, railway lines, inland waterways, maritime shipping routes, ports, airports and rail-road terminals. The network consists of two layers – the Comprehensive Network, an EU wide transport network ensuring accessibility and connectivity to all regions of the Union and the Core Network, consisting of the most strategically important linkages in the TEN-T network.

From its connection to the M50 motorway, the M4/N4 route forms part of the TEN-T Comprehensive Network, linking Dublin to Galway, Westport, Sligo and Donegal. Article 4 of the TEN-T Regulations sets out the objectives of the Core and Comprehensive Network including demonstrating European added value through (a) cohesion, (b) efficiency, (c) sustainability and (d) increasing the benefits for its users. Within this context, it is imperative that the efficiency, reliability and long-term resilience of the M4/N4 corridor is assessed.

1.2.3 Previous Related Studies

In response to transportation issues in the Greater Dublin Area, some previous related studies have been undertaken. These studies include:

- Leinster Orbital Route - Feasibility Study, published in March 2007;
- Leinster Orbital Route - Corridor Protection Study, published in June 2009;
- N4 / N7 Corridor Study, published in February 2017;
- Enhancing Motorway Operation Services, M50 Traffic Flow Optimisation and M50 Resilience between M50 J6 and J7: N3 to N4 Link, published in May 2019; and
- TII Draft Briefing Note on Public Transport on National Roads, published in July 2020.

1.2.4 Need for Intervention

1.2.4.1 Context

The aim of the project is to assess the needs of the M4/N4 mainline corridor and junctions from Maynooth to Leixlip in terms of catering for future demand from a safety and operational efficiency perspective. In terms of safety, there are some isolated safety issues along the corridor that should be assessed and addressed. In terms of operational efficiency, at present, traffic congestion at peak times impacts the operational efficiency of the route. Therefore, there is a need to consider interventions from both a safety and operational perspective.

Regarding operational efficiency, examples of intervention categories that will be investigated include:

- Optimise use of other transport modes;
- Optimise utilisation of the existing asset; and
- Increased capacity.

Some existing transport issues that are affecting the performance of the network are discussed below.

1.2.4.2 Modal Shift

Although there is an extensive public transport network (both bus and rail, refer to Chapter 2 for further details) within the study area, a sufficient modal shift from private car to public transport has not materialised.

There is a high dependency on private cars as a preferred mode of travel within the study area and, given the range of public transport options available to road users, the public transport services are underutilised. Reasons for this may include the following:

- Accessibility to rail-based public transport is limited due to inadequate cyclist infrastructure and a general lack of availability of park and ride facilities;
- Lack of availability of park and ride facilities for bus services;
- Bus services utilising the M4/N4 must negotiate the same traffic volumes as private cars and are subject to the same peak time journey time increases – this in turn disincentivises take up of public transport alternatives to the private car; and
- Perception that public transport may be convoluted, difficult to use and is not reliable.

1.2.4.3 Existing Transport Problems

There are traffic and congestion problems along the M4/N4, particularly at peak times. The Annual Average Daily Traffic between Junction 6 and Junction 8 increased by circa 19% between 2013 and 2019. The M4 serves strategic traffic and also local traffic in the Greater Dublin Area. Due to insufficient modal shift and congestion, quality of life is being impacted because people are required to commute earlier to avoid congestion, or alternatively have longer commutes because of congestion. These problems will be exacerbated with the number of planned developments in the study area resulting in significant future population increases.

Approximately 89% of the labour force in Kildare have their place of work in Kildare. This shows that there is significant local traffic within the Greater Dublin Area and wider commuter belt, which is impacting on the M4 capacity to act as a strategic route.

There is an extensive public transport network in the study area serving commuters. However, there is a high dependency on private cars as a preferred mode of transport (>60% for those living in Maynooth but working outside of Maynooth). Therefore, the modal shift from private car to public transport has not sufficiently materialised.

Accessibility to rail-based public transport is an issue due to inadequate cyclist infrastructure and a general lack of availability of park and ride facilities. There is also an issue regarding the availability of park and ride facilities for bus services.

In addition, bus services utilising the M4/N4 must negotiate the same traffic volumes as private cars, which disincentivises the take up of public transport alternatives to the private car. There may also be a perception that public transport may be convoluted and more time consuming as a result.

Junction 7 Maynooth currently has geometric and safety issues particularly from a vulnerable road users' perspective. There are high volumes of vulnerable road users accessing Maynooth Business Park to the south of the junction from Maynooth town. These users need to navigate through the junction where they will interface with traffic using the slip roads and Straffan Roundabout. The problems at Junction 7 require intervention in the short to medium term.

A collision cluster was highlighted at Junction 5 Leixlip. This cluster of incidents correlates with a reduction in speed from 120km/h to 80km/h travelling eastbound approaching the N4 from the M4. This cluster of collisions was within a twice below average speed rate zone and a below average speed rate zone.

The existing Junction 5 eastbound merge consists of a two-lane slip road with a bus lane in the nearside lane and general traffic in the offside lane. This provides a 2-lane gain resulting in a 4-lane cross section downstream of the merge, with three general traffic lanes and a nearside bus lane.

The existing approach angle of the slip road results in a relatively short nose length of approximately 60m. There is an existing off-road cycle lane provided along the N4 downstream of the merge.

This 4-lane cross section extends eastbound to Junction 4A, where a diverge is provided and the nearside lane exits onto the slip road. Potential interventions at Junction 4A are outside the scope of the Maynooth to Leixlip Project, however it should be considered for potential future intervention.

1.2.4.4 Policy

From a policy perspective, the M4/N4 is part of the TEN-T comprehensive network and also specifically noted in the National Planning Framework, connecting Dublin to the west and northwest. The M4/N4 ability to act as this strategic link is compromised due to its utilisation for local Greater Dublin Area commuter traffic purposes. The National Development Plan also lists the project to be progressed through pre-appraisal and early planning, subject to appropriate approvals. This requires a significant intervention to resolve the problems identified in this report. A short-term intervention in isolation will not suffice. Any intervention should also look to grasp the opportunity to enhance or complement the existing BusConnects proposals within the study area. The overall solution to the current and future transportation problems require a number of interventions which are integrated and connected and support a dedicated modal shift from private car to public transport. This may involve collaboration with other transportation bodies to deliver and facilitate an overall integrated solution.

1.2.5 Development of the Project

Phase 1 (Concept and Feasibility) was undertaken in 2020 and sought to investigate the feasibility of the Maynooth to Leixlip Project by identifying the cause of the existing problems, identifying potential interventions and establishing the viability and direction of further studies. Initial work during this time focussed on a detailed examination of conditions on the existing national route. These studies identified a number of transport problems including:

- Congestion on the M4/N4, particularly at peak times;
- AADT between J6 and J8 increased by 19% between 2013 and 2019;
- M4/N4 currently serves both strategic traffic and also local Greater Dublin Area traffic, which is impacting on its operational efficiency as a strategic route;
- High dependency on private cars within the study area (approximately 68%);
- Bus services utilising the M4/N4 must negotiate the same traffic volumes as private cars;
- There are a number of public transport options within the study area, however sufficient modal shift from private car to public transport has not materialised; and
- Junction 7 Maynooth has geometric and safety issues.

The outcome of the Phase 1 studies, as documented in the Feasibility Report, was that a strong justification for the advancement of the Maynooth to Leixlip Project to Phase 2 existed. A number of feasible transportation measures meriting more rigorous assessment were identified, including road improvements options, demand management solutions and public transport alternatives.

1.2.6 Project Objectives

The overall ambition of the Maynooth to Leixlip Project is to achieve a number of specific objectives which were outlined during Phase 1 and may be refined during the development of the project. In accordance with the TII Project Appraisal Guidelines and the Common Appraisal Framework (now referred to as the Transport Appraisal Framework), published by the Department of Transport, objectives were established under each of the following criteria:

- Economy;
- Safety;
- Environment;
- Accessibility and Social Inclusion;
- Integration; and
- Physical Activity.

The specific objectives of the Maynooth to Leixlip Project are listed in Table 1.1 below.

Table 1.1: Project Objectives

Criteria	Project Specific Objective
Economy	• Provide a more reliable and resilient transport solution. • Manage congestion on the M4/N4 corridor. • Provide the infrastructure to enable transport solutions to move more people more efficiently. • Support the protection of the economic prospects of Maynooth, Leixlip, Celbridge, Kilcock, Enfield and their rural hinterland. • Facilitate effective strategic traffic movement, including from regional centres of Athlone and Sligo. • Facilitate effective freight movement.
Safety	• Enable the provision of a safer travelling environment for all road users, including vulnerable road users.
Environment	• Facilitate an increase in modal shift from private car to public transport and walking/cycling thus supporting a transition towards low carbon and climate resilience.
Accessibility and Social Inclusion	• Provide improved accessibility to the GDA public transport network from regions outside of the GDA. • Support improved connectivity for all road users to public transport. • Enable the successful creation of place making and assist in the generation of vibrant communities.
Integration	• Provide the infrastructure to support an improved balance of transport modes. • Support greater road-based user integration and connectivity with all other transport modes.
Physical Activity	• Improve infrastructure in, across and adjacent to the M4/N4 corridor which may form barriers to physical activity and in particular linkage between key local trip attractors including education, work, residential, leisure and natural environment. • Support the provision for cycle parking and infrastructure at key public transport nodes and destinations. • Support the creation of a healthy environment conducive to active travel.

1.2.7 Policy Change

Subsequent to the development of the above objectives, during Phase 2 there were significant amendments to existing policy and the introduction of new policies. Policy changes were evident through the establishment of the National Investment Framework for Transport in Ireland (NIFTI) in December 2021, the National Cycle Network (NCN), the Transport Appraisal Framework (TAF) (formally Common Appraisal Framework) in June 2023, the updating of the Greater Dublin Area (GDA) Transport Strategy 2022 - 2042 and multiple revisions of the Climate Action Plan (CAP).

1.3 Purpose of the Options Report

Having advanced the Maynooth to Leixlip Project to Phase 2, this Options Report represents the primary deliverable for this project phase as outlined in the TII Project Management Guidelines. The purpose of Phase 2 is to:

- Identify a suitable study area for the examination of options;
- Identify key constraints within that study area;
- Develop feasible transportation options; and
- Carry out a systematic assessment of these options leading to the selection of a preferred option.

The purpose of the Options Report is to document each step in the analysis during Phase 2 of the project, recording the assessments and decisions undertaken in order to identify and make recommendation on the preferred option for the project.

The Options Selection assessments and reporting structure aligns with the TII Project Management Guidelines and follows the three-stage process outlined below:

- **Stage 1 – Preliminary Options Assessment.** A number of feasible options which respond to the transportation problems identified are developed in accordance with TII PAG and a multi-criteria analysis is carried out under the assessment criteria of Engineering, Environment and Economy. Typically, a number of distinct options are assessed at this stage, including Do-Something and Do-Nothing or Do-Minimum Options.
- **Stage 2 – Project Appraisal Matrix.** The options advanced from Stage 1 are further evaluated by undertaking a full cost benefit analysis and multi-criteria analysis of the quantifiable and non-quantifiable impacts under the headline criteria of, Economy, Safety, Environment, Accessibility & Social Inclusion, Integration and Physical Activity.
- **Stage 3 – Preferred Option.** After the completion of Stage 2, a preferred option for the project is selected based on the multi-criteria analysis and a Project Appraisal Balance Sheet (PABS) prepared for the preferred option only.

1.4 Structure of the Options Report

This Options Report comprises of three volumes, namely:

- Volume A – Main Report;
- Volume B – Figures; and
- Volume C – Appendices.

Volume A comprises of seven separate chapters, as follows:

- Chapter 1 – *Introduction and Description;*
- Chapter 2 – *Project Context, Need, Strategic Fit and Priority,* presents the justification for the progression of the project in terms of its strategic fit within transport development policy at European, national, regional and local levels, together with an exploration of the existing transport deficiencies which further support the need to advance this assessment.
- Chapter 3 – *Description of Options*, discusses the range of options and considered as part of the Phase 2 process, as well as describing the structured appraisal methodology used to evaluate the merits of these options.
- Chapter 4 – *Transport Assessment Approach and Analysis Tools*, provides an overview of the scope and methodology adopted for the transport modelling undertaken to inform option appraisal and selection. This chapter also examines the various factors relevant to informing the most appropriate level of intervention required.
- Chapter 5 – *Stage 1 Preliminary Options Assessment*, describes the initial comparative assessment of options carried out under the headings of Environment, Engineering and Economy.
- Chapter 6 – *Stage 2 Project Appraisal Matrix*, presents a summary of the detailed comparative multi-criteria analysis undertaken to inform the recommendation of the preferred option.
- Chapter 7 – Stage 3 *Preferred Option and PABS*, provides a concise summary of the expected impacts and benefits of the proposed development in consideration of the objectives of the project.

1.5 Project Operational Goals and Design Strategies

1.5.1 Existing Transport Network and Context

The existing M4/N4 route functions heavily as a commuter artery into the metropolitan area, supporting a high car mode share for trips to work in the city and other key towns in the study area. The M4/N4 road remains a singular component within a broader transport network.

As outlined in Section 1.2.2 above, the role of the M4/N4 corridor is multi-faceted, supporting a significant commuting need in tandem with strategic trips, such as facilitating freight distribution along the M4/N4 to the west and northwest of Ireland.

The existing M4/N4 also currently caters for a significant number of shorter trip purposes supporting retail, amenity and community activities. This multifunctional purpose and associated congestion, results in the overall strategic transport needs being impacted and the route becoming less efficient when it is needed the most during peak periods.

1.5.2 Design Strategies

The design strategy for any road-based component ultimately deemed necessary will be linked to the concurrent delivery of an improved public transport system in the study area and Greater Dublin Area. Road-based interventions should be complementary to, rather than supplementary to public transport systems and it is imperative that road-based interventions do not undermine the future need for investment in other sustainable transport solutions.

The delivery of a successful project outcome sits hand-in-hand with the delivery of a sustainable solution. Alignment with Ireland's commitments around circular economy principles represents a key area of focus, ensuring that resource efficiency, designing out waste and optimising use of existing infrastructure are foremost in the project design strategy.

The need to address transport issues across all modes must be carefully balanced with government targets to reduce the demand for commuter travel and support more efficient patterns of development and travel. Project design strategies will aim to actively manage road demand as distinct from stimulating or promoting undesired travel patterns.

1.5.3 Project Operational Goals

The project operational goals include:

- Address the current scenario that the M4/N4 currently serves both strategic traffic and also local GDA traffic. This is impacting on the M4/N4 ability to perform its primary function as a strategic route;
- Improve the efficiency and effectiveness of all transport modes in the vicinity of the M4/N4 corridor to support sustainable growth of the region and beyond; and
- Support better integration of transport modes, improve transport choice and move more people more efficiently.

1.6 References

Eastern and Midland Regional Assembly (2019) Regional Spatial and Economic Strategy 2019-2031. Available from: https://emra.ie/final-rses/

Leinster Orbital Route - Feasibility Study, published in March 2007.

Leinster Orbital Route - Corridor Protection Study, published in June 2009.

N4 / N7 Corridor Study, published in February 2017.

Enhancing Motorway Operation Services, M50 Traffic Flow Optimisation and M50 Resilience between M50 J6 and J7: N3 to N4 Link, published in May 2019.

Transport Infrastructure Ireland (2023) Project Management Guidelines PE-PMG02041. Available from: https://www.tiipublications.ie/library/PE-PMG-02041- 03.pdf.

2 Project Context, Need, Strategic Fit and Priority

2.1 Introduction

This chapter assesses the Project Context, Need, Strategic Fit and Priority of the Maynooth to Leixlip Project in accordance with Transport Infrastructure Ireland (TII) Project Manager's Manual for National Road Schemes[1] and TII Project Management Guidelines (PMG) for National Road Schemes[2], specifically including the following:

- Strategic fit and priority within National Policy;
- Road development policy - European, national, regional and local; and
- Project specific need.

2.1.1 Summary of Constraints

The constraints were identified and documented under the following headings:

- Natural Constraints;
- Artificial Constraints; and
- External Parameters.

The natural constraints include the topography, Rye Water Valley/Carton SAC, Rye Water Valley/Carton pNHA, Ballynafagh Bog SAC, Ballynafagh Lake SAC, Royal Canal pNHA, Grand Canal pHNA and the River Liffey.

The primary artificial constraints comprise the existing road network and rail line. Other constraints within the project in the built environment consist of the urban and residential zones, disused quarries, and a number of amenity areas.

External parameters include policy documents, procedural and legal requirements, technical standards and project funding.

The Constraints Report is included in Appendix 2.1 of Volume C of this report.

[1] Transport Infrastructure Ireland (2023) Project Manager's Manual for National Road Schemes. Available from: https://www.tiipublications.ie/library/PE-PMG-02042-01.pdf [Accessed: 11th July 2023]

[2] Transport Infrastructure Ireland (2023) Project Management Guidelines PE-PMG-02041. Available from: https://www.tiipublications.ie/library/PE-PMG-02041-02.pdf [Accessed: 11th July 2023]

2.2 Strategic Fit and Priority with National Policy

2.2.1 Project Ireland 2040: National Planning Framework

The National Planning Framework[3] (NPF) is the Government's high-level strategic plan for shaping the future growth and development of the country to the year 2040. It is a framework to guide public and private investment, to create and promote opportunities and to protect and enhance the environment.

One of the "National Strategic Outcomes" within this framework relates to "Enhanced Regional Accessibility", key objectives of which are:

"Inter-Urban Roads

- *Maintaining the strategic capacity and safety of the national roads network including planning for future capacity enhancements;*
- *Improving average journey times targeting an average inter-urban speed of 90kph;*
- *Enabling more effective traffic management within and around cities and re-allocation of inner-city road-space in favour of bus-based public transport services and walking/cycling facilities."*

The National Planning Framework also advocates for the "*National Road Network*" as one of its Strategic Investment Priorities and lists "*High-Quality International Connectivity*" as a "*National Strategic Outcome*". In this regard, the Maynooth to Leixlip Project will enhance the transport operational efficiency and safety of the national road network particularly from the midlands and west of Ireland to Dublin Port, a key port from Ireland to Europe.

In this regard, for National Strategic Outcome 2 (Enhanced Regional Accessibility) of the National Planning Framework, the National Development Plan aims to *"ensure a high degree of accessibility for all regions and urban areas, to other regional centres and to our cities"* while *"developing and supporting regional connectivity also being a focus with respect to many road projects"*.

2.2.2 National Development Plan 2021-2030

The National Development Plan 2021-2030 was published by the Government of Ireland on the 4th of October 2021. This sets out an investment plan for Ireland over a ten-year period. It states that investment in national, regional and local road infrastructure will be delivered in accordance with the National Planning Framework, specifically:

"…retrofitting/ improving some national road assets, for example to provide greater use by public transport (e.g. bus lane)…"

[3] Project Ireland 2040 (2018) National Planning Framework. Available from: http://npf.ie/. [Accessed: 11th July 2023]

"National Roads programme will continue to provide for improved connectivity across the years 2021 – 2030"

"…progressing new National Road projects which will improve compact growth and regional connectivity across the country"

The revised National Development Plan aligns with the National Planning Framework with a particular focus on *"ensuring that our regional cities are enabled to become centres of appropriate scales"* while their growth is *"compact and sustainable"*. The improved transport operational efficiency and safety of this section of the national road network would support these outcomes.

The Maynooth to Leixlip Project was part of the previous National Development Plan and is subject to further approvals.

2.2.3 National Roads 2040

The National Roads 2040 (NR2040) is TII's strategy to enable delivery of Project Ireland 2040 and was published in April 2023. It responds to evolving national policy and aligns to National Investment Framework for Transport in Ireland (NIFTI), with a vision for the "*National Roads network to be an evolving sustainable transport system focused on safety, innovation, accessibility and mobility of people, goods, and services*". It is a guide on how to maintain, operate, and upgrade the national road network and demonstrates how investments can be made to realise the objectives of Project Ireland 2040 and abide by NIFTI's hierarchies.

This strategy acknowledges the challenges faced by the transport sector in reaching the country's climate goal of a 50% reduction in GHG emissions by 2030. In order to achieve this goal NR2040 stresses the importance of facilitating active travel measures alongside new road infrastructure. "*While TII has a limited role in behavioural change, the provision of high quality multi modal infrastructure has an important role in enabling and encouraging a modal shift to support a reduction in carbon emissions*". In more urban areas it is vital to combat congestion, especially by giving road users a viable alternative to the private vehicle in the context of shorter trips, typically those under 15 minutes.

In terms of the Maynooth to Leixlip Project, improvements to all modes of travel, walking, cycling, and public transport are being considered in addition to the private car as part of the options selection process which aligns with the objectives of NR2040 by seeking to reduce congestion across the M4/N4 corridor and creating greater modal choice for people.

Another priority of NR2040 is road safety, linking in with the Road Safety Authority's Road Safety Strategy 2021-2030. The need for new and existing roads to be optimised and designed to the highest degree of safety is paramount in reaching the Strategy's goal of zero road deaths by 2050. The Maynooth to Leixlip Project realises the above goals by seeking to improve and optimise the existing corridor and junctions.

2.2.4 Climate Action Plan 2024

The Government of Ireland's Climate Action Plan 2024[4] was published in December 2023. The plan sets out a detailed sectoral roadmap to deliver a cumulative reduction in emissions.

The Climate Action and Low Carbon Development (Amendment) Act 2021[5] was published by government in July 2021. The Act sets out the national objective of transitioning to a low carbon, climate resilient and environmentally sustainable economy in the period up to 2050.

The Act provides for the preparation of Sectoral Plans which will specify policies to reduce greenhouse gas emissions for each sector.

On the 14th of July 2021, the European Commission adopted a series of legislative proposals setting out how it intends to achieve climate neutrality in the EU by 2050, including the intermediate target of an at least 55% net reduction in greenhouse gas emissions by 2030. The package of proposals includes revisions to the legislation put forward as part of the Climate and Energy Framework 2021-2030. Ireland's new 2030 target is to achieve a 40% reduction of non-Emissions Trading Scheme (ETS) sector emissions on 2005 levels with annual binding limits set for each year over the period 2021-2030.

The proposed development area lies within the South Dublin County Council and Kildare County Council administrative areas.

The South Dublin County Council Climate Change Action Plan 2019-2024[6] was adopted in 2019. South Dublin County Council are working towards achieving its four main targets:

- A 33% improvement in the Council's energy efficiency by 2020;
- A 40% reduction in the Council's greenhouse gas emissions by 2030;
- To make Dublin a climate resilient region, by reducing the impacts of future climate change-related events; and
- To actively engage and inform citizens on climate change.

A Climate Change Team is working with Action Teams across the five main action areas to ensure the plan is delivered effectively.

Kildare County Council has prepared a Local Authority Climate Change Adaptation Strategy[7]. The Kildare County Council Climate Change Adaptation Strategy takes on the role as the primary instrument at local level to:

- Ensure a proper comprehension of the key risks and vulnerabilities of climate change;

[4] Climate Action Plan, Government of Ireland 2024
[5] Climate Action and Low Carbon Development (Amendment) Act 2021
[6] South Dublin County Council Climate Action Plan, 2019 -2024
[7] Kildare County Council Climate Change Adaptation Strategy, 2019-2024

- Bring forward the implementation of climate resilient actions in a planned and proactive manner; and
- Ensure that climate adaptation considerations are mainstreamed into all plans and policies and integrated into all operations and functions of Kildare County Council.

The Maynooth to Leixlip Project will assess transportation demands and will seek to facilitate and promote the use of sustainable modes of transport to meet demand, where practicable and appropriate to the problem identified.

2.2.5 National Investment Framework for Transport in Ireland

The Department of Transport has prepared and finalised the National Investment Framework for Transport in Ireland (NIFTI). This document is the Department of Transport's high-level strategic framework to support the consideration and prioritisation of future investment in land transport. It represents the Department's contribution to Project Ireland 2040, Government's long-term, overarching strategy to make Ireland a better country for all and to build a more sustainable future. NIFTI has been developed to ensure sectoral investment is aligned with the National Planning Framework and supports the delivery of the National Strategic Outcomes (NSOs).

NIFTI establishes a common lens through which to consider potential investment. In doing so, NIFTI sits alongside other Government priorities and policy objectives, such as the Programme for Government and Climate Action Plan.

NIFTI is the result of extensive background research and analysis, comprising 14 background papers that considered a range of factors with the potential to impact upon future transport investment, and public consultation, with engagement from the public, key sectoral stakeholders and the Regional Assemblies. NIFTI has also been informed by a number of environmental assessments, which have helped ensure that future investment delivered in accordance with the framework takes due consideration of environmental issues.

To be considered for funding, future transport projects will be required to align with four specific investment priorities established by the framework, namely:

- Decarbonisation;
- Protection and Renewal;
- Enhanced Regional and Rural Connectivity; and
- Mobility of People and Goods in Urban Areas.

To ensure that transport investment is delivered in a sustainable manner, the four investment priorities are supplemented by modal and intervention hierarchies, aimed at identifying solutions which are preferred from an environmental and cost-effectiveness perspective, as illustrated in Figure 2.1 and Figure 2.2 below.

Alignment, or otherwise, with NIFTI is assessed within the Multi-Criteria Analysis (MCA) in the Stage 1 Preliminary Options Assessment and the Stage 2 Project Appraisal Matrix in later chapters of this report.

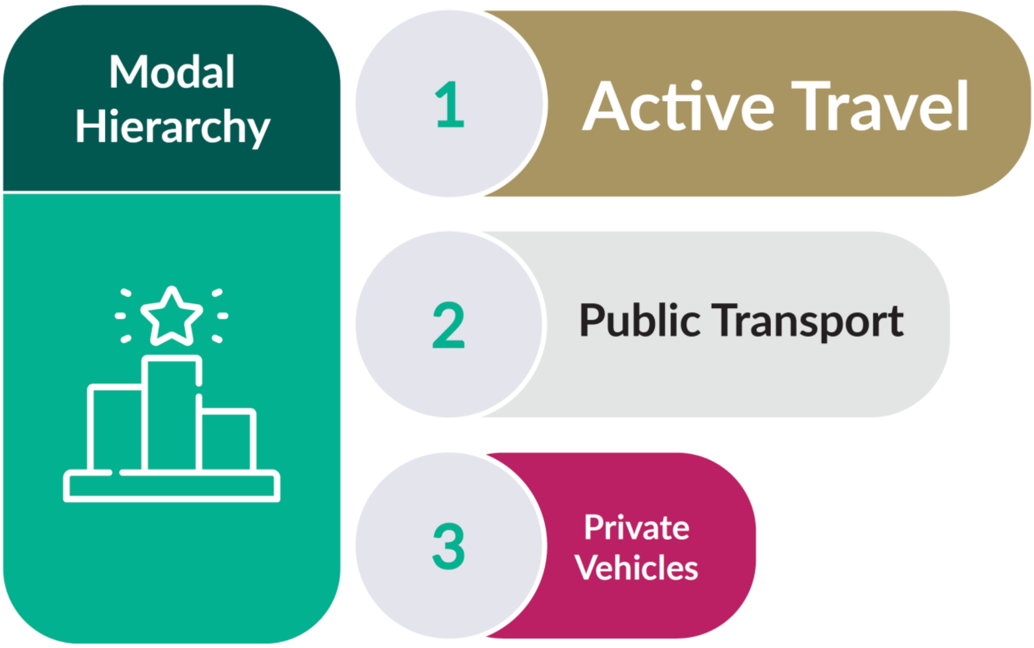

Figure 2.1: National Investment Framework for Transport in Ireland Modal Hierarchy

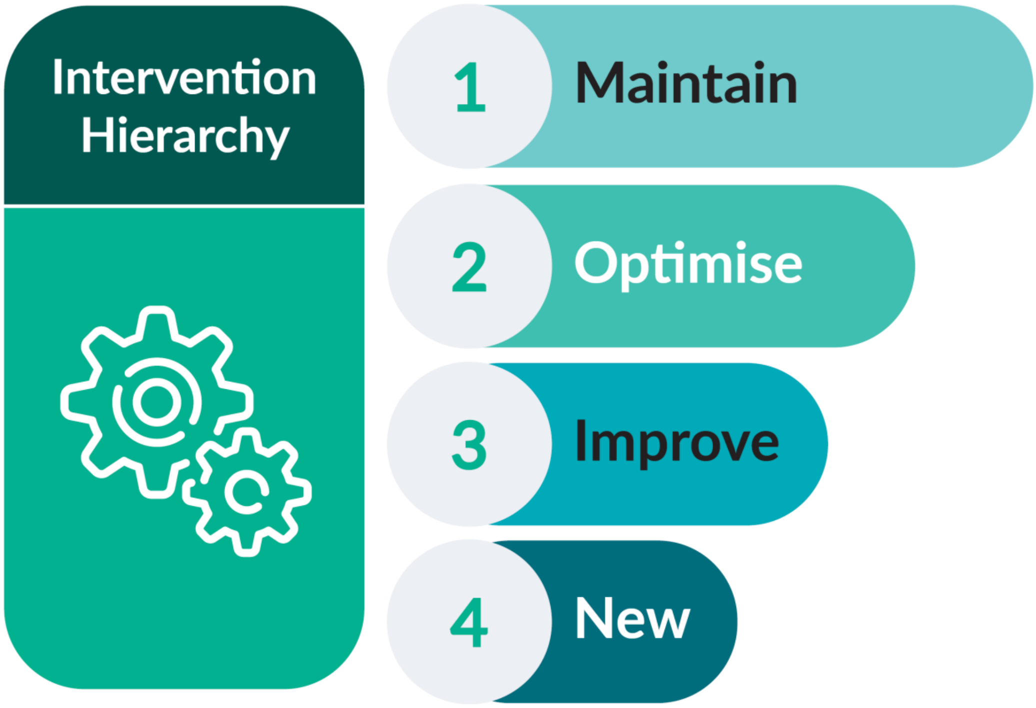

Figure 2.2: National Investment Framework for Transport in Ireland Intervention Hierarchy

The modal hierarchy prioritises sustainable transport modes (i.e. active travel and public transport) over less sustainable modes such as the private car, whilst acknowledging that certain modes may not be conducive to all travel needs, for example, interurban travel in rural areas. The modal hierarchy seeks to encourage a shift from private transport to alternative modes in a manner that supports the investment priorities and the objectives of the Climate Action Plan.

The hierarchy of intervention aims to ensure that transport investment is proportionate to the problem identified, that the value of existing assets is maximised, and that more efficient behaviour and sustainable use of the existing network is encouraged.

The above considerations will inform the Options selection appraisal process.

2.2.6 Department of Transport Statement of Strategy 2021-2023

One of the high-level goals outlined in the Department of Transport[8] Statement of Strategy 2021-2023 in relation to land transport is:

"Maintaining and developing the transport links between households, communities and businesses on the island of Ireland and ensuring our international connectivity, a key element in growing our economy."

It identifies strategic approaches to achieving the goals of the strategy vis-à-vis connectivity include the development of:

"high quality sustainable road, public transport and active travel networks to enable economic activity, essential services and social connections between and within our cities, regions and communities."

This is in addition to improved transport links to:

"foster balanced economic and social regional development in a post-Brexit context".

The Maynooth to Leixlip Project will contribute to the development of improved, high quality, sustainable road transport links in the area.

2.2.7 National Ports Policy 2013

The National Ports Policy was published by the Department of Transport in 2013. The report introduces clear categorisation of the ports sector based on significance and the port governance model to be adopted by Ireland.

Dublin Port is a Tier 1 port of National Significance. Tier 1 ports are categorised as ports that:

- Are responsible for 15% to 20% of overall tonnage through Irish ports; and,

[8] Department of Transport, Statement of Strategy 2021-2023. Available from: https://www.gov.ie/en/publication/70e6d-statement-of-strategy-2021-2023/ [Accessed: 17th November 2021]

- Have clear potential to lead the development of future port capacity in the medium and long term, when and as required.

In order to provide resilience to the Irish trading networks following Brexit, it is important that the internal linkages to Tier 1 ports are effective. The M4/N4 is the primary link from Project Ireland 2040 assigned urban growth regions of Galway, Athlone and Sligo as well as the Northwest of the country to this Tier 1 port.

2.2.8 National Sustainable Mobility Policy

The National Sustainable Mobility Policy[9] sets out a strategic framework to 2030 for active travel and public transport journeys to help Ireland meet its climate obligations. It is accompanied by an action plan to 2025 which contains actions to improve and expand sustainable mobility options across the country by providing safe, green, accessible and efficient alternatives to car journeys. It also includes demand management and behavioural change measures to manage daily travel demand more efficiently and to reduce the journeys taken by private car.

The policy is guided by 3 key principles (safe and green mobility, people focused mobility and better integrated mobility) and they are underpinned by 10 high level goals:

- Improve mobility safety;
- Decarbonise public transport;
- Expand availability of sustainable mobility in metropolitan areas;
- Expand availability of sustainable mobility in regional and rural areas;
- Encourage people to choose sustainable mobility over the private car;
- Take a whole of journey approach to mobility, promoting inclusive access for all;
- Design infrastructure according to Universal Design Principles and the Hierarchy of Road Users model;
- Promote sustainable mobility through research and citizen engagement;
- Better integrate land use and transport planning at all levels; and
- Promote smart and integrated mobility through innovative technologies and development of appropriate regulation.

[9] Department of Transport (2022) National Sustainable Mobility Policy. Available from: https://www.gov.ie/en/publication/848df-national-sustainable-mobility-policy/ [Accessed: 3rd June 2022]

The associated Action Plan 2022-2025[10] details core actions including to:

"Review, develop and update guidelines, standards and supporting legislation to allow for a range of solutions to be developed for road space reallocation/ redesign to repurpose existing legacy car-based road design"

2.2.9 TII Statement of Strategy 2021 to 2025

The TII Statement of Strategy 2021 to 2025[11] states that its mission is to provide high quality transport infrastructure and services, delivering a better quality of life and supporting economic growth.

The Statement of Strategy sets out a number of "Strategic Objectives" including:

Safety: Reduce the risk and number of collisions, injuries and deaths on our light rail and road infrastructure.

Existing Infrastructure: Operate, maintain and extend the life of national roads and light railway infrastructure to ensure the safety and efficiency of our transport networks, ensure appropriate management of environmental resources and contribute to the transition to a low-carbon and climate resilient society.

New infrastructure: Deliver national road, light railway, metro and Active Travel infrastructure, contributing to a compact growth, sustainable mobility, enhanced regional accessibility and the transition to a low carbon future.

Engagement and Collaboration: Engage and collaborate, partnering effectively with external parties, both nationally and internationally, to support the achievement of our strategy

People: Maintain, enhance and harness the capability of the TII team, promoting TII values, to ensure the delivery of our goals.

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[10] Department of Transport (2022) National Sustainable Mobility Policy Action Plan 2022 - 2025. Available from: https://www.gov.ie/en/publication/848df-national-sustainable-mobility-policy/ [Accessed: 3rd June 2022]
[11] Transport Infrastructure Ireland Statement of Strategy 2021 to 2025. Available from: TII_StatementOfStrategy_Report_FINAL_261023.pdf [Accessed: 11th November 2023]

2.3 Strategic Fit and Priority with Regional Policy

2.3.1 Transport Strategy for the Greater Dublin Area 2022-2042

The Transport Strategy for the Greater Dublin Area 2022-2042 [12] provides a framework for the planning and delivery of transport infrastructure and services in the Greater Dublin Area (GDA). It provides a transport planning policy around which other agencies involved in land use planning, environmental protection, and delivery of other infrastructure such as housing, water and power, can align their investment priorities. It is, therefore, an essential component, along with investment programmes in other sectors, for the orderly development of the Greater Dublin Area over the next 20 years.

The Strategy examines a number of options, studies and assessments and outlines the strategic transport infrastructure that is proposed to be delivered.

The M4/N4, via Chapelizod Bypass is identified as a core bus network in this Strategy as it serves longer distance bus routes from Galway, Mayo, Sligo and the Midlands, whilst also accommodating regional bus services along the M4/N4 corridor.

The Greater Dublin Area Strategy states that in relation to bus travel originating outside the Metropolitan Area, it is an aim of the NTA to ensure that the reliability and efficiency of regional bus services is maximised. It further states that in order to achieve this, a degree of bus priority will be sought on the national routes where traffic congestion does or could easily cause delays to bus/ coach services, including on approaches to the M50 and the built-up area of the city.

It further states that on certain corridors, the priority will then tie-in to that proposed as part of the BusConnects Dublin corridor programme and its expansion.

The M4/N4 route has been identified within the Greater Dublin Area Strategy as one of the core radial bus corridors for the region, as presented in Figure 2.3.

[12] National Transport Authority (2021) Transport Strategy for the Greater Dublin Area 2022-2042. Available from: https://www.nationaltransport.ie/wp-content/uploads/2021/11/NTA-GDA-Transport-Strategy-2022-42-15.11.21-FA-WEB-1.pdf [Accessed: 17th November 2022]

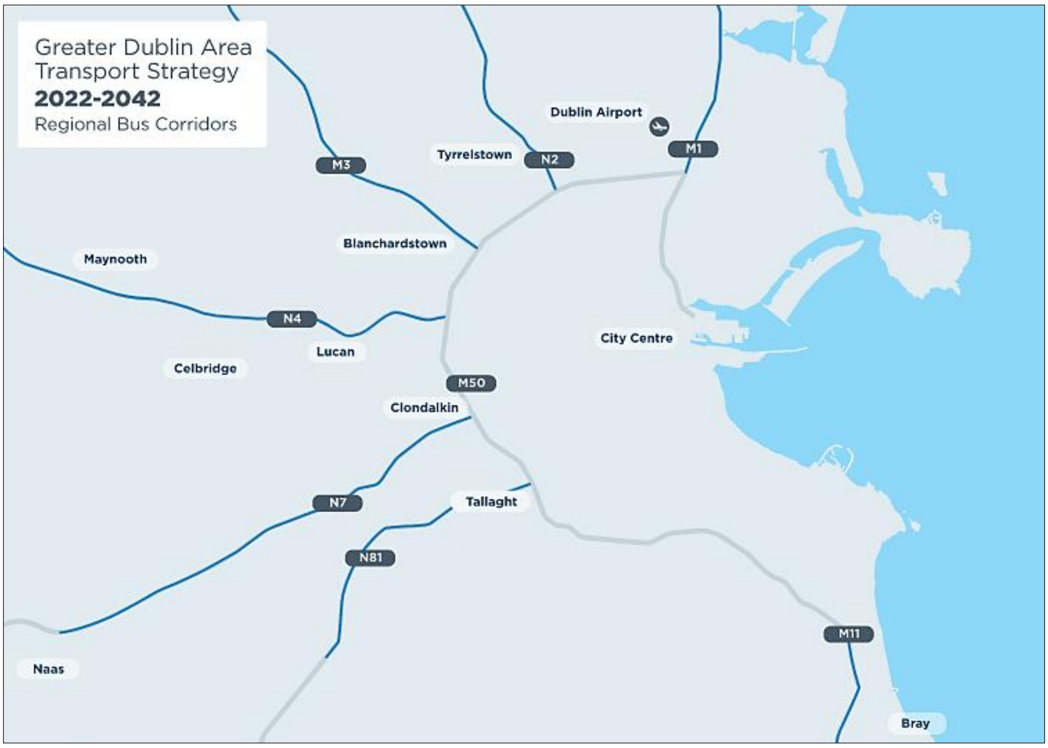

Figure 2.3: Regional Core Bus Corridors (NTA GDA Strategy)

In relation to the national road network, the Greater Dublin Area Strategy identifies a number of projects that will be delivered, including:

"Improvements to Junctions 5,6 and 7 on the M4 in order to address queuing onto the mainline and associated traffic safety issues plus the provision of bus priority between Junctions 5 and 7".

The Maynooth to Leixlip Project represents an intrinsic component of the Greater Dublin Area Strategy, which will enhance the economic and social progress of the Greater Dublin Area by providing for the efficient, effective and sustainable movement of people and goods.

2.3.2 BusConnects

2.3.2.1 Overview

BusConnects is an extensive programme of priority investment for public transport which plans to fundamentally transform Dublin's bus system. The objective of BusConnects is to develop the radial and orbital bus corridors as identified in the NTA Transport Strategy for the Greater Dublin Area 2016 – 2035, so that each will have continuous bus priority.

BusConnects seeks the development of a more attractive and convenient bus service with greater scope for interconnection between routes, where connecting passengers do not necessarily have to travel to Dublin City Centre. The proposed bus network for the west region is shown in Figure 2.4.

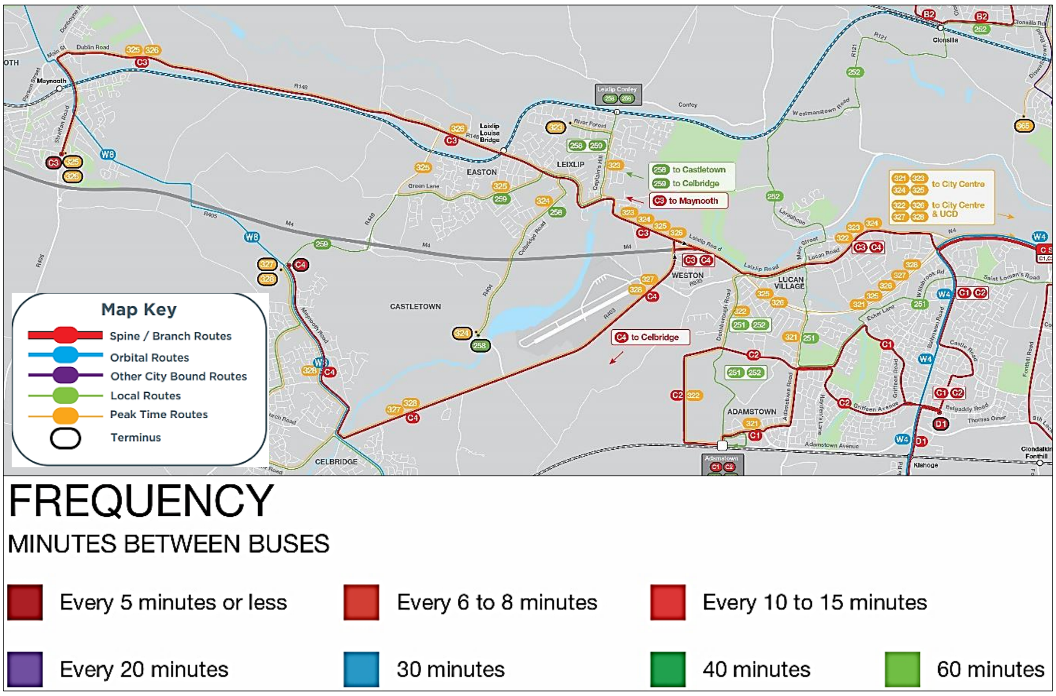

Figure 2.4: Proposed Bus Network for the Overall West Region (https://busconnects.ie/)

The proposed bus network for Maynooth, Leixlip and Celbridge is shown in Figure 2.5.

2.3.2.2 BusConnects Proposal for Maynooth and Leixlip

The BusConnects proposal for weekday midday frequencies for Maynooth and Leixlip are as follows:

- Bus service every 20 to 25 minutes for Maynooth;
- Orbital bus service every 30 minutes for both Maynooth and Leixlip; and
- Bus service every 10 to 15 minutes for Leixlip. This is comprised of 2 No. 20 to 25-minute services.

There are also commuter rail services every 30 minutes.

2.3.2.3 BusConnects Proposal for Celbridge

The BusConnects proposal for weekday midday frequencies for Celbridge is as follows:

- Bus service every 20 to 25 minutes; and
- 2 No. orbital bus services every 30 minutes.

There are also rail services greater than 30-minute frequencies.

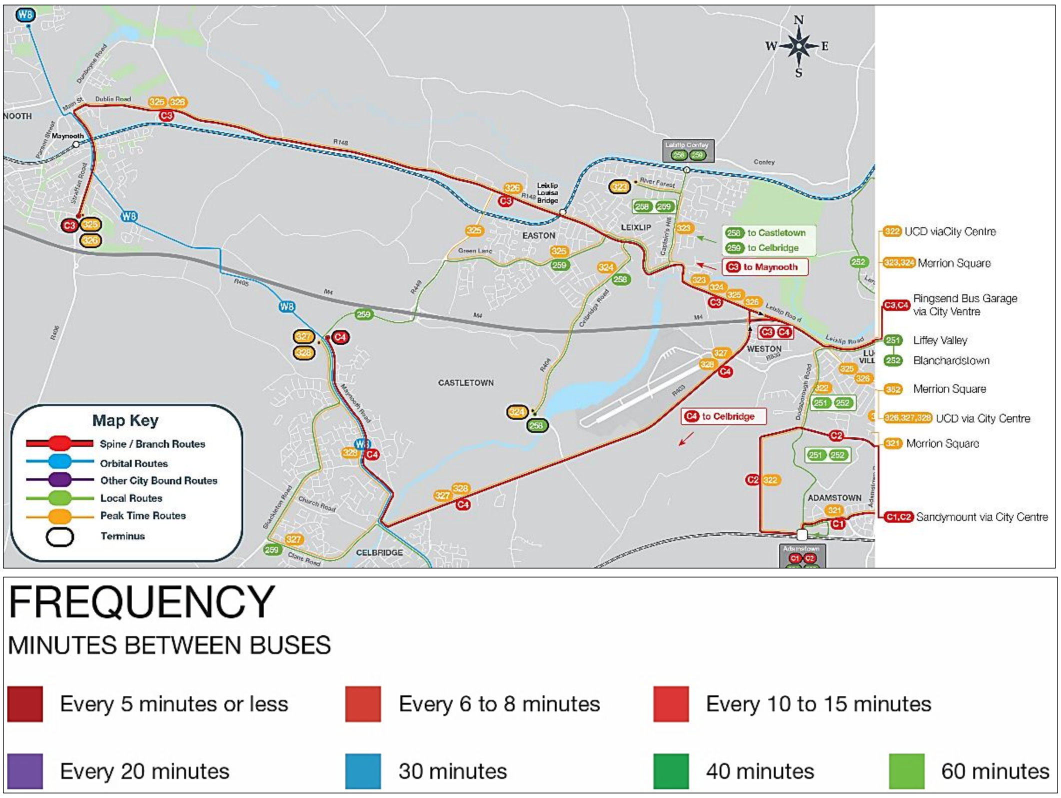

Figure 2.5: Proposed Bus Network for Maynooth, Leixlip and Celbridge (https://busconnects.ie/)

2.3.3 NTA Greater Dublin Area Cycle Network Plan

The NTA Greater Dublin Area Cycle Network Plan sets out the strategy for the development of an integrated cycle network. It identifies that within the Maynooth to Leixlip Project study area, there are a number of proposed primary, secondary, inter-urban and greenway cycle networks and thus form a key part of the strategic cycle network.

The objectives of the Maynooth to Leixlip Project will take cognisance of the current cycle network and the proposed cycle network outlined in this plan, as shown in Figure 2.6.

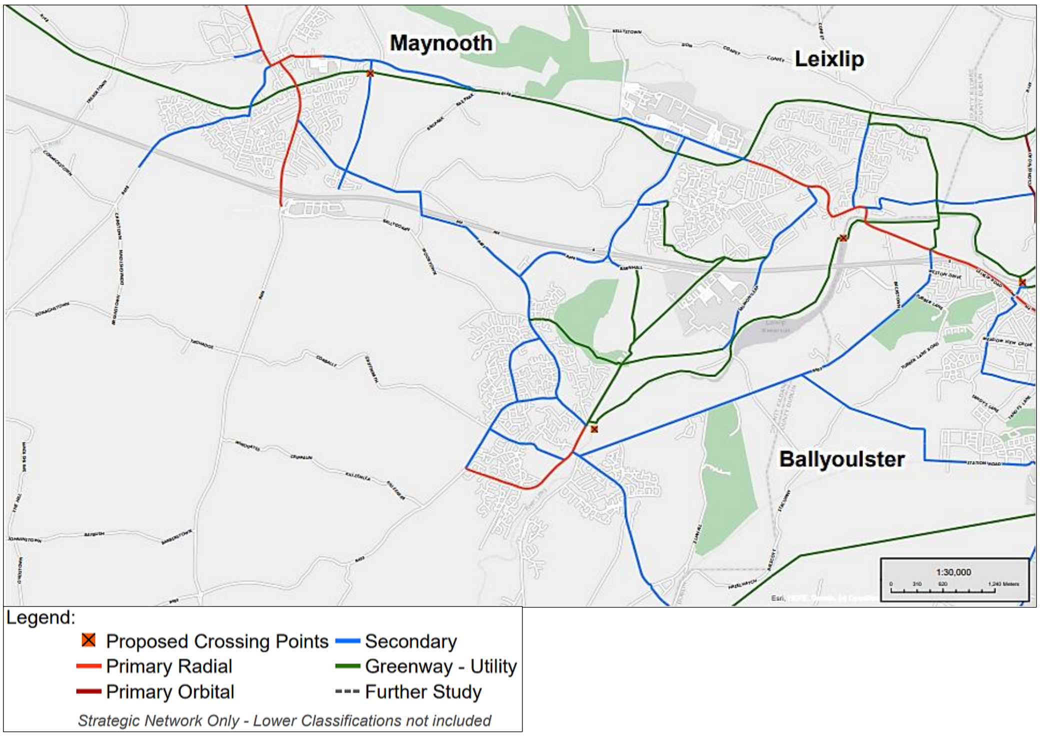

Figure 2.6: Maynooth, Leixlip and Celbridge Proposed Cycle Network (https://www.nationaltransport.ie/publications/strategic-planning/gda-cycle-network-plan/)

2.3.4 Eastern and Midland Regional Assembly, Regional Spatial and Economic Strategy 2019-2031

A Regional Spatial and Economic Strategy is a strategic plan which identifies regional assets, opportunities and pressures and provides appropriate policy responses in the form of Regional Policy Objectives. At this strategic level it provides a framework for investment to better manage spatial planning and economic development throughout the Region.

The principal statutory purpose of the Eastern & Midland Regional Assembly, Regional Spatial and Economic Strategy (RSES)[13] is to support the implementation of Project Ireland 2040[14] and the economic policies and objectives of the Government by providing a long-term strategic planning and economic framework for the development of the Region.

The Regional Spatial and Economic Strategy is required under the Planning and Development Act, 2000, as amended, to address employment, retail, housing, transport, water services, energy and communications, waste management, education, health, sports and community facilities, environment and heritage, landscape, sustainable development and climate change.

[13] Eastern and Midland Regional Assembly (2019) Regional Spatial and Economic Strategy 2019-2031. Available from: https://emra.ie/final-rses/ [Accessed: 6th February 2020]
[14] Government of Ireland (2018) Project Ireland 2040. Available from: https://www.gov.ie/en/policy/project-ireland-2040-policy/ [Accessed: 6th February 2020]

The Maynooth to Leixlip Project is identified as a "*Key transport infrastructure investment[s] in the metropolitan area*".

Regional Policy Objective (RPO) 8.10 states:

"The RSES supports appraisal and or delivery of the road projects set out in Table 8.4 subject to the outcome of appropriate environmental assessment and the planning process."

The Maynooth to Leixlip Project is identified as one such road project in Table 8.4 of the Regional Spatial and Economic Strategy.

With regard to public transportation outside the Metropolitan Area, the Strategy states:

"…where bus services provide the backbone of the regional public transport system, in particular for those without access to the private car, investment will be focussed on improving connectivity between regional settlements, including Dublin, and enhancing the reliability and the level of service within key settlements."

With regard to Park and Ride, Objective Regional Policy Objective 8.14 is also relevant:

"The RSES supports delivery of the strategic park and ride projects set out in Table 8.5 subject to the outcome of appropriate environmental assessment and the outcome of the planning process."

Table 8.5 of the Regional Spatial and Economic Strategy lists park and ride facilities at Liffey Valley. The delivery of the Maynooth to Leixlip Project will aim to complement and support the success of such facilities.

The Maynooth to Leixlip Project will contribute towards public transport modal shift, within the Eastern & Midland Regional area, by facilitating greater bus movements and connectivity to other public transport schemes, such as the Luas extension, DART Expansion and BusConnects.

Enhancing inter-regional connectivity is recognised in the Regional Spatial and Economic Strategy as one of the key growth enablers for the Eastern and Midland region, the delivery of which is supported by the improvement of the M4/N4 corridor as one of the primary strategic arteries through the region.

2.4 Strategic Fit and Priority with Local Policy

2.4.1 Kildare County Development Plan (2017 – 2023)

Kildare County Development Plan outlines the importance the motorway network as follows:

"The motorway network primarily serves long and middle-distance traffic originating in or passing through the county including the transportation of freight. These routes have an important role to play in the economic development of the county and the state."

The following policies and objectives taken from the Development Plan outline support for ensuring the efficient operation and strategic functionality of the motorway network is maintained and improved, together with identification of studies and projects pertinent to the Maynooth to Leixlip Project:

- Improve safety and capacity at the M4 Maynooth Interchange (Junction 7) and to investigate the provision of a future improved connection to the M4, at this location or elsewhere near Maynooth;
- Examine the feasibility of delivering an overpass of the M4 to link the Wonderful Barn at Leixlip to Castletown Demesne in Celbridge in consultation with TII; and
- Examine options in consultation with South Dublin County Council, Fingal County Council, Meath County Council, TII and other statutory agencies for the delivery of an orbital link road from the M4 to the M3 in Meath.

2.4.2 South Dublin County Development Plan (2022 – 2028)

The South Dublin County Development Plan contains policies and objectives. The most significant directly related to the Maynooth to Leixlip Project is the Adamstown Strategic Development Zone.

Adamstown is a planned urban development of 10,000 residential units with associated transport and community infrastructure, located circa 2km south of Junction 5 Leixlip. A planning scheme has been prepared, which provides a legal framework for phased development of residential and infrastructural works. Adamstown is based around walkable neighbourhoods located in close proximity to high quality public transport linkages.

2.4.3 Local Area Plans / Planning Projects

There are a number of Local Area Plans / Planning Projects for areas that are within the Maynooth to Leixlip Project study area. These include the following:

- Maynooth Local Area Plan 2013 - 2019[15]
- Celbridge Local Area Plan 2017 - 2023[16]
- Leixlip Local Area Plan 2020 - 2023[17]

The Maynooth Local Area Plan states that the upgrade of access to the M4 motorway and the provision of an additional access may be necessary to facilitate ease of access to the national road network. It further states the provision of additional M4 connection, and the upgrade of existing facilities is necessary to allow efficient access to the town centre, University and new employment areas. The Maynooth Local Area Plan promotes the study of an investigation of the safety and capacity of the existing Straffan Road M4 junction to establish whether a new junction is required. Kildare County Council and Meath County Council are in the process of preparing a Joint Local Area Plan for Maynooth 2024 – 2040) and its environs.

The Celbridge Local Area Plan contains a large quantity of road objectives although these plans are primarily related to local roads within the town of Celbridge.

These road objectives include improved safety measures, reduced congestion and new minor road infrastructure. Although not directly related to the Maynooth to Leixlip Project, many of the proposed options within the Maynooth to Leixlip Project will have beneficial results for the town of Celbridge.

The provision of additional capacity on the M4/N4 between Maynooth and Leixlip/Lucan as identified in Section 8.4 'Transport Investment Priorities' of the Regional Spatial and Economic Strategy is also supported by the Leixlip Local Area Plan. The Leixlip Local Area Plan states supporting the provision of capacity enhancements to the strategic road network in particular the management of traffic to optimise and protect capacity at the M4 - R449 Leixlip/Celbridge Interchange.

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[15] Kildare County Council. Maynooth Local Area Plan 2013 – 2019. Available at: https://www.kildare.ie/CountyCouncil/AllServices/Planning/LocalAreaPlans/LocalAreaPlans/MaynoothLAP2013-2019incorporatingAmendmentNo1/ [Accessed 17th November 2021]

[16] Kildare County Council. Celbridge Local Area Plan 2017 – 2019. Available at: https://kildare.ie/CountyCouncil/AllServices/Planning/LocalAreaPlans/LocalAreaPlans/CelbridgeLocalAreaPlan2017-2023/ [Accessed 17th November 2021]

[17] Kildare County Council. Leixlip Local Area Plan 2020 – 2023. Available at: https://kildare.ie/CountyCouncil/AllServices/Planning/LocalAreaPlans/LocalAreaPlans/LeixlipLocalAreaPlan2020-2023/ [Accessed 17th November 2021]

2.5 Road Development Strategy

2.5.1 Trans-European Network for Transport

Regulation (EU) No. 1315/2013 of the European Parliament and of the Council, Trans-European Network for Transport (the "TEN-T Regulations") is a European Union policy directed towards the implementation and development of a Europe-wide network of roads, railway lines, inland waterways, maritime shipping routes, ports, airports and rail-road terminals. The network consists of two layers:

The Comprehensive Network: Covering all EU regions.

The Core Network: A subset of the Comprehensive Network, this consists of the strategically most important connections, linking the most important nodes.

The objective of TEN-T is to close gaps, remove bottlenecks and eliminate technical barriers that exist between transport networks of EU Member States, strengthening the social, economic and territorial cohesion of the Union and contributing to the creation of a single European transport area. Under the TEN-T Regulations, the Core Network is due to be completed by the 31st of December 2030, while the Comprehensive Network is due to be completed by the 31st of December 2050.

The aim of the EU's Transport Policy is to promote a mobility that is efficient, safe, secure and environmentally friendly. Congestion is not just a nuisance for road users; it also results in an enormous waste of fuel and productivity. Many manufacturing processes depend on just-in-time deliveries and free flow transport for efficient production.

Congestion costs the EU economy more than 1% of GDP – to reduce this, the EU needs more efficient transport and logistics, better infrastructure and the ability to optimise capacity use. The EU Commission also recognises that Europe needs transport which is cleaner and less dependent on oil.

Moving towards low-carbon and more energy efficient transport, as well as developing more efficient urban and intermodal transport solutions as alternatives are essential to developing a more environmentally friendly transport policy.

The TEN-T Regulations set out the requirements for high quality roads that form part of the TEN-T road network, both Core (2030) and Comprehensive (2050), 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 as referred to in paragraphs 1 and 2."*

Article 4 of the TEN-T Regulations 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.

The following sub-articles are relevant:

"Cohesion through:

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

The M4/N4 corridor forms part of the TEN-T Comprehensive Network connecting Dublin to the west and northwest of the country as illustrated in Figure 2.7.

Improvements to the TEN-T comprehensive network would enhance growth in the Project Ireland 2040 assigned urban growth regions of Galway, Athlone and Sligo thus enhancing the M4/N4 capabilities to provide a reliable strategic route between the east and west of the country. The Maynooth to Leixlip Project will provide for cohesion, efficiency and benefits for users by providing a more resilient transport corridor for long-distance, regional and local traffic passenger and freight traffic.

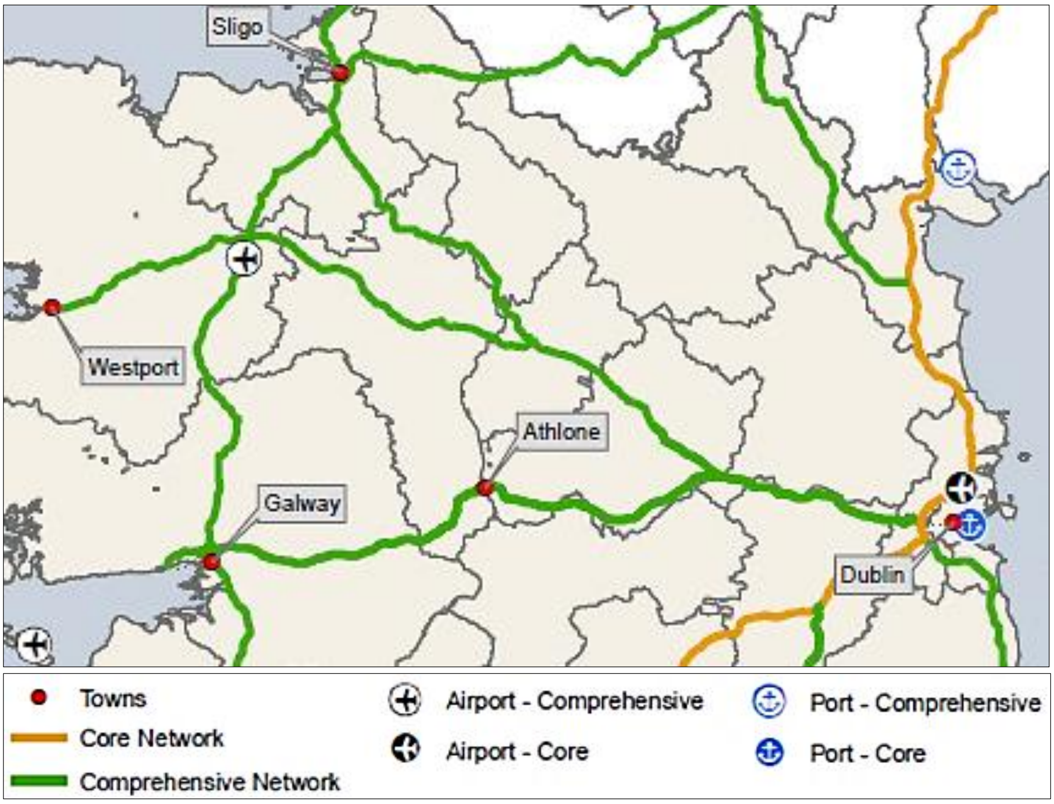

Figure 2.7: TEN-T Network (© Google Map data ©2024 Tele Atlas)

2.5.2 Road Safety Authority – Our Journey Towards Vision Zero - Road Safety Strategy 2021 - 2030

The Road Safety Authority (RSA) Our Journey Towards Vision Zero, Ireland's Government Road Safety Strategy 2021 – 2030, sets outs targets to be achieved in terms of road safety in Ireland as well as policy to achieve these targets. The primary target of this strategy is:

"Ireland's fifth Road Safety Strategy will adopt a transformational and partnership-based approach to road safety in Ireland to achieve a 50% reduction in deaths and serious injuries by 2030.

The 2020 Programme for Government commits to achieving 'Vision Zero' – i.e. no deaths or serious injuries on the roads – which we will achieve by 2050."

The plan sets out seven safe system priority intervention areas for engineering and infrastructure in terms of the benefits that they can have in terms of reducing collisions. Any potential project should align and support this Road Safety Authority strategy.

2.6 Project Specific Need

2.6.1 Overview

Phase 1 (Concept and Feasibility) undertaken in 2020 identified a robust need for intervention and concluded that there was strong justification for advancing the Maynooth to Leixlip Project to provide potential solutions to these transportation issues.

This section of the report provides an overview of the existing transportation deficiencies within the study area in the context of establishing and supporting the need for the proposed project.

2.6.2 Existing Road Network

As noted in Chapter 1, the M4/N4 national road is the primary artery connecting Dublin to the west and northwest of the country. In addition, the route provides access to international markets for freight and tourist traffic through Dublin Port as well as serving a high commuting demand within the Dublin metropolitan region.

The existing M4/N4 within the study area and its surrounds is an amalgamation of several separate construction projects and upgrades over a period of approximately 30 years.

2.6.2.1 History and Description of the M4/N4 and associated Road Network

The existing M4/N4 is a national primary road from the M50 in Dublin to Sligo over a length of approximately 200km. It is a dual carriageway standard from the M50 to Junction 5 Leixlip incorporating direct accesses, bus facilities, bus stops, footways and cycleways over a length of approximately 7km. The section from the M50 to Lucan was constructed in the mid-1980’s with the Lucan Bypass constructed in the late 1980’s, severing the old village to the north from the newer areas to the south. In 2009, the section from the M50 to Lucan was upgraded to three lanes in both the westbound and eastbound directions and closed off the majority of local accesses. It is motorway standard from Junction 5 Leixlip in Dublin to Coralstown in County Westmeath over a length of approximately 53km.

It is a mixture of single and dual carriageway from Coralstown in County Westmeath to Sligo over a length of approximately 140km. The section of the M4 between the Junction 5 and Junction 7 is a strategic two-lane motorway that has been in operation since 1994.

The surrounding regional and local road network provide access to the M4/N4 and various towns and villages throughout the study area. The R148 runs from Dublin to Kinnegad in County Westmeath. The road is 45km in length. It is generally of a very high standard for a regional road, with wide lanes, hard shoulders, and turning bays.

It is still heavily used by traffic avoiding the tolled M4 between Kilcock and Kinnegad. The R148 was previously categorised as a National Primary route until the opening of the M4 motorway.

It follows the same corridor and serve the same east west commuters as the M4. The R148 regional road extends from Leixlip, crossing the River Liffey and the Royal Canal. From the canal, it passes the Intel campus and continues to Maynooth. It then extends outside of the study area in a westerly direction via Kilcock and Enfield and finally terminates in Kinnegad in County Meath/Westmeath.

The R403 connects the M4 at Junction 5 and continues through Celbridge in a southwest direction outside of the study area.

The R449 links into the M4 at Junction 6. From here it continues north and ties into the R148 at the Intel Ireland campus to the west of Leixlip town. The R449 ties into the R405 southwest of Junction 6. The R405 extends from Celbridge to Maynooth and crosses the M4 via an overbridge. The R406 (Straffan Road) links to the M4 at Junction 7. From here it continues north before tying into the R148 in Maynooth town centre. The R406 extends south and ties into the R403 and Barberstown Road at a four-armed roundabout. Barberstown Road extends south before tying into the L2007 which then connects to Straffan Road tying into the N7 at Junction 7. Alternatively, from Barberstown Roundabout, traffic can progress through Clane and onto the Sallins Bypass to Junction 9a. This provides a link from the M4 to the M7. The existing road network is shown in Figure 2.8.

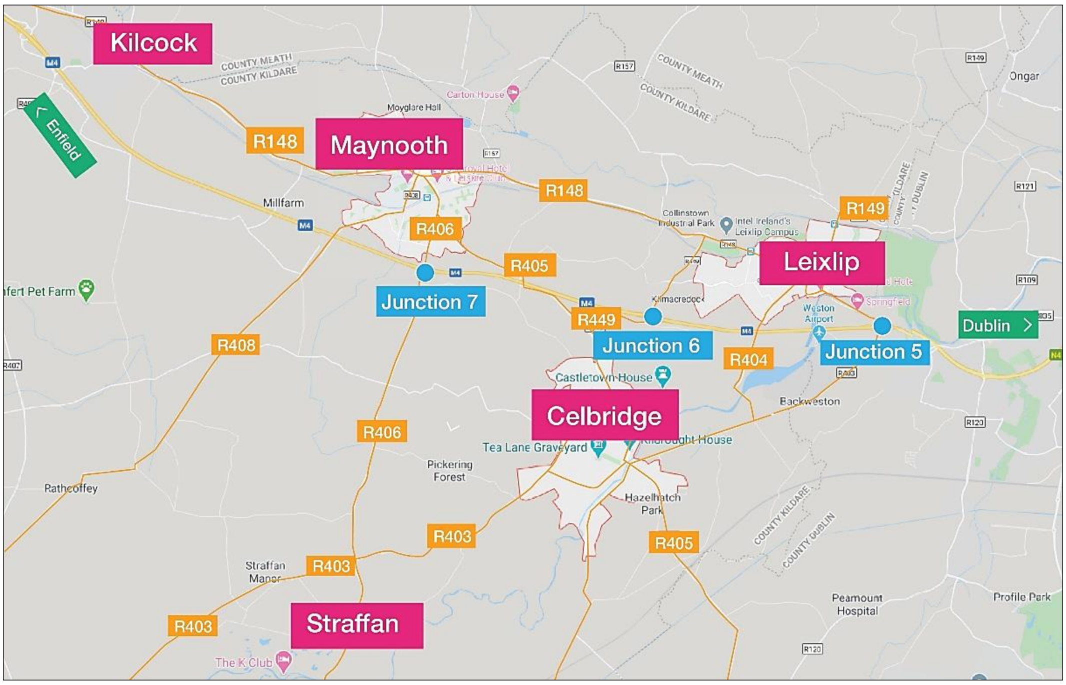

Figure 2.8: Existing Road Network (© Google Map data ©2024 Tele Atlas)

2.6.2.2 Corridor and Mainline

The corridor under consideration includes the M4/N4 mainline carriageway from Maynooth to Leixlip and the associated mainline junctions. The M4/N4 network forms part of the Trans-European Transport Network (TEN-T) comprehensive network.

The existing M4/N4 cross section varies minimally over the length of the corridor under consideration. Initial investigation indicates that the M4/N4 cross section comprises of a central reserve of 7m in some areas reduced from the nominated 9m and lane widths of approximately 3.65m.

The mainline is of motorway standard, which was designed and constructed as per relevant standards appropriate in 1994. There are no substandard direct accesses along this route within the study area. There are three junctions within the study area, moving from east to west; Junction 5 Leixlip, Junction 6 Celbridge and Junction 7 Maynooth.

2.6.2.3 Junction 5 Leixlip

Junction 5 Leixlip is located towards the east of the study area. A schematic is shown in Figure 2.9 and an aerial view shown in Figure 2.10. It serves Leixlip to the north via the R148, and Celbridge to the south via the R403. It is a grade separated junction with a dumbbell roundabout to the north and signalised junction to the south.

The eastbound diverge and westbound merge are both standard 1 lane slip roads. The eastbound merge is unorthodox and is a 2-way road from the roundabout for a length of 100m to accommodate 2 No. private dwelling houses. From here to the M4/N4 eastbound mainline, it incorporates 1 No. traffic lane, 1 number bus lane and a footway. The westbound diverge incorporates a footway, on-road cycleway and 2 No. traffic lanes. The overbridge incorporates 1 No. northbound lane, 1 No. southbound lane, 1 No. right-turn lane and 2 No. footways.

Continued planned growth around the Leixlip and Adamstown area may put additional pressure on Junction 5 particularly during peak traffic times. The junction is also located close to busy urban environments and provides direct access from the M4/N4 to Leixlip, Celbridge and Weston Airport.

The provision of a new Celbridge Link Road as part of Phase 7 of the Adamstown Strategic Development Zone (SDZ) may put additional pressure on the operation and capacity of Junction 5 as it will provide a link between the Strategic Development Zone and the M4 and also facilitate access to the proposed Adamstown Train Station, Park and Ride facility and BusConnects Terminus. The link road also makes provision for pedestrian and cyclist facilities which may increase vulnerable road users in the vicinity of Junction 5. This will be further examined during this Phase along with the impact of future growth on the operation and capacity of the junction.

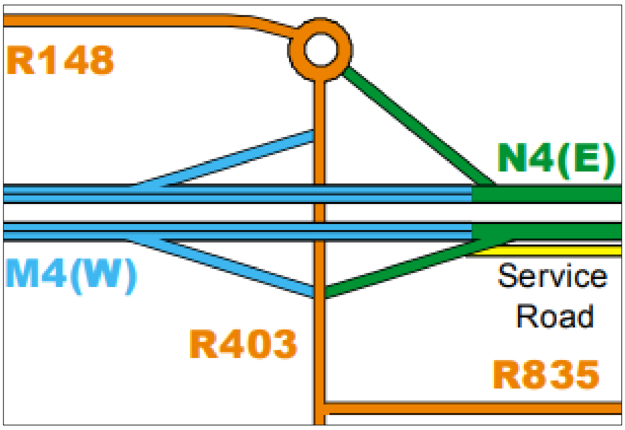

Figure 2.9: Junction 5 Leixlip – Schematic (www.tii.ie/tii-library/Network_Management/Junction%20Layout%20Maps/M4-Junctions.pdf)

Figure 2.10: Junction 5 Leixlip – Aerial (© Google Imagery ©2024 DigitalGlobe)

2.6.2.4 Junction 6 Celbridge

Junction 6 Celbridge is located centrally within the study area. A schematic is shown in Figure 2.11 and an aerial view shown in Figure 2.12. It serves Intel Ireland, located west of Leixlip town and north of Junction 6 via the R449 and Celbridge and the Liffey Business Campus to the south via the R449 and an access road respectively. It is a grade separated 2 lane rotary junction with a roundabout to the north.

The rotary overbridge incorporates 2 No. traffic lanes throughout. The R449 Leixlip Road to the north of the junction incorporates 2 No. traffic lanes, footway and cycleway in each direction along the entire length to the R148. There is a free-flow slip-road from the R449 to the M4 eastbound.

The R449 Celbridge Road to the south of the junction incorporates 1 No. traffic lane, footway and cycleway in each direction along the entire length to the R405. The Liffey Business Campus access road to the south of the junction incorporates 1 No. traffic lane, footway and cycleway in each direction along the entire length to the campus site.

The westbound merge is a standard 1 lane slip road. The eastbound merge incorporates 2 No. traffic lanes at the start and immediately prior the nose of the slip road, the left-hand slip lanes merges into one lane. From here the slip road is a typical standard 1 lane slip road. The westbound diverge incorporates 2 No. traffic lanes with a left-hand slip road to the Liffey Business Campus. The eastbound diverge incorporates 2 No. traffic lanes.

Continued growth in the Leixlip and Celbridge areas, in particular industry such as expansion of the Intel Campus and the potential of the Liffey Business Campus, may put additional pressure on Junction 6, particularly during peak traffic times. The junction also makes provision for vulnerable road users with footpaths, cycle facilities and uncontrolled crossing points to allow vulnerable road users to traverse the junction. This will be further examined during this Phase along with the impact of future growth on the operation and capacity of the junction.

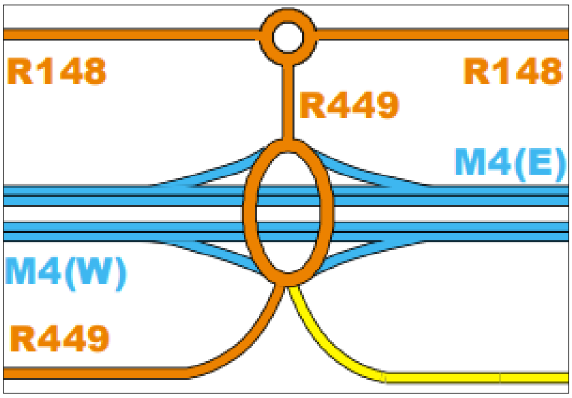

Figure 2.11: Junction 6 Celbridge – Schematic (www.tii.ie/tii-library/Network_Management/Junction%20Layout%20Maps/M4-Junctions.pdf)

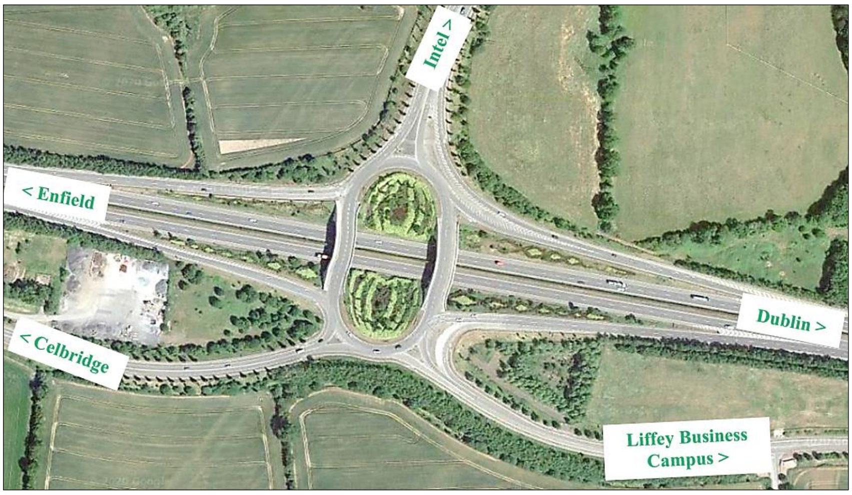

Figure 2.12: Junction 6 Celbridge – Aerial (© Google Imagery ©2024 DigitalGlobe)

2.6.2.5 Junction 7 Maynooth

Junction 7 Maynooth is a grade separated junction located towards the west of the study area. A schematic is shown in Figure 2.13 and an aerial view is shown Figure 2.14. It serves Maynooth to the north via the R406 and Straffan and Clane to the south, also via the R406.

The westbound diverge is a standard 1 lane slip road connecting to the Straffan Road Roundabout. The westbound merge, eastbound merge and eastbound diverge are all a standard 1 lane slip road. The overbridge incorporates 1 No. northbound lane, 1 No. southbound lane, 1 No. right-turn lane and 2 No. footways.

The Straffan Road Roundabout also incorporates access to Maynooth Business Campus to the east and a number of local businesses to the west.

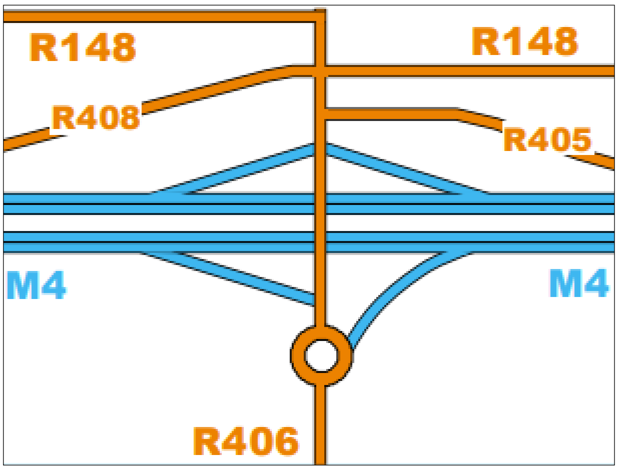

Figure 2.13: Junction 7 Maynooth – Schematic (www.tii.ie/tii-library/Network_Management/Junction%20Layout%20Maps/M4-Junctions.pdf)

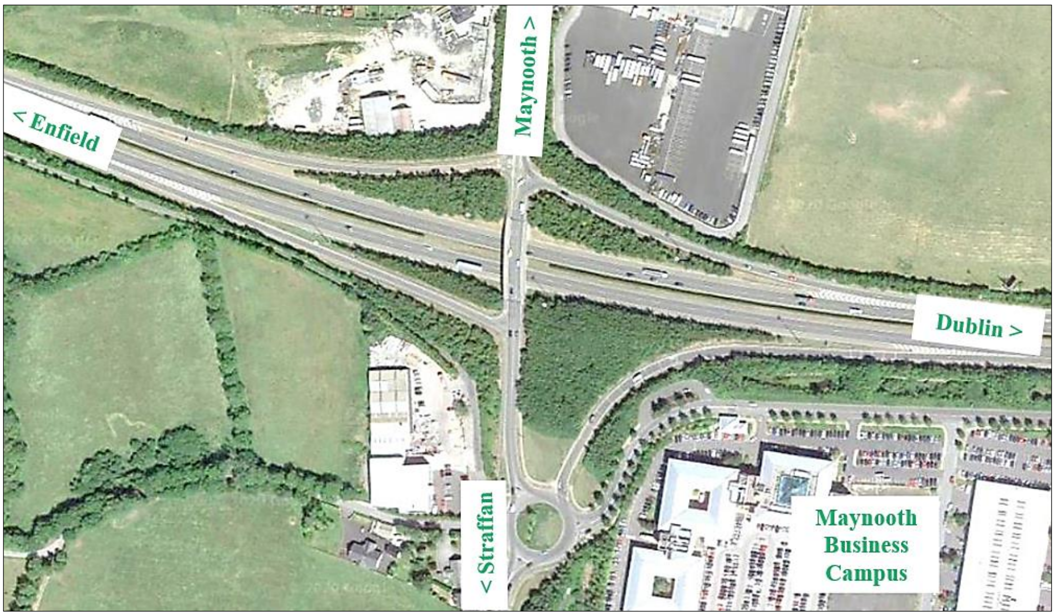

Figure 2.14: Junction 7 Maynooth – Aerial (© Google Imagery ©2024 DigitalGlobe)

2.6.3 Existing Traffic Volumes

Transport Infrastructure Ireland's (TII) Traffic Count Data website presents information on traffic volume and composition obtained via a network of traffic counters embedded in the road surface. Using this database, Annual Average Daily Traffic (AADT) volumes for the existing M4/N4 in the vicinity of the study area for the year 2019 have been obtained from TII Traffic Monitoring Units (TMU) located on the route. These are presented in Table 2.1. The Traffic Monitoring Units locations are shown in Figure 2.15.

Table 2.1: Existing M4/N4 AADT

Traffic Counter Location	AADT (2019)	HGV (%)	HGV (AADT)
N4 Junction 3 Newcastle – Junction 4 Lucan	85,939	4.5	3,867
M4 Junction 6 Celbridge – Junction 7 Maynooth	59,435	5.6	3,328
M4 Junction 7 Maynooth – Junction 8 Kilcock	46,585	9.6	4,472
M4 Junction 8 Kilcock – Junction 9 Enfield (east)	29,402	10.3	3,028
M4 Junction 9 Enfield (west)	14,671	10.6	1,555

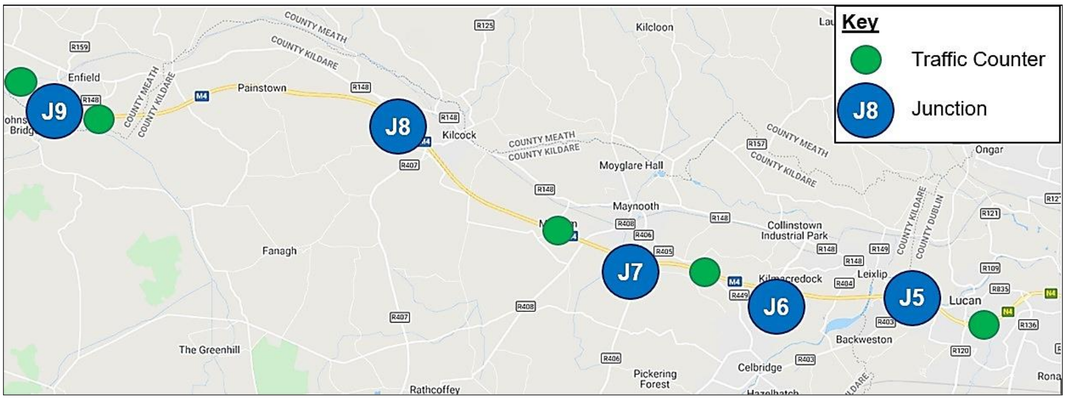

Figure 2.15: Traffic Counter Locations (© Google Map data ©2024 Tele Atlas)

Table 2.1 shows that traffic volumes on the M4/N4 between Junction 9 Enfield and Junction 3 Newcastle increases significantly as the population centres of Enfield, Kilcock, Maynooth, Celbridge, Leixlip, Lucan and the surrounding hinterlands utilise the M4/N4 as their main route to access the M50 and Dublin.

There is a circa six-fold increase (85,939/14,671) in traffic volumes from Junction 9 Enfield to Junction 3 Newcastle. There is a circa two-fold increase (29,402/14,671) in traffic volume at Junction 9. This is due to the traffic accessing the M4 from the town of Enfield and its surrounds. This pattern of increase is replicated at all junctions from Junction 9 through the study area and onto Junction 3. Increases, based on traffic counter data, include 128% (59,435/46,585) between Junction 6 and 7 and 158% (46,585/29,402) between Junction 7 to 8. Trends in HGV volumes indicate a spike in Annual Average Daily Traffic between Junction 7 and 8, which drops off either side of both junctions.

This trend may be influenced by a number of factors including the toll, orbiting routes and local businesses, which will be examined further in this Phase.

Based on the TII traffic counters located between Junction 6 Celbridge and Junction 7 Maynooth, the M4 is carrying approximately 20% of the daily traffic on the route during the AM peak period (06:00 – 09:00) and 24% of the daily traffic on the route during the PM peak period (16:00 – 18:00). This constitutes approximately 44% of the total daily traffic. These figures are comparable with two other major commuter routes into Dublin, the N11 and N7.

2.6.4 Existing Speed Data Analysis

2.6.4.1 Overview

Additional speed data was also obtained from the TII Traffic Monitoring Units (TMU's) along the M4/N4 – three of which were examined[18]. Mean speed measurements were extracted at five-minute intervals across the day during 2019 at each Traffic Monitoring Units location in both the eastbound and westbound directions.

2.6.4.2 M4 Eastbound

Speed data obtained from the TII Traffic Monitoring Units in the eastbound direction is presented in Figure 2.16, Figure 2.17 and Figure 2.18. The Traffic Monitoring Units record spot speeds at each monitoring unit location and the figures below present the mean values obtained from data from the 30th of September 2019 to the 3rd of November 2019.

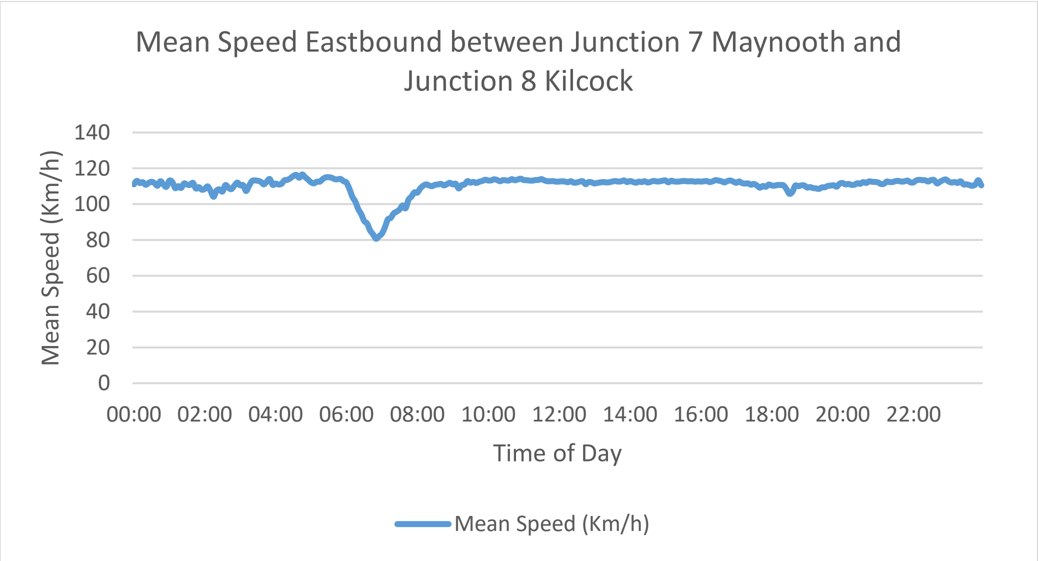

Figure 2.16: Mean Speed Eastbound between Junction 7 Maynooth and Junction 8 Kilcock

[18] TMU N04 between Junction 3 (Newcastle) and Junction 4 (Lucan)
TMU M04 015 between Junction 6 (Celbridge) and Junction 7 (Maynooth)
TMU M04 020 Maynooth West

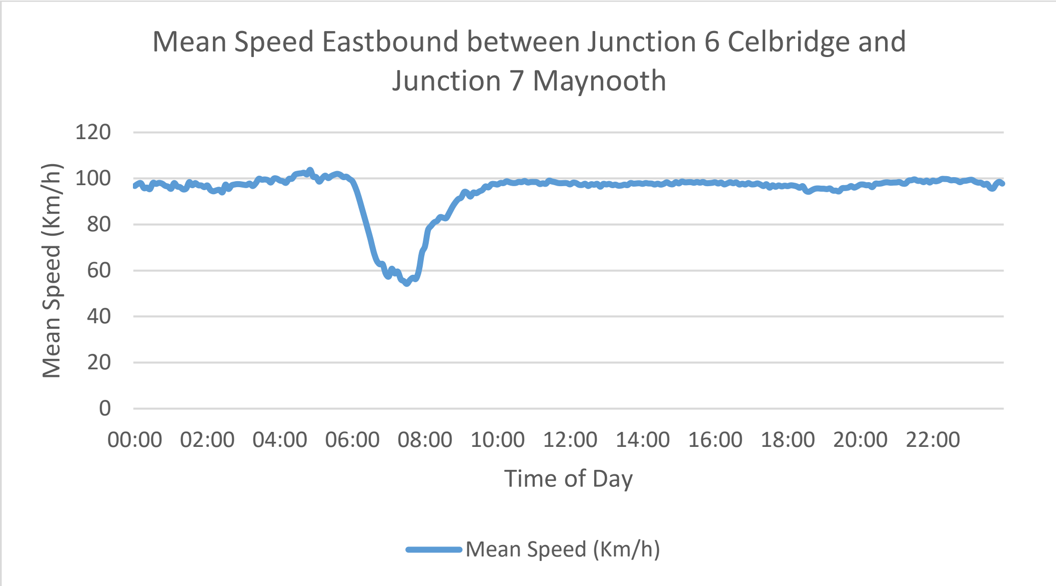

Figure 2.17: Mean Speed Eastbound between Junction 6 Celbridge and Junction 7 Maynooth

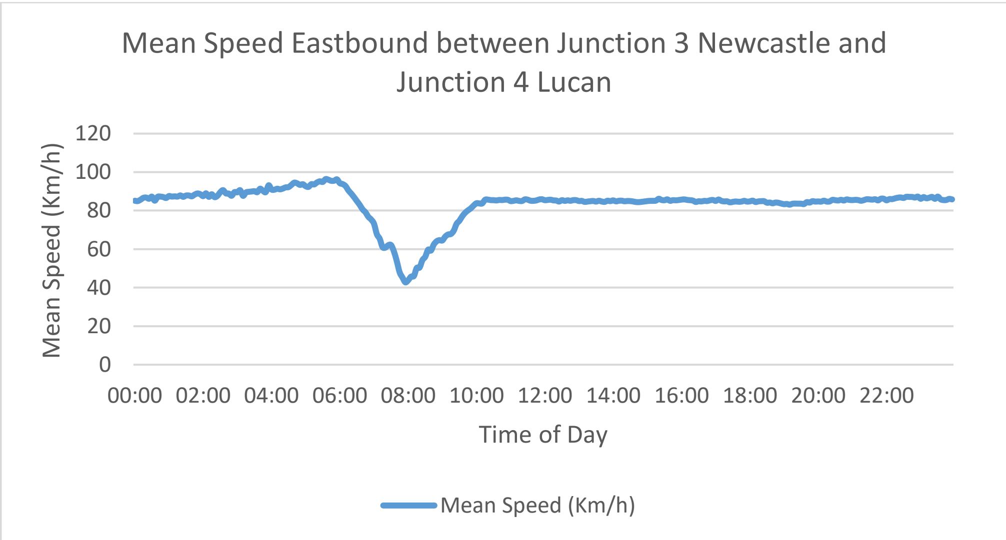

Figure 2.18: Mean Speed Eastbound between Junction 3 Newcastle and Junction 4 Lucan

The above figures are particularly useful in understanding the duration of the AM peak and the degree to which journey delay extends across the AM period. Between Junction 6 Celbridge and Junction 7 Maynooth, speeds drop sharply from 06:00, only returning to average levels at approximately 10:00. A similar trend is evident with other counters between Junction 7 Maynooth and Junction 8 Kilcock, and between Junction 3 Newcastle and Junction 4 Lucan.

2.6.4.3 M4 Westbound

Speed data obtained from the TII Traffic Monitoring Units in the westbound direction is presented in Figure 2.19, Figure 2.20 and Figure 2.21. The Traffic Monitoring Units record spot speeds at each monitoring unit location and the figures below present the mean values obtained from data across 2019.

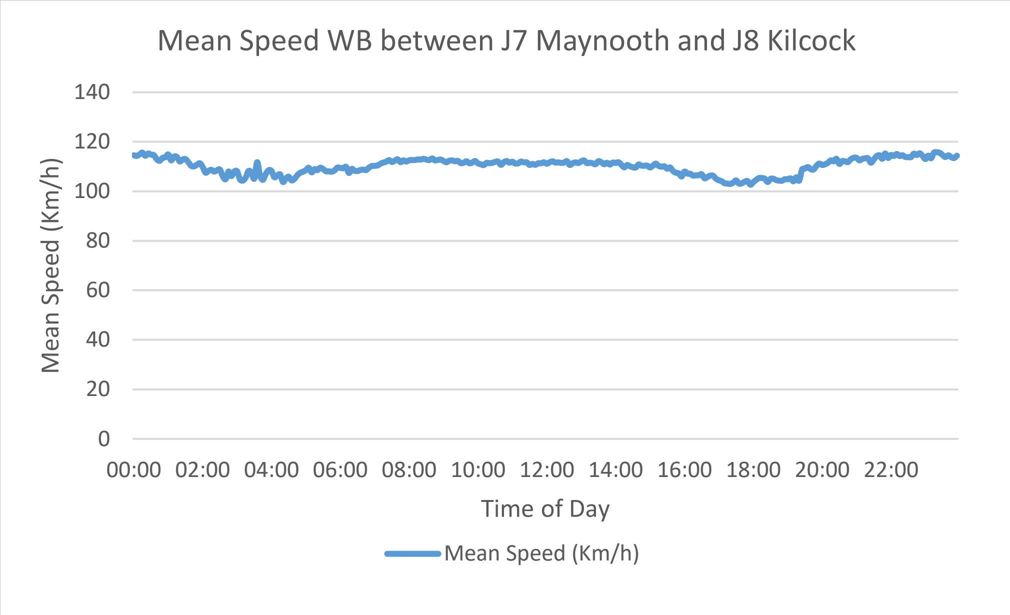

Figure 2.19: Mean Speed Westbound between J7 Maynooth and J8 Kilcock

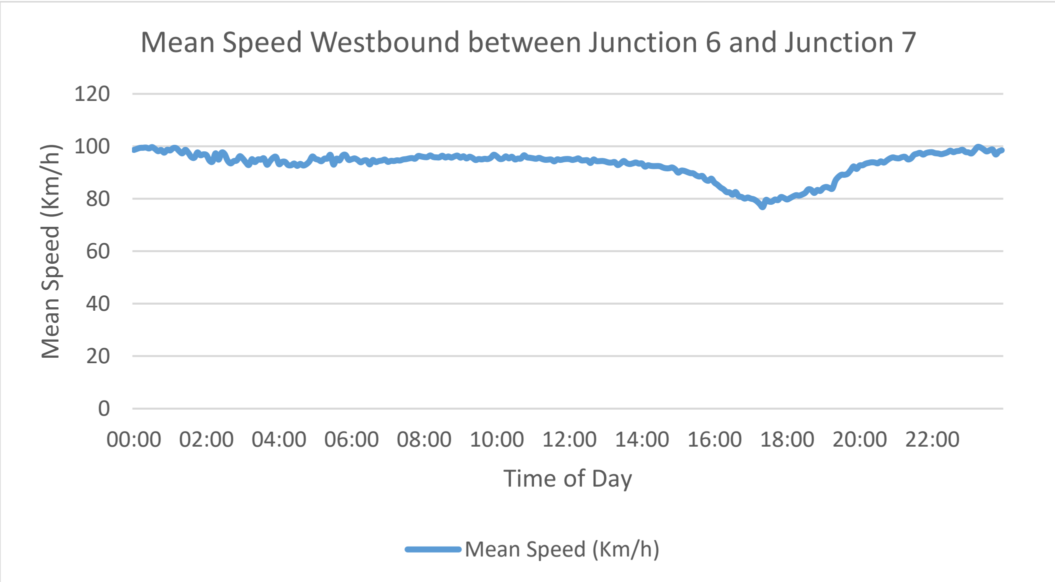

Figure 2.20: Mean Speed Westbound between Junction 6 Celbridge and Junction 7 Maynooth

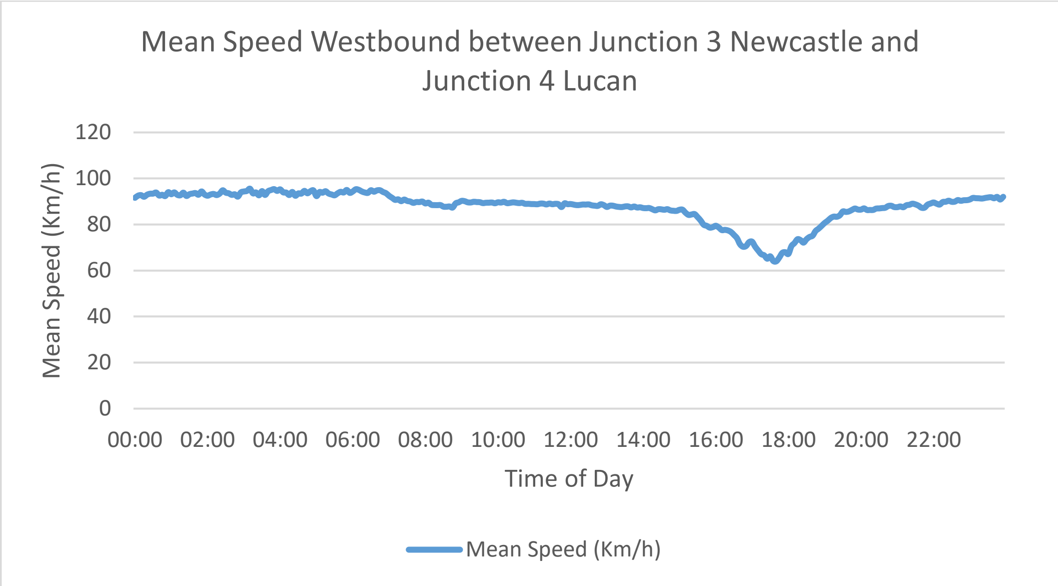

Figure 2.21: Mean Speed Westbound between Junction 3 Newcastle and Junction 4 Lucan

These figures provide evidence of the duration of PM peak delay, with mean speeds dropping before 15:00 and only recovering close to 19:30 between Junction 3 Newcastle and Junction 4 Lucan. Similarly, between Junction 6 Celbridge and Junction 7 Maynooth, mean speeds drop sharply from approximately 16:00, and only recover at approximately 20:00. Speed analysis between Junction 7 and Junction 8 presents a lesser reduction when compared to other Traffic Monitoring Units. This is as expected as vehicles move west from Junction 7.

2.6.4.4 Summary

The analysis demonstrates the volume of traffic and the delays in journey times on the M4/N4. In particular, there is a circa six-fold increase (85,939/14,671) in traffic volumes from Junction 9 Enfield to Junction 3 Newcastle. There is also a circa two-fold increase (29,402/14,671) in traffic volume at Junction 9. This pattern of increase is replicated at all junctions from Junction 9 through the study area and onto Junction 3. In addition, during the pm peak, the outbound journey times are significantly longer than the inbound journey times. Outbound PM peak journey times to Junction 5, Junction 6, Junction 7 and to Celbridge are approximately double those of the inbound PM peak journey times.

Unreliability of journey time, particularly during the AM and PM peaks, hinders the intended strategic function and wider economic benefits of the M4/N4 corridor as an efficient transport corridor. Congestion issues inhibit economic prospects at a local and regional level and pose a quality of life constraint on those needing to use the corridor for business and social needs.

2.6.5 Existing Road Safety

2.6.5.1 Average Collision Rates

To ensure compliance with the EU Road Infrastructure Safety Management (RISM) Directive, TII undertakes network safety analysis across the national road network with the primary aim of identifying high collision locations. Collision rates are calculated based on all fatal, serious and minor injury collisions occurring along a section of road and an exposure measure, typically in the form of vehicle kilometres of travel over the same section.

The collision rates for the M4/N4 corridor covering the period 2014 – 2016 are illustrated in Figure 2.22.

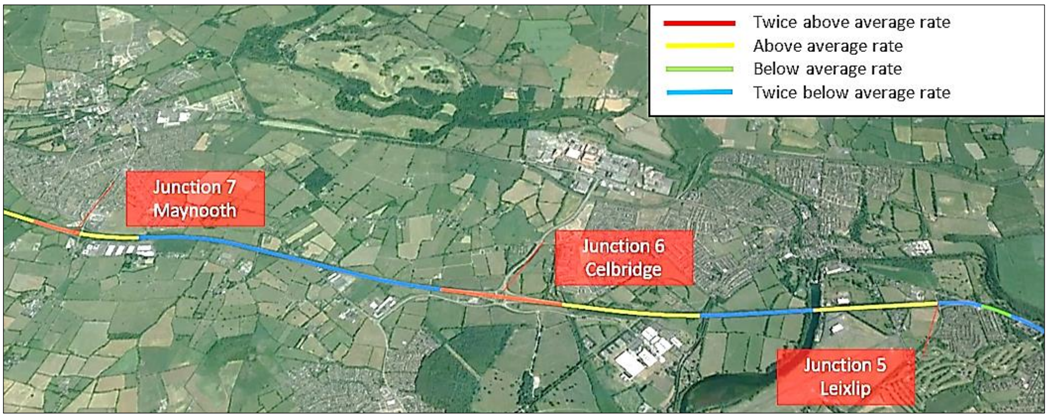

Figure 2.22: M4/N4 Average Collision Rates (© Google Imagery ©2024 DigitalGlobe) Typical Collisions Profile

2.6.5.2 Typical Collision Profile

The collision type witnessed within the study area including the overall average for each type of collision at each location are illustrated in Figure 2.23. As expected, pedestrian involvement is lower at the three main junctions of the mainline in comparison to the wider study area. A high quantity of rear end shunt type collisions are evident at Junction 5 while Junction 6 displays a higher than average level of single vehicle collisions.

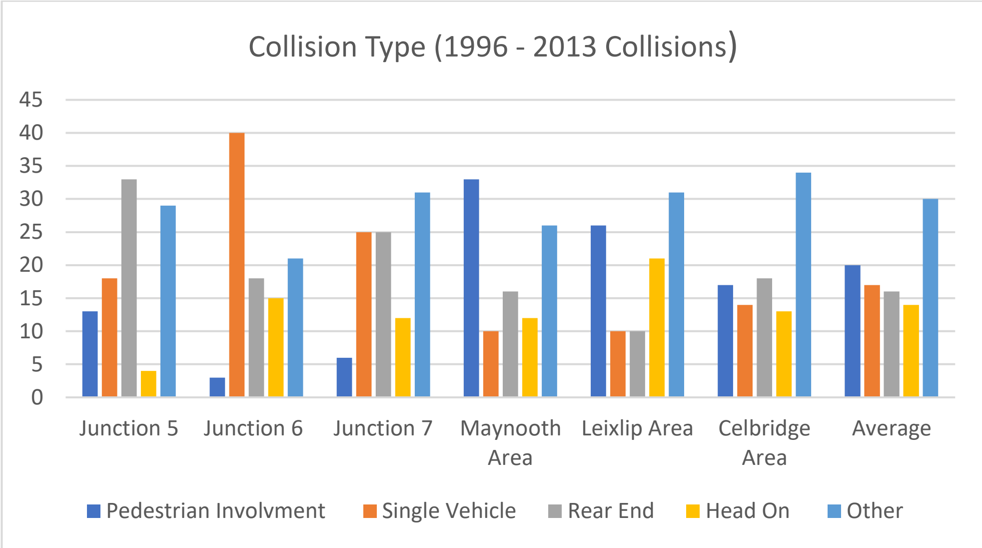

Figure 2.23: Collision Type (1996 – 2013 Collisions)

2.6.6 Existing Public Transport Provision

The key existing public transport hubs and proposed hubs based on strategy documents are illustrated in Figure 2.24. The spaces shown represent approximate on-site car parking facilitates provided by each public transport hub.

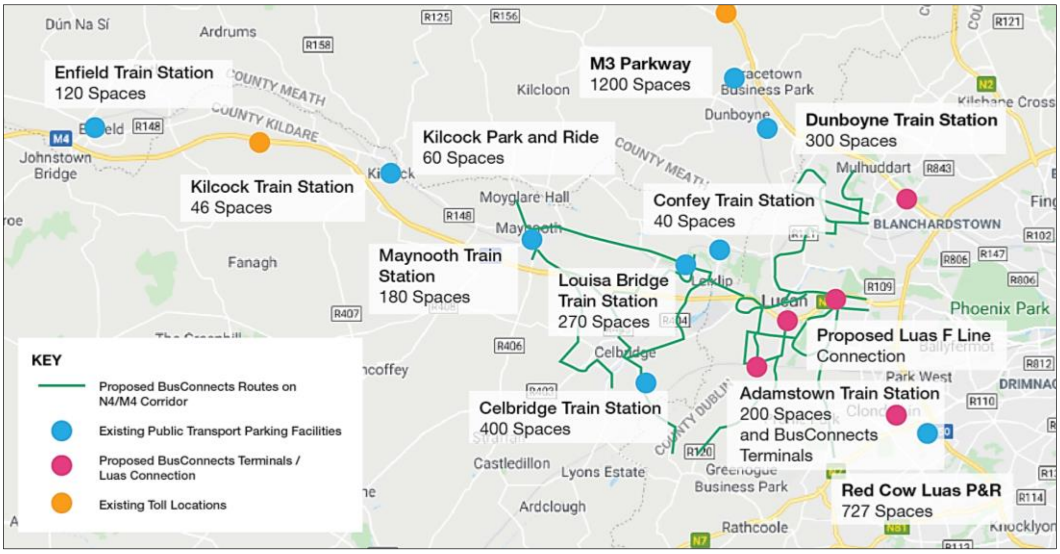

Figure 2.24: Key Public Transport Hubs (© Google Map data ©2024 Tele Atlas)

2.6.6.1 Rail Network

The study area interacts with two rail lines:

- Western rail line extending from Dublin Connolly (City Centre) to Sligo and passes through Leixlip and Maynooth.
- Southern rail line extending from Dublin Heuston to Cork and passes to the south of Celbridge, where it is serviced by the Hazelhatch / Celbridge station.

The frequency of the existing rail services through the study area is as follows:

- Maynooth is serviced by two routes:
    - Dublin-Maynooth route with services typically running every 20 to 30 minutes to Maynooth during the weekdays and typically every 30 minutes to one hour during the weekends.
    - Longford-Maynooth route with services typically running every 120 minutes Monday – Sunday.
    - Dublin Connolly - Sligo with 11 services daily during weekdays and a reduced number of services during weekends.
- Leixlip is serviced by two stations - Leixlip Confey and Leixlip Louisa Bridge. These stations are serviced by the Dublin-Maynooth route. This route typical runs every 20 to 30 minutes during the weekdays to Leixlip and every 30 minutes to one hour during weekends.
- Celbridge is serviced by three routes:
    - Dublin Heuston – Galway with one service during weekdays.
    - Dublin Heuston – Waterford with two services during the weekdays, one service on Saturdays. There are no services on Sundays.
    - Grand Canal Dock and Dublin Heuston – Portlaoise – Cork with up to 45 services during weekdays, 19 services on Saturdays and 5 services on Sundays.

2.6.6.2 Bus Network

The population centres within the study area are reliant on the bus network to a considerable degree with a variety of routes served by Dublin Bus, Bus Eireann, Go Ahead and private operators, as shown in Figure 2.25.

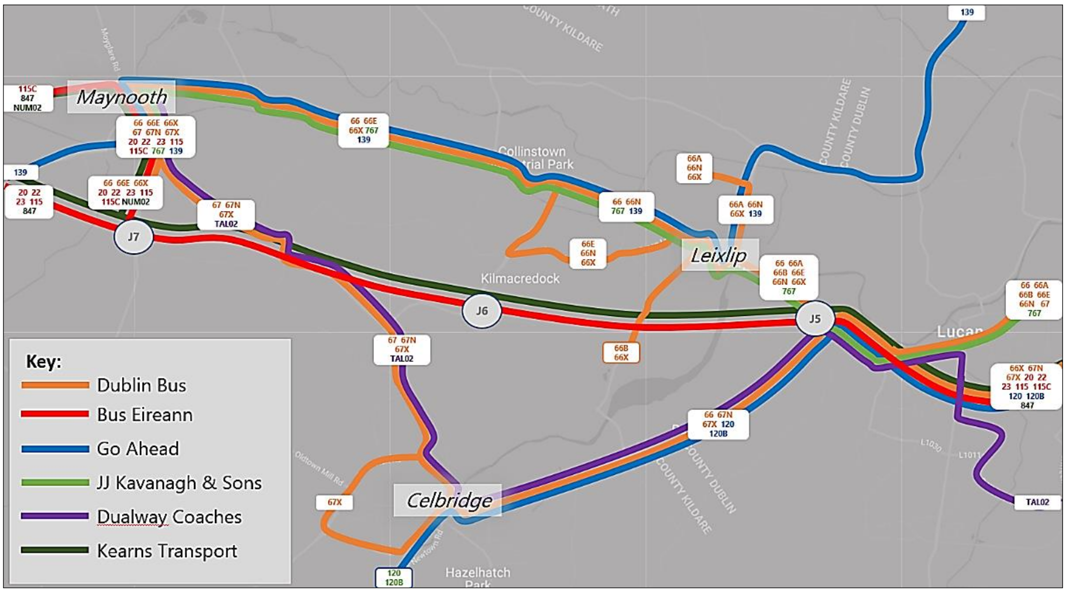

Figure 2.25: Bus Routes within the Study Area (© Google Map data ©2024 Tele Atlas)

- **Dublin Bus Route 66:** Operates from Merrion Square to Maynooth Straffan road via Parkgate Street, Chapelizod, Lucan Village and Leixlip Village with frequency up to every 30 minutes.
- **Dublin Bus Route 66a:** Operates from Merrion Square to Leixlip Captains Hill via O Connell Bridge, Parkgate Street, Chapelizod, Liffey Valley Shopping Centre and Lucan Village with frequency up to every hour.
- **Dublin Bus Route 66b:** Operates from Merrion Square to Castletown (Hewlett Packard) via O Connell Bridge, Parkgate Street, Chapelizod, Liffey Valley Shopping Centre, Lucan Village and Leixlip Village with frequency up to every hour.
- **Dublin Bus Route 66e:** Operates from Merrion Square to Maynooth via Parkgate Street, Chapelizod, Liffey, Lucan Village and Leixlip Village five services during the weekdays only.
- **Dublin Bus Route 66x:** Operates from UCD Belfield to Maynooth Straffan Road with three services during weekdays only. Operates from UCD Belfield to Captains Hill or Castletown Rd one service each during the weekdays only. Operates from Westmoreland Street to Straffan Road two services during weekdays only.
- **Dublin Bus Route 67:** Operates from Merrion Square to Maynooth Straffan road via O'Connell Bridge, Parkgate Street, Chapelizod, Liffey Valley Shopping Centre, Lucan Village and Celbridge with frequency up to every 30 minutes. Last service of the day departs from Westmoreland Street.

- **Dublin Bus Route 67x:** Operates from UCD Belfield to Maynooth (via Aghards Road) through Celbridge Salesian College with four services during the weekdays only. Operates from UCD Belfield to Maynooth (via Celbridge Main Street) through Celbridge Salesian College, with two services during the weekdays only. Operates from Westmoreland Street to Maynooth (via Celbridge Main Street) through Celbridge Salesian College with two services during the weekdays only. Operates from Merrion Square to Maynooth (via Celbridge Main Street) through Celbridge Salesian College with one service during the weekdays only. Operates from Merrion Square to Maynooth (via Aghards Road) through Celbridge Salesian College with one service during the weekdays only.
- **Dublin Bus 66n:** Operates from Westmoreland Street to Leixlip Louisa Bridge via Glen Easton. Night bus with 5 services on Friday and Saturday night only.
- **Dublin Bus 67n:** Operates from Westmoreland Street to Celbridge/Maynooth. Night bus with 4 services on Friday and Saturday night only.
- **Bus Eireann 20:** Operates from Dublin Airport to Galway, with five services through Maynooth daily.
- **Bus Eireann 22:** Operates from Dublin Airport/Dublin Busarus to Ballina with seven services through Maynooth daily.
- **Bus Eireann 23:** Operates from Dublin Airport/Dublin Busarus to Sligo with two to three services through Maynooth daily.
- **Bus Eireann 115:** Operates from Dublin Connolly to Mullingar via Maynooth with service frequencies of 30 minutes.
- **Bus Eireann 115C:** Operates from Kilcock to Mullingar with one service through Maynooth daily.
- **Go Ahead 120:** Operates from Dublin Connolly to Edenderry via Celbridge with service frequencies of 30 minutes.
- **JJ Kavanagh & Sons 139:** Operates from Blanchardstown IT to Naas via Leixlip and Maynooth.
- **Kearns:** 847 Operates from Portumna to Dublin Cathal Brugha Street with two service through Maynooth during the weekdays and 2-4 services on the weekend. Kearns NUM02 Operates during college term only from Birr to Maynooth.
- **Airport Hoper 767:** Operates from Maynooth to Dublin Airport via Leixlip with service frequencies of 30 minutes.
- **Maynooth TAL02:** Operates from Maynooth to IT Tallaght via Leixlip and Celbridge.

2.6.7 Existing Conditions for Vulnerable Road Users

In accordance with current road design standards, the provision of cycle/pedestrian facilities along national roads may vary in form, including adjacent cycleways running directly along the verge of the road and off-line facilities remote from the carriageway. Cycle/pedestrian facilities may also potentially include forest trails, greenways, and re-utilising disused railway lines. Alternatively, pedestrians and cyclists may need to be accommodated on an alternative route, where an appropriate alternative facility exists.

As a designated motorway, pedestrians and cyclists are prohibited from accessing this section of existing M4 mainline within the study area.

Junction 5 Leixlip is located at the approximate commencement of the N4 dual carriageway, which is an all-purpose route and, as such, must consider the need to accommodate vulnerable road users in a safe manner. In the case of dual carriageways, such as the existing N4, it is typically preferable for cyclists and pedestrians to be accommodated away from the road carriageway, using alternative facilities to limit interaction with high volumes of motorised traffic and to ensure a more comfortable and spacious environment for vulnerable users.

Vulnerable road user facilities east of Junction 5 vary in form. Segregated cycle facilities are evident directly adjacent to Junction 5 on the N4. Further east, both the cycle facility and pedestrian footpath merge into a shared space.

Figure 2.26: N4 Vulnerable Road User Space at Junction 5 (©2024 Google)

Figure 2.27: Shared Space Facility East of Junction 5 (©2024 Google)

Junction 7 Maynooth has geometric and safety issues, particularly from the perspective of a vulnerable road user. Site observations indicate high volumes of vulnerable road users accessing Maynooth Business Park to the south of the junction from Maynooth town. These users need to navigate through the junction where they will interface with traffic using the slip roads and the Straffan Road Roundabout.

Observed driver behaviour onsite was also noted; as a result of congestion at peak times, drivers using the eastbound diverge planning to turning right towards Straffan had reduced opportunities to cross the junction and some turned left at the top of the slip road and undertook a U-turn at Barton Transport to proceed towards Straffan.

Figure 2.28: Junction 7 - Barton Transport Entrance (Arup Site Visit 5th of February 2020)

Figure 2.29: Vulnerable Road Users at Junction 7 (©2024 Google)

2.7 Summary

Fundamentally, the Maynooth to Leixlip Project is required to address the significant transportation issues within the study area. The existing issues identified will not improve in the future without intervention to address the base problems.

Feasible solutions, combined with recommendations from the Greater Dublin Area Transport Strategy 2022–2042, BusConnects and other projects need to be taken forward.

The project objectives will ultimately provide the basis upon which options and alternatives are developed and assessed, with the aim of delivering upon the full range of performance targets.

Transportation options include maintaining and optimising the operational efficiency and safety of the strategic corridor. Furthermore, the project will aim to increase the mode share of cyclists, pedestrians and public transport users, such that a holistic solution accommodating all transport users is obtained.

The protection and enhancement of existing amenities and quality of life within the study area needs to be considered when assessing options and resolutions to the existing transportation issues.

The Phase 1 Feasibility Report is included in Appendix 2.2 of Volume C of this report.

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3 Description of Options

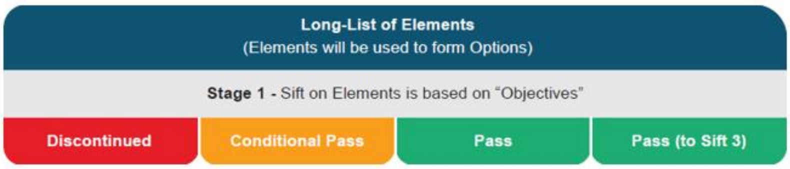
3.1 Introduction

As set out in Chapter 2, it is necessary to define the existing problem for which a solution is being sought prior to project development. Once the nature of the problem is defined and understood and the key constraints have been identified, then it is possible to commence a review of the potential options available to resolve the problems whilst also delivering on the project objectives.

The outcome of Phase 1 (Concept and Feasibility) was that a strong justification for the advancement of the project to Phase 2 existed. A number of potential transportation interventions meriting more rigorous assessment were identified, including public transport options, road options and demand management proposals. This chapter sets out the options which were considered as potential solutions, defines the criteria under which these options were assessed and outlines the analysis which concluded whether these options were worthy of further assessment or not.

Within the context of TII Project Appraisal Guidelines Unit 4.0 (*Consideration of Alternatives and Options*), an *alternative* refers to a specific transport mode (rail, bus, air etc.) or demand management proposal (fiscal, control, ITS measures etc.) which could address the need for an intervention. An option refers to a specific road-based measure (new route, road upgrade, junction improvements etc.).

A breakdown of the sifting approach used is presented in Figure 3.1 noting “option” means options or alternatives in the context of the TII Project Appraisal Guidelines.



Outcome	Description
Pass (to Sift 3)	These are passed to Sift 3 when sufficient design development and detail will be available to accurately appraise.
Pass	These will typically be the base of any "core" Option i.e. Option on their own and/or combined with another Option
Conditional Pass	These are considered insufficient on their own to be a "core "Option and must be joined to be sufficient
Discontinued	These are discontinued typically either (a) as they fail to meet primary objective or (b) there is another similar element/Option but it provides greater benefits or alignment with the objectives

Figure 3.1: Sifting Process Overview

3.2 Methodology for Development of Options

The methodology for the development of options for the Maynooth to Leixlip Project followed a rigorous and thorough multi-stage process. As outlined in TII Project Appraisal Guidelines Unit 4.0 *(Consideration of Alternatives and Options)*, the initial step focussed on drafting a long list of potential options that may address the need for intervention.

A process flow chart was prepared and utilised for the development and assessment of options. The process flow chart is illustrated in Figure 3.2.

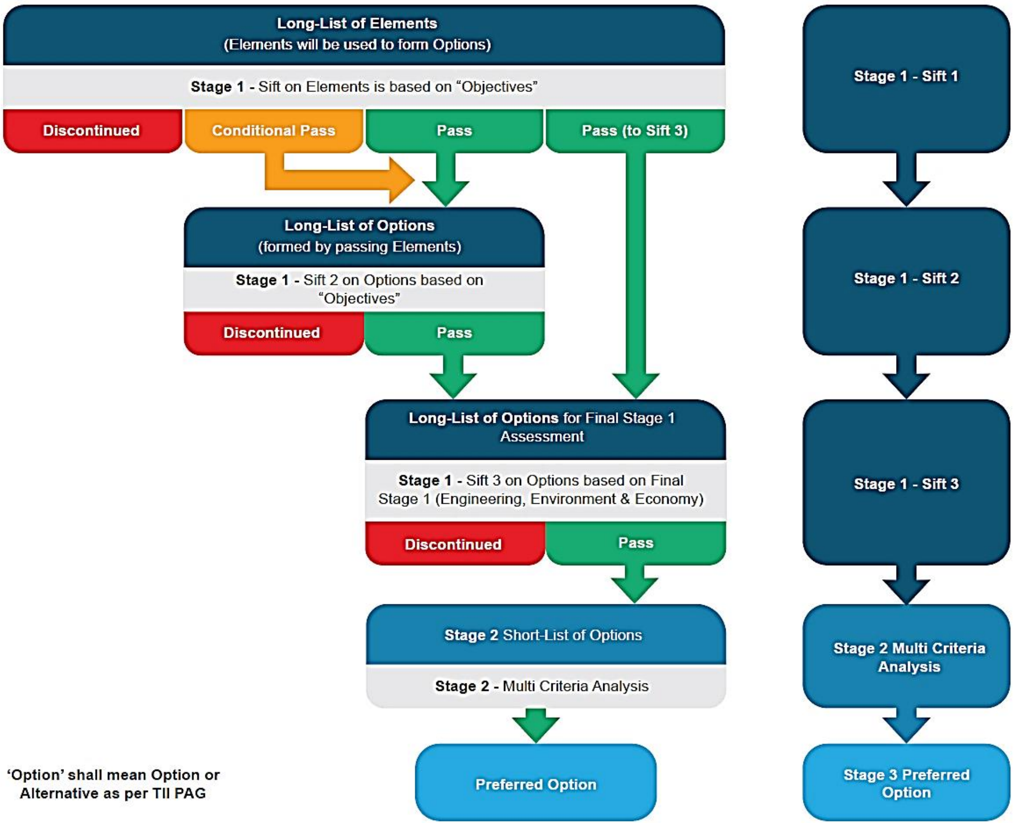


Figure 3.2: Phase 2 Process Flow Chart

Given the range of options that may potentially address the need for an intervention and the project objectives, Stage 1 is divided into three sub-stages (or sifts) as outlined in Table 3.1. Stage 1 Sift 1 and 2 are described in this Chapter 3, with Stage 1 Sift 3 Preliminary Options Assessment (POA) described in Chapter 5.

Table 3.1: Stage 1 Sift Overview

Sift	Description	Assessment
Sift 1	Long-List of Elements	Elements assessed against Project Objectives
Sift 2	Long-List of Options (formed by passing Elements)	Options assessed against Project Objectives
Sift 3	Long-List of Options for Final Stage 1 Assessment	Preliminary Options Assessment (POA) based on Engineering, Environment & Economy

3.3 Stage 1 Sift 1 Long-List of Elements

3.3.1 Overview

Elements are part of a potential intervention that may form an option or alternative. The Stage 1 Sift 1 Long-List of Elements is illustrated in Figure 3.3.

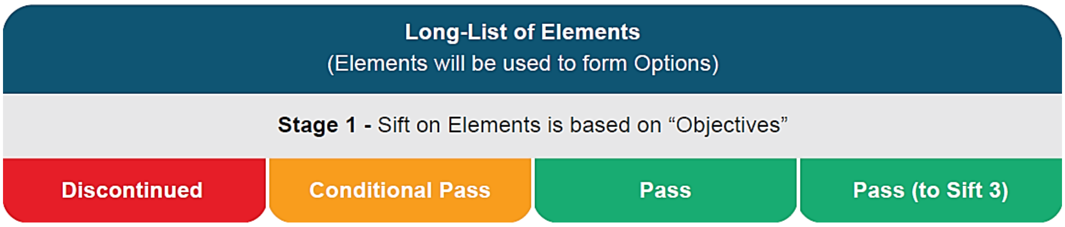


Figure 3.3: Sift 1 Long-List of Elements Process

Elements comprise of different categories, with a number of different elements under each category. These are summarised in Table 3.2.

Table 3.2: Element Categories entering Stage 1 Sift 1

Number of Elements	Element Category
6	Bus
10	Park and Ride
2	Rail
6	Active Travel
39	Demand Management
14	Road
20	Junctions/Bridges
97	**Total**

A total of 97 elements were identified under seven different categories. These were then qualitatively assessed against the project objectives to establish, at a fundamental level, if these elements would respond to the transportation problems identified within the study area and surrounds.

This initial sifting exercise was undertaken in advance of any detailed transportation modelling, engineering analysis or environmental appraisal and sought primarily to identify potentially viable elements for more detailed analysis.

3.3.2 Elements Assessment

3.3.2.1 Context

The Maynooth to Leixlip Project study area lies entirely within the Greater Dublin Area (GDA) as defined in the National Transport Authority's *Transport Strategy for the Greater Dublin Area 2022–2042*. The study area is already served by public transport systems. However, public transport mode share for all trip purposes stands at just 18%, with car mode share for all trip purposes standing at 68%. This overreliance on private car use is a key contributing factor to the peak congestion problems experienced on the M4/N4 and emphasises the need for a multi-modal holistic approach to solve the transport problems.

3.3.2.2 Bus

The study area is already served by a bus network, as outlined in Chapter 2. However, bus services mode share for all trip purposes within the study area stands at 10%. Therefore, bus elements formed a significant part of the options identification process.

There were six bus elements identified in Stage 1 Sift 1. These were a combination of the addition of bus facilities including, eastbound only, westbound only and both directions, together with enhanced bus infrastructure. All six bus elements were assessed against the project objectives. Graphics and a detailed analysis are included in Appendix 3.1.

3.3.2.3 Park and Ride

The National Transport Authority's *Transport Strategy for the Greater Dublin Area 2022–2042* includes significant park and ride proposals on a number of corridors accessing Dublin, including the M4/N4 corridor.

There were ten park and ride elements identified in Stage 1 Sift 1. These were a combination of strategic park and ride, local mobility hubs and local park and ride elements. Locations included, from west to east, Enfield, Tolling Point, Kilcock, Millfarm, Junction 7 Maynooth, Junction 6 Celbridge, Collinstown and Junction 5 Leixlip. All ten park and ride elements were assessed against the project objectives. Graphics and a detailed analysis are included within Appendix 3.1.

3.3.2.4 Rail

The study area is already served by a rail network, as outlined in Chapter 2. However, rail services mode share for all trip purposes within the study area stands at 8%. Therefore, rail elements formed part of the options identification process.

There were two rail elements identified in Stage 1 Sift 1. These were DART+ West benefit analysis and regional rail improvement testing. Both rail elements were assessed against the project objectives. Graphics and detailed analysis are included within Appendix 3.1.

3.3.2.5 Active Travel

There is potential to increase active travel mode share for local trips. There are high numbers of internal trips within and between settlements, and the distances between settlements are reasonably short, between 4.8km and 7.6km. However, active travel mode share is between 3% and 5%. Therefore, active travel elements formed part of the options identification process.

There were six active travel elements identified in Stage 1 Sift 1. These were a combination of active travel enhancements at an array of locations including Junction 7 Maynooth on the R406, the R405 Overbridge, Junction 6 on the R449, the R404 Overbridge and Junction 5. A further element was the supporting of cycle parking and infrastructure at key public transport nodes and destinations within the study area. All six active travel elements were assessed against the project objectives. Graphics and a detailed analysis are included within Appendix 3.1.

3.3.2.6 Demand Management

Phase 1 (Concept and Feasibility) identified a potential role for demand management in the overall solution; a role which is supported within existing planning policy (refer to Chapter 2). The extent of demand management measures available for consideration are varied and wide-ranging, but all with the intended purpose of reducing travel demand on the M4, thereby protecting the strategic function of the road, maximising the efficiency of the existing asset and incentivising modal shift to public transport.

There were 39 demand management elements identified in Stage 1 Sift 1. These measures included, but not limited to, land use, fiscal, traffic demand management, parking management, behavioural change programs, information awareness and built environment measures. All 39 demand management elements were assessed against the project objectives. Graphics and a detailed analysis are included within Appendix 3.1.

3.3.2.7 Road

In response to the transportation problems identified in Chapter 2, a wide array of road improvement measures were considered as offering potential solutions along the M4/N4 corridor.

As with all potential transport solutions, road-based interventions need to sit in the context of wider transportation policy and mobility within the corridor and study area. Road-based interventions should be complementary to public transport systems, with a design focus that prioritises person throughput.

There were 14 road elements identified in Stage 1 Sift 1. These included, but not limited to, offline options, online widening in various directions and ancillary lanes at various locations. All 14 road elements were assessed against the project objectives. Graphics and a detailed analysis are included within Appendix 3.1.

3.3.2.8 Junctions/Bridges

In response to the transportation problems identified in Chapter 2, a wide array of junctions/bridges improvement measures were considered as offering potential benefits along the M4/N4 corridor.

There were 20 junction/bridge elements identified in Stage 1 Sift 1. These included elements at the existing M4/N4 junctions and also at each of the existing overbridges within the study area. All 20 junction/bridge elements were assessed against the project objectives. Graphics and a detailed analysis are included within Appendix 3.1.

3.3.3 Assessment Outcome

The outcome of this sifting exercise and the descriptions of same are outlined in Table 3.3.

Table 3.3: Stage 1 Sift 1 Outcome Descriptions

Outcome	Description	
Pass (to Stage 1 Sift 3)	These are passed to Stage 1 Sift 3 when sufficient design development and detail will be available to accurately appraise	✓
Pass	These will typically be the base of any core option i.e. option on their own and/or combined with another option	✓
Conditional Pass	These are considered insufficient on their own to be a core option and must be joined with another element(s) to be sufficient	✓
Discontinued	These are discontinued typically either (a) as they fail to meet primary project objective or (b) there is another similar element/option, but it provides greater benefits or alignment with the project objectives	✗

Graphics and detailed sifting analysis of each of the 97 elements is contained within Appendix 3.1.

3.3.4 Summary

A summary of the Stage 1 Sift 1 Long-List of Elements is shown in Table 3.4.

Table 3.4: Stage 1 Sift 1 Long-List of Elements Summary

Element Category	Number of Elements	Pass (to Stage 1 Sift 3)	Pass	Conditional Pass	Discontinued
Bus	6	1	2	1	2
Park and Ride	10	6	0	0	4
Rail	2	2	0	0	0
Active Travel	6	6	0	0	0
Demand Management	39	11	0	0	28
Road	14	0	0	3	11
Junctions/Bridges	20	0	0	9	11
Total	**97**	**26**	**2**	**13**	**56**

Of the 97 elements identified, 56 were discontinued with 41 used to form options and taken forward. Of these 41, 26 were taken forward to Stage 1 Sift 3 and therefore were not assessed as part of Stage 1 Sift 2. The 2 elements identified as ‘Pass’ and 13 identified as ‘Conditional Pass’ were taken forward to Stage 1 Sift 2.

3.4 Stage 1 Sift 2 Long-List of Options

3.4.1 Overview

The options identified to enter the Stage 1 Sift 2 consisted of the 2 elements identified as 'Pass' and the 13 elements identified as 'Conditional Pass'. These were taken forward from Stage 1 Sift 1 and used to form options. A total of 77 options were identified under the two different categories, which are summarised in Table 3.5.

Table 3.5: Options Categories entering Stage 1 Sift 2 Categories

Number of Options	Option Category
9	Corridor Options
68	Junctions/Bridges Options
77	**Total**

These were then qualitatively assessed against the project objectives to establish, at a fundamental level, if these options would respond to the transportation problems identified within the study area and surrounds. As with Sift 1, this sifting exercise was undertaken in advance of any detailed transportation modelling, engineering analysis or environmental appraisal and sought primarily to identify potentially viable options, for more detailed analysis. The Stage 1 Sift 2 Long-List of options sift is illustrated in Figure 3.4.

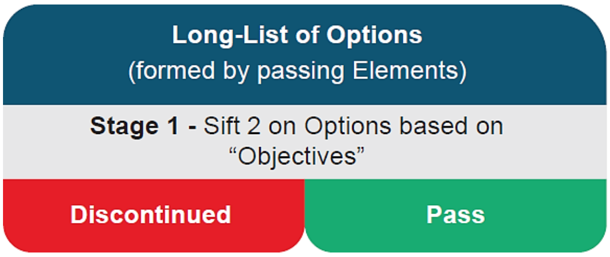


Figure 3.4: Stage 1 Sift 2 Long-List of Options

This was a high-level appraisal focussed on likely fit against the project objectives and was not a prioritisation exercise.

3.4.2 Parallel Roads Sub-Sift

Parallel roads are capable of being applied to all corridor options. Therefore, a sub-sift was completed to identify the preferred parallel road layout which may was then applied to all corridor options in Stage 1 Sift 2.

There were two sub-sifts for the parallel roads. Initially, three options were examined:

- Northern Parallel Road;
- Southern Parallel Road; and

- Combination of Northern and Southern.

The Southern Parallel Road was brought forward to parallel road sub- sift 2, which focused then on the extent of the option. Following sub-sift 2, the option that was chosen to be included within Stage 1 Sift 2 was a parallel road to the south of the M4/N4 from Junction 7 to the R404 Celbridge Road Overbridge. It also incorporates linkage and a connection to the R405 Ballygoran Overbridge. Additionally, a proportion of this proposal is included within the Leixlip Local Area Plan.

Graphics and details are contained within Appendix 3.2.

3.4.3 Options Assessment

This section outlines the various Corridor options and Junction/Bridges options evaluated as part of Stage 1 Sift 2.

3.4.3.1 Corridor Options

Corridor options included both bus and road-based options. Nine corridor options were identified and assessed as part of Stage 1 Sift 2:

- Corridor Option 1A – Bus facility in both the eastbound and westbound directions;
- Corridor Option 1B – Bus facility in both the eastbound and westbound directions and a parallel road;
- Corridor Option 2A – Bus facility in both the eastbound and westbound directions and an upgrade to three lanes in the westbound direction;
- Corridor Option 2B – Bus facility in both the eastbound and westbound directions, an upgrade to three lanes in the westbound direction and a parallel road;
- Corridor Option 3A – Bus facility in both the eastbound and westbound directions and an upgrade to three lanes in both directions;
- Corridor Option 3B – Bus facility in both the eastbound and westbound directions, an upgrade to three lanes in both directions and a parallel road;
- Corridor Option 4A – Bus facility in the eastbound direction only and an upgrade to three lanes in the westbound direction only;
- Corridor Option 4B – Bus facility in the eastbound direction only, upgrade to three lanes in the westbound direction and a parallel road; and
- Corridor Option 5 - Bus facility in the eastbound and a parallel road.

Junction/bridges options, park and ride infrastructure, active travel and demand management will be considered and applied equally on all Corridor options, when the preferred Corridor option (if any) is established.

Graphics and a detailed analysis are included within Appendix 3.2.

3.4.3.2 Junctions/Bridges Options

- **Junction 5 Leixlip**

There were three junction/bridges options for Junction 5 Leixlip. These included the upgrading of the existing junction and the provision of one new junction combined with the conversion of the existing Junction 5 to an overbridge. Graphics and a detailed analysis are included within Appendix 3.2.

- **Junction 6 Celbridge**

There was one junction/bridges option for Junction 6 Celbridge. This included the upgrading of the existing junction. Graphics and a detailed analysis are included within Appendix 3.2.

- **Junction 7 Maynooth**

There were 62 junction/bridges options for Junction 7 Maynooth. These included, but not limited to, the addition of a second junction, the conversion of the existing Junction 7 to an overbridge and improving the existing junction. All 62 junction/bridges options were assessed against the project objectives. Junction 7 options include the Maynooth Outer Orbital Route (MOOR) with active travel provisions. The MOOR, when referred to in the Maynooth to Leixlip Project, shall mean the section from the R406 Straffan Road to the L5041 at Jackson’s Bridge. Graphics and a detailed analysis are included within Appendix 3.2.

- **R405 Ballygoran Overbridge**

There was one junction/bridges option for the R405 Ballygoran Overbridge. This included the upgrading of the existing overbridge. Graphics and a detailed analysis are included within Appendix 3.2. Note, Junction 7 junction/bridge options also include options for improvements at and around the R405 Ballygoran Overbridge.

- **R404 Celbridge Road Overbridge**

There was one junction/bridges option for the R404 Celbridge Road Overbridge. This included the upgrading of the existing overbridge. Graphics and a detailed analysis are included within Appendix 3.2.

3.4.4 Assessment Methodology

The outcome of this sifting exercise and the descriptions of same are outlined in Table 3.6.

Table 3.6: Stage 1 Sift 2 Outcome Descriptions

Outcome	Description	
Pass (to Stage 1 Sift 3)	These are passed to Stage 1 Sift 3 when sufficient design development and detail will be available to accurately appraise	✓
Discontinued	These are discontinued typically either (a) as they fail to meet primary project objective or (b) there is another similar element/option, but it provides greater benefits or alignment with the project objectives	✘

3.4.5 Summary

A summary of the Stage 1 Sift 2 Long-List of Options is shown in Table 3.7. Graphics and detailed sifting analysis of each of the 77 options is contained within Appendix 3.2.

Table 3.7: Stage 1 Sift 2 Long-List of Options Initial Summary

Option Category	Number of Options	Pass (to Sift 3)	Discontinued
Corridor options	9	6	3
Junctions/Bridges options	68	21	47
Total	**77**	**27**	**50**

Of the 77 options identified, 50 were discontinued with 27 proposed to be taken forward to Stage 1 Sift 3 Preliminary Options Assessment (POA) which will be an assessment based on Engineering, Environment & Economy.

Where overlaps and similarities occurred or where the same junction location was chosen for more than one option, only one option was taken forward.

In total, 6 Corridor options and 21 Junction/Bridge options were ultimately taken forward to Stage 1 Sift 3 Preliminary Options Assessment (POA), based on Engineering, Environment & Economy, as shown in Table 3.8.

Table 3.8: Stage 1 Sift 2 Long-List of Options Final Summary

Option Category	Initial Pass (to Sift 3)	Final Pass (to Sift 3)
Corridor options	6	6
Junctions/Bridges options	21	14
Total	**27**	**20**

This was then combined with options for other categories to form the list of options to be assessed in the Stage 1 Sift 3 Preliminary Options Assessment (POA), as follows:

- 6 Corridor options (Corridors contain bus and road-based options);
- 1 Enhanced Bus Infrastructure;
- 14 Junctions/Bridges options;
- 11 Demand Management options;
- 6 Park and Ride options;
- 6 Active Travel options; and
- 2 Test Rail options.

3.5 Base Case Options

The appraisal of major transportation projects requires the development of a Base Case scenario, which would represent a minimum level of intervention on the part of the Sponsoring Agency. Within TII Project Appraisal Guidelines Unit 4.0 *(Consideration of Alternatives and Options)*, base case options are typically referred to as the Do-Nothing or Do-Minimum options. While it may not be expected that these options would fully address the need for intervention outright, their capacity to do so should still be assessed within the context of incremental development and appraisal of options. Irrespective of how these options perform individually, they provide a baseline for establishing the economic, integration, safety, environmental and accessibility impacts of all other options and a status quo option against which Do-Something options are compared against. A description of the Do-Nothing and Do-Minimum options is provided below.

3.5.1 Do-Nothing Option

The Do-Nothing option assumes that there will be no other investment in the transport network within the study area or surrounds (other than regular maintenance) during the appraisal period. As such, this option assesses the capability of the existing transportation infrastructure to meet future transportation demands, in the absence of any upgrade works.

For the Maynooth to Leixlip Project, a number of other infrastructure projects have been identified within the study area which are committed and very likely to be implemented. These projects are either currently progressing through the planning process or have been progressed through the planning process and are either under construction or are programmed into the capital expenditure budget. The existence of other committed projects within the study area renders the traditional Do-Nothing option redundant, with the progression of such committed projects more appropriately described as a Do-Minimum option. Accordingly, the Do-Nothing option was eliminated from further consideration.

3.5.2 Do-Minimum Option

As outlined in TII Project Appraisal Guidelines, the Do-Minimum option, often referred to as *'The Base Case'*, typically includes all those transportation projects and services that are committed within the appraisal period of the Maynooth to Leixlip Project.

This includes road projects, public transport improvements, smart mobility and demand management measures and the provision of pedestrian and cyclist facilities; but does not include the delivery of the Maynooth to Leixlip Project itself. All elements of the Do-Minimum are included as part of each Do-Something option such that the only difference between the two is the Maynooth to Leixlip Project option being proposed. This approach ensures that the true impact of the Maynooth to Leixlip Project option can be isolated and objectively assessed.

When deciding the appropriate components of the Do-Minimum option, there are often two possible definitions of complementary projects that should be considered in the appraisal of the project in question, namely:

1. *"Planned"* improvements that are included in the fiscally constrained long-range plan for which the need, commitment, financing and public and political support are identified and may be reasonably expected to be implemented; and
2. *"Committed"* improvements that have been progressed through the planning process and are either under construction or are programmed into the capital expenditure budget.

The choice of which approach to adopt can largely depend on the local situation, the degree of certainty that other transport interventions may occur and the likely impact such interventions may have on future travel demand (which will be used to appraise the project in question). Any extension of the Do-Minimum option beyond committed projects to also include planned interventions must be treated with caution, as this may lead to a set of project options which incorporate projects that do not subsequently happen.

In developing an initial list of options for the Maynooth to Leixlip Project, the Do-Minimum option was identified as including "committed" complementary projects and "planned" projects outlined within the NTA's *Transport Strategy for the Greater Dublin Area 2022–2042*.

A number of transportation proposals for the study area, largely outlined within the Greater Dublin Area Strategy have the potential to significantly impact on the future transport demand and consequent proposals for the Maynooth to Leixlip Project. In particular, these proposals include BusConnects and Dart + West.

The NTA's Eastern Regional Model currently include all of the Greater Dublin Area Strategy projects up to 2042. Given the potential impact these proposals are likely to have on the projected demand along the M4/N4 corridor, it was proposed that these projects should be included in all tests carried out during Phase 2 (Option Selection) of the Maynooth to Leixlip Project.

The Do-Minimum option encompasses both "committed" and "planned" interventions, reflecting the projected roll-out of the Greater Dublin Area Strategy up to 2042.

It is considered that this approach provides a robust basis for evaluating the performance of options for the following reasons:

- The Greater Dublin Area strategy is an approved plan for the area providing a framework for investment in transport within the region up to 2042.
- The future year demand forecasts are aligned with National Planning Framework population forecasts which contain significant amounts of growth for the study area corridor and Dublin city. The Greater Dublin Area Strategy therefore provides a consistent basis for the likely future environment that is consistent with Government plans and policies such as:
    - Future Land Transport Investment Framework;
    - National Planning Framework (NPF); and

    - National Development Plan (NDP).

  Therefore, it provides a consistent basis for the comparative assessment of the various Maynooth to Leixlip Project options in Phase 2.

- The use of the Greater Dublin Area strategy as the basis for the Do-Minimum option avoids bias towards which schemes to incorporate. In particular, adopting the Greater Dublin Area Strategy will ensure that all public transport options assessed as part of this project in Phase 2 will be given the best chance possible to meet the project objectives. Therefore, this approach will ensure that there is no bias towards projects which enhance vehicular capacity and that the best option for all modes is selected.
- Projects within the Greater Dublin Area Strategy are a means to deliver a set of objectives of the Strategy, with the optimal outcome of aiming to accommodate future growth in travel demand in sustainable modes.
- The approach will mean that the assessment of this project is aligned with the assessment of other major projects for the Greater Dublin Area, including Bus Connects and Dart + West.

3.6 Public Consultation

A public consultation on the option selection process was held in September 2022 through a combination of a virtual consultation room and a two day in-person event which was held in Leixlip. Display boards provided information on the options assessment process, highlighting that a multi-component solution (i.e. public transport, active travel, demand management and road) would likely be needed to achieve the project objectives. Maps showing the proposed options along with all identified constraints at that stage were also displayed.

The primary aim of the consultation was to engage the public in the project delivery process, inform the public of the statutory process and likely time scales, seek the public's cooperation and understanding of the project and capture local knowledge to input into the appraisal process.

Submissions received following the consultation provided very valuable feedback across a broad range of topics.

Full details of this consultation and submissions received from the public and other interested stakeholders are included in Appendix 3.3.

3.7 Summary

A summary of Stage 1 Sift 1 (Long-List of Elements) and Sift 2 (Long-List of Options) is illustrated in Figure 3.5.

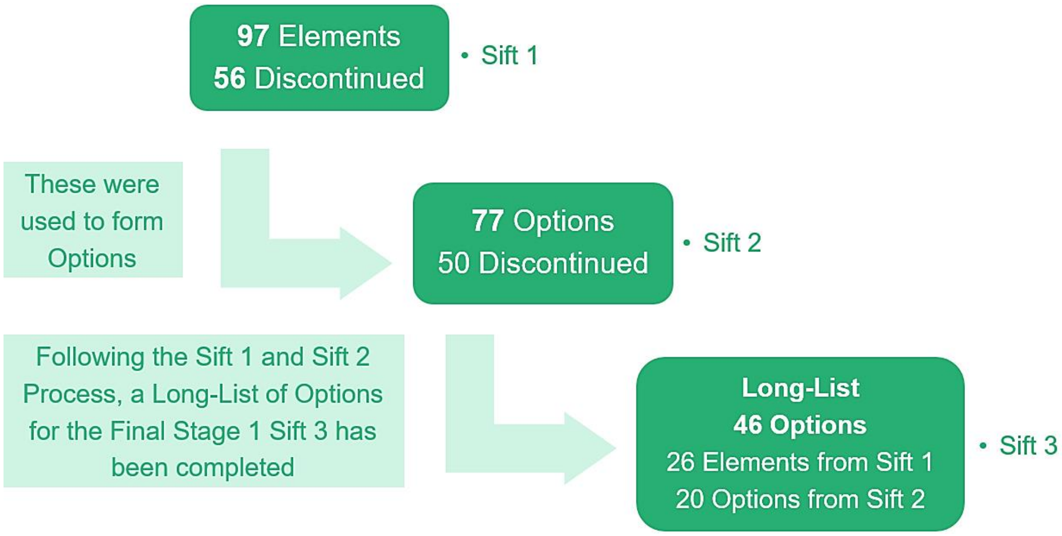


Figure 3.5: Stage 1 Sift 2 Long-List of Options

The combination of this forms the Stage 1 Sift 3 Preliminary Options Assessment (POA) as follows:

- 6 Corridor options (Corridors contain bus and road-based options);
- 1 Enhanced Bus Infrastructure;
- 14 Junctions/Bridges options;
- 11 Demand Management options;
- 6 Park and Ride options;
- 6 Active Travel options; and
- 2 Test Rail options.

Full details are included within Appendix 3.1 and Appendix 3.2.

Stage 1 Sift 3 Preliminary Options Assessment (POA), which focussed on the comparative analysis of these options under the headings of Environment, Engineering and Economy, and is presented in Chapter 5.

4 Transport Assessment Approach and Analysis Tools

4.1 Introduction

This chapter provides an overview of the scope and methodology adopted for the transport assessment undertaken to inform the options selection. In addition, a discussion on the initial selection of intervention(s) required on the M4/N4 is included in Section 4.3, along with a description of the preliminary junction and access strategy considered for the project presented in Section 4.4.

4.2 Scope of Traffic Modelling and Methodology

An overview of the methodology adopted in undertaking the transport modelling work on the project is presented in this Section 4.2 of the Options Report. As outlined in PAG Unit 5.4, the purpose of the transport modelling is to describe the transport forecasting that has been undertaken to inform Phase 2 (Option Selection) of the Maynooth to Leixlip Project. It outlines the process of the development of the base year transport model and provides justification for the use of this model as the basis for the appraisal of the project. The transport modelling also provides a basis for future year forecasting and travel demand projections, to be used in the testing of options. Figure 4.1 provides an overview of the model development process, leading to the development of a Local Area Model (LAM) used in the appraisal of options.

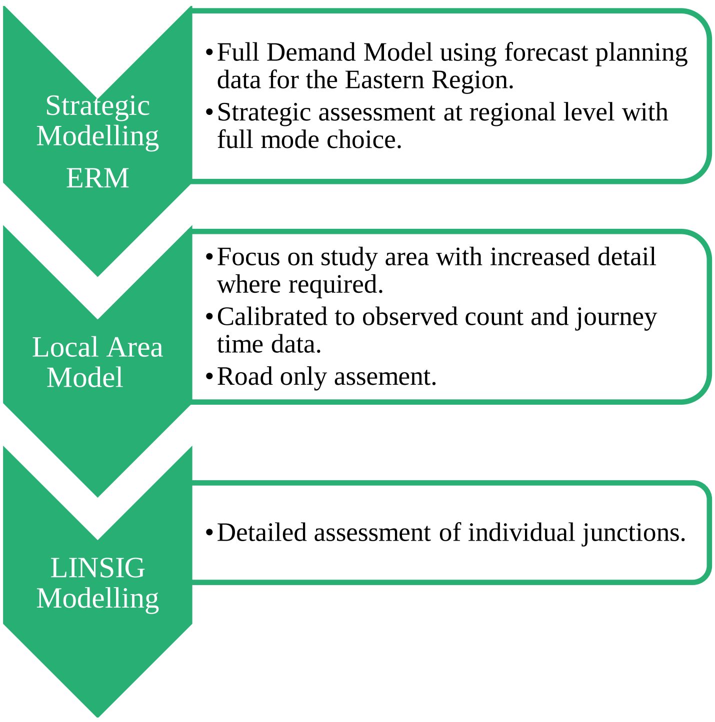


Figure 4.1: Model Development Process

4.2.1 Modelling Overview

4.2.1.1 Eastern Regional Model – Multi-Modal Demand Modelling

Given the nature of the transport options tested and the potential for these scenarios to result in modal shift, at the commencement of the project it was decided that the National Transport Authority's (NTA) Eastern Regional Model (ERM) should be used to assess each of the proposed options for the following reasons:

- It is a regional model covering the entire Greater Dublin Area and is therefore capable of assessing the regional impacts (as well as local impacts) likely to arise from a project of this scale.
- It provides a detailed representation of the urban environment within Dublin City and along the M4/N4 corridor.
- It provides a detailed representation of the public transport network and services and can predict demand on the different public transport services within the regions.
- It provides a representation of all major transport modes including active modes (walking and cycling) and includes accurate mode-choice modelling of residents.
- It is comprised of a variable demand model which provides a detailed representation of travel demand on the network broken down by journey purpose, mode of travel, person types, user classes and socio-economic classes. This demand is modelled at a granular (Census Small Area) level within the ERM and is critical for modelling transport demand within a mix of urban and rural areas like the M4/N4 corridor. The ERM also provides a prediction of changes in trip destination in response to changing traffic conditions, transport provision and/or policy.

4.2.1.2 M4/N4 Local Area Model (LAM) – Highway Modelling

While the ERM achieves an excellent level of highway calibration, the highway element of the ERM lacks sufficient detail and calibration along the M4/N4 corridor to meet the required guidelines for model development as outlined in TII PAG Unit 5.1 *Construction of Transport Models*. Therefore, an M4/N4 Local Area Traffic Model (M4/N4 LAM) was developed and used to assess the traffic impacts of the options tested. The M4/N4 LAM has been calibrated and validated to Base Year (2021) conditions using existing traffic survey data along the M4/N4 corridor, obtained from a number of sources.

4.2.2 Data Collection

A review of existing traffic survey data available for the model area was initially undertaken using the NTA count database, any pre-existing M4/N4 model data (where available) and TII counter data.

The development of the LAM required the collection of a significant amount of traffic survey data to inform the model calibration and validation. It was originally planned to carry out a comprehensive data collection exercise in April/May of 2021 to help inform the development of this LAM. However, given the recent travel restrictions imposed by the government in relation to the Covid-19 pandemic, and associated reduction in traffic flows, it was not possible to carry out meaningful (representative of typical travel patterns) traffic surveys in April/May 2021 to inform the development of a LAM for the project. Therefore, a LAM has been developed using existing survey data in the study area. This LAM will be used for the Phase 2 appraisal of various options.

Prior to the commencement of the Phase 3 appraisal, it will be necessary to carry out a comprehensive data collection exercise in the study area during a period with no travel restrictions. This data will then be used to carry out a full recalibration of the LAM in advance of the Phase 3 appraisal of the emerging preferred option.

4.2.3 Model Development

The National Transport Authority's (NTA) Regional Modelling System (RMS) was used as a basis for the M4/N4 LAM development, providing initial network detail and demand matrices.

Further refinement was undertaken for the model area, and it was calibrated and validated to observed count data in-line with relevant guidelines. The NTA RMS comprises of the following three main components:

- The National Demand Forecasting Model (NDFM);
- 5 Regional Models (Including the Eastern Regional Model (ERM)); and
- A suite of appraisal modules.

The NDFM takes input attributes such as land use data, population etc., and estimates the total quantity of daily travel demand produced by, and attracted to, each of the 18,488 Census Small Areas in Ireland.

4.2.3.1 Eastern Regional Model (ERM) Overview

The ERM is a strategic multi-modal transport model representing travel by all the primary surface modes – including, walking and cycling (active modes), and travel by car, bus, rail, tram, light goods and heavy goods vehicles. The model broadly covers the Leinster province of Ireland including the counties of Dublin, Wicklow, Kildare, Meath, Louth, Wexford, Carlow, Laois, Offaly, Westmeath, Longford, Cavan and Monaghan.

Destination and mode choice parameters within the ERM have been calibrated using two main sources: Census 2016 Place of Work, School or College - Census of Anonymised Records (2011 POWSCAR), and the Irish National Household Travel Survey (2017 NHTS). The NTA's RMS is the most sophisticated modelling tool available for assessing complex multi-modal movements within an urban context. This provides a consistent framework for transport assessment.

The ERM is comprised of the following key elements:

- **Trip End Integration:** The Trip End Integration module converts the 24-hour trip ends output by the NDFM into the appropriate zone system and time period disaggregation for use in the Full Demand Model (FDM);
- **The Full Demand Model (FDM):** The FDM processes travel demand, carries out mode and destination choice, and outputs origin-destination travel matrices to the assignment models. The FDM and assignment models run iteratively until an equilibrium between travel demand and the cost of travel is achieved; and
- **Assignment Models:** The Road, Public Transport, and Active Modes assignment models receive the trip matrices produced by the FDM and assign them in their respective transport networks to determine route choice and the generalised cost for each origin and destination pair.

Therefore, the ERM is the ideal tool to use as a basis for the development of the M4/N4 LAM, and to estimate the multi-modal impact of transport projects within the model area. In addition, it provides the platform to forecast future trip demand and distribution.

4.2.3.2 LAM Development

The methodology for developing the M4/N4 LAM from the RMS is illustrated in Figure 4.2 below.

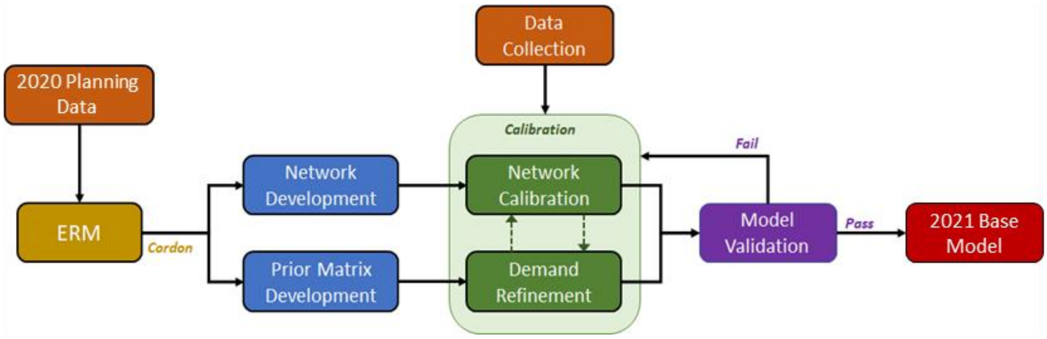


Figure 4.2: M4/N4 LAM Development Methodology

In summary:

- **2020 ERM Run:** 2016 Census planning data for population, employment and education was reviewed within the model area and updated where appropriate to 2020. This data was passed through the NDFM to generate base year demand which was run in the NTA's ERM.

- **ERM Cordon:** The 2020 ERM road assignment was cordoned to extract the initial network and traffic matrix covering the LAM extents (Figure 4.3).
- **Network and Prior Matrix Development:** The initial ERM cordoned road network was reviewed in greater detail for the study area for items including junction layouts, network speeds, missing links etc. The zone system from the ERM was disaggregated where necessary to provide a more accurate representation of traffic loading onto the road network.
- **Data Collection:** Traffic data including link counts, junction turning counts and journey time information was collected and used to calibrate and validate the LAM.
- **Calibration:** Calibration is the process of adjusting the model to better represent observed data. This is normally undertaken in two steps:
  - **Network Calibration:** adjustments to the road network based on observations extracted from traffic survey data e.g. altering turning capacities at junctions, updating link speeds etc.; and
  - **Demand Refinement:** adjustments to the prior matrix to better represent observed travel movements from count data.

The M4/N4 LAM was calibrated in-line with Transport Infrastructure Ireland's (TII) Project Appraisal Guidelines (PAG) and the UK Department for Transport (DfT) Transport Analysis Guidance (TAG).

- **Validation:** Validation is the assessment of the validity of the calibrated model, and its robustness in representing observed traffic conditions. Calibration and validation are an iterative process. If the results of the validation checks are unsatisfactory, then adjustments will be made as required in order to achieve a better representation of reality. The M4/N4 LAM was validated in-line with TII and DfT TAG guidance.

4.2.3.3 Model Area

The area to be analysed in detail in the M4/N4 LAM is illustrated in Figure 4.3 and was identified through a detailed review of all major transport infrastructure within the study area. This essentially represents the extents of the area of influence of the M4/N4 transport corridor.

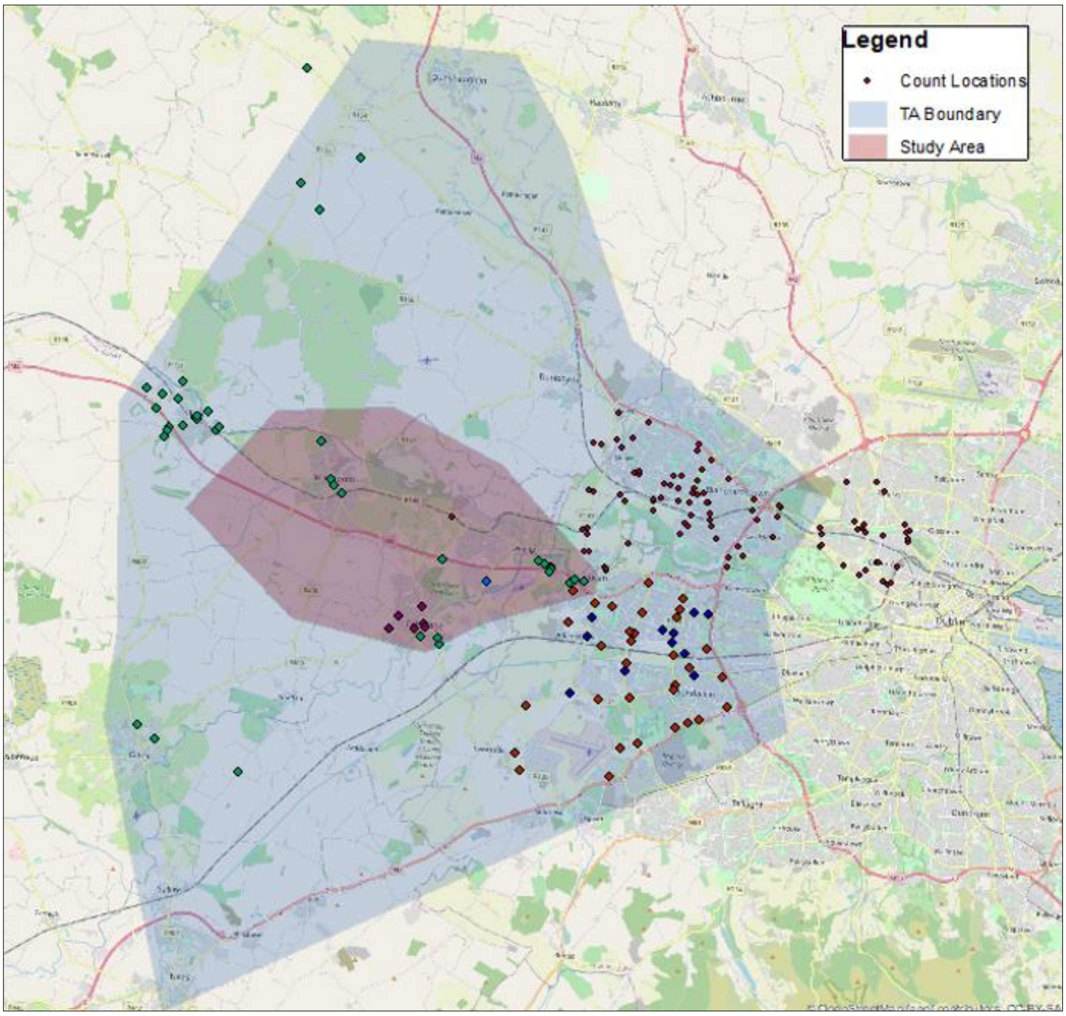


Figure 4.3: LAM Model Area

4.2.3.4 Model Time Periods

The M4/N4 LAM uses a specific hour within each peak period to represent traffic flow. These peak hours can then be factored up to a full peak period using a Period to Hour factor derived from count data.

The M4/N4 LAM was developed, calibrated and validated to represent the following peak hours:

- AM Morning peak period: 08:00 to 09:00;
- PM Evening peak period: 17:00 to 18:00; and
- Average Interpeak Hour: 1 hour taken from average of 13:00-16:00.

4.2.3.5 Model Software

The model software used to develop the M4/N4 LAM is the SATURN (Simulation Assignment of Traffic to Urban Road Networks) suite of transportation modelling programs.

4.2.4 Network Development

As mentioned previously, the NTA's ERM was utilised as a base for generating the road network for the M4/N4 LAM.

The base ERM network was developed from a detailed GIS representation of all national primary, national secondary, regional and local roads in Ireland.

The M4/N4 LAM road network, extracted from a cordon of the ERM, is illustrated in Figure 4.4 below. A detailed review was undertaken of all model coding in the study area using digital mapping systems such as Google Earth to ensure it represented, as accurately as possible, the existing road network. This included aspects such as network speed limits, availability of bus lanes, junction layouts, pedestrian crossing points etc.

As part of the regional model development process for the NTA, a review of traffic modelling processes was undertaken, which generated a best practice approach for coding road networks, including:

- Standardised turning saturation flows at junctions;
- Standardised speeds used on different types of road;
- The use of flares for turns at junctions with sufficient space etc.

This best practice approach was utilised to generate the detailed traffic network for the M4/N4 LAM, reviewing existing link detail and adding junction detail to the ERM network to enhance the modelled road network and better represent localised access points for traffic.

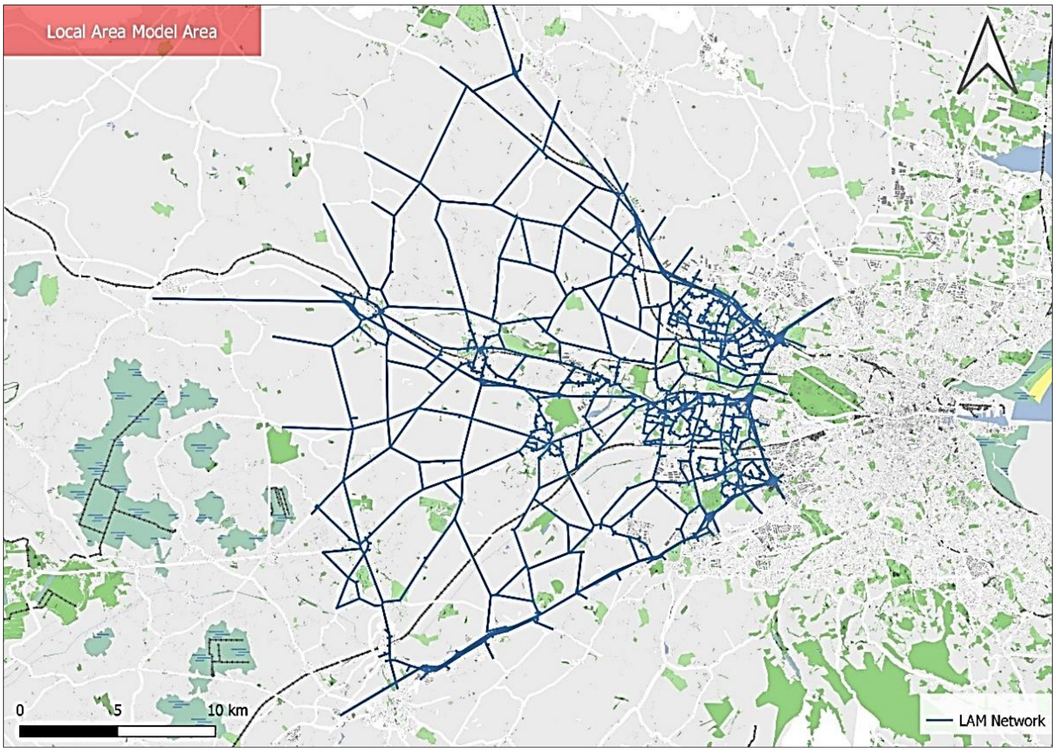


Figure 4.4: M4/N4 Road Network

As illustrated in the figure above, the ERM provides a detailed representation of all significant roads within the study area. To ensure full network coverage and route choice, all roads have been considered, from the national primary routes to minor residential streets.

4.2.5 Zone System Development

Similar to the road network described previously, the base M4/N4 LAM zone system was adopted from the ERM. The ERM zone system was developed using the Census Small Area Population Statistics (SAPS) and Place of Work, School or College Census of Anonymised Records (POWSCAR) to get detailed information on population, employment and education centres across the model area.

Other data sources such as MyPlan and Geo Directory are services offering information on planning. These were also used to obtain information on specific land use zoning and location of commercial developments. The following rules were then applied to generate the zone system:

- **Population, Employment and Education** – zones containing residential population, jobs and/or person in education over a certain threshold should be disaggregated to ensure an accurate representation of origin and destination demand loading points within the model;
- **Activity Levels** – the number of zones with activity levels that have very low or very high levels of trips should be minimised;
- **Intra-zonal Trips** – threshold values should be applied to the proportion of intra-zonal trips within each zone, to avoid an underestimation of flow, congestion and delay on the network;
- **Land Use** – zones should be created with homogeneous land use and socio-economic characteristics where possible;
- **Zone Size/Shape** – zone size and the regularity of zone shape should be considered in order to avoid issues with inaccurate representation of route choice;
- **Political Geography** –aggregate all zones to Electoral District level i.e. zone boundaries do not intersect ED boundaries; and
- **Special Generators/Attractors** – large generators/attractors of traffic such as airports, hospitals, shopping centres etc. should be allocated to separate zones.

The ERM zone system within the study area is illustrated in Figure 4.5.

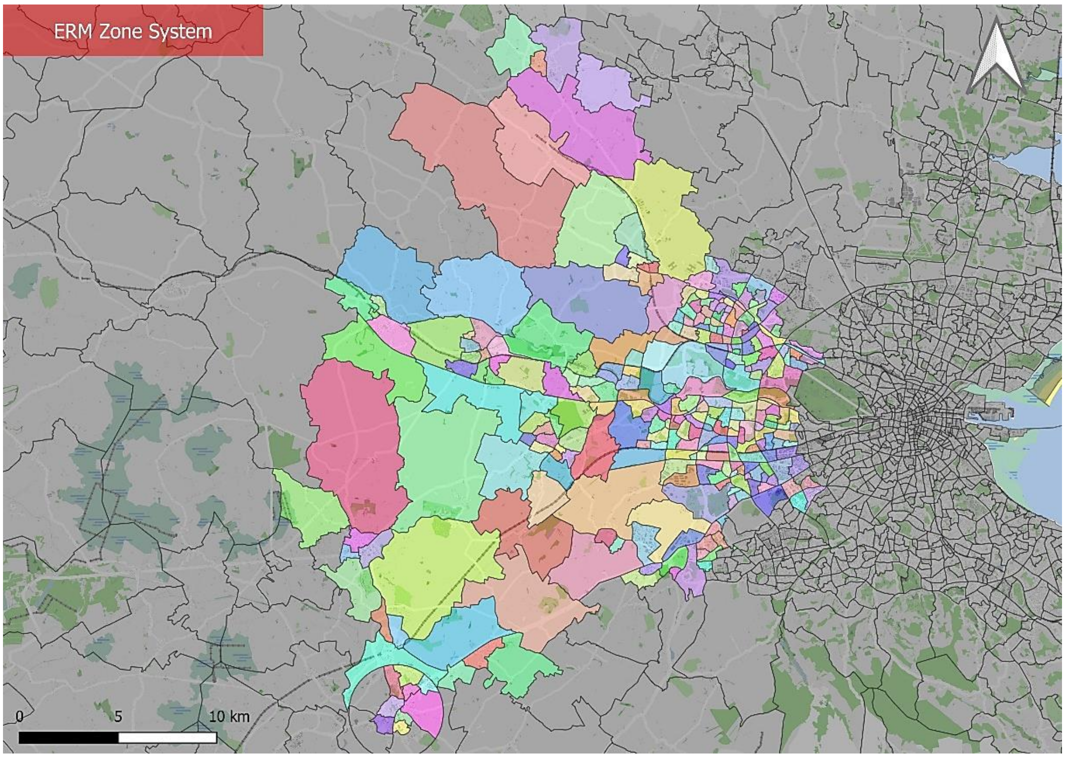


Figure 4.5: ERM Zone System with zones relevant to the LAM area highlighted

In the parts of the study area close to Dublin City Centre, the ERM zones are represented in quite a high level of detail. As such, individual housing estates and key employers have been given their own zones. To the west of the study area, the ERM zones become larger and more aggregate in nature primarily due to the low levels of activity (population and employment) in these areas.

A detailed review was undertaken of all ERM zoning and centroid connectors in the study area as part of the LAM development process. On foot of this review a number of edits were applied to the zone system in order to develop a zone system for the LAM and provide a more accurate representation of traffic loading onto the road network.

The refined zonal system developed for the study area is illustrated in Figure 4.6. In total, 43 additional zones were created through disaggregation of ERM zones, with 341 internal zones within the study area and 15 external zones representing the roads that enter the area of interest. This level of detail ensures that traffic loads accurately on the M4/N4 and the surrounding road network.

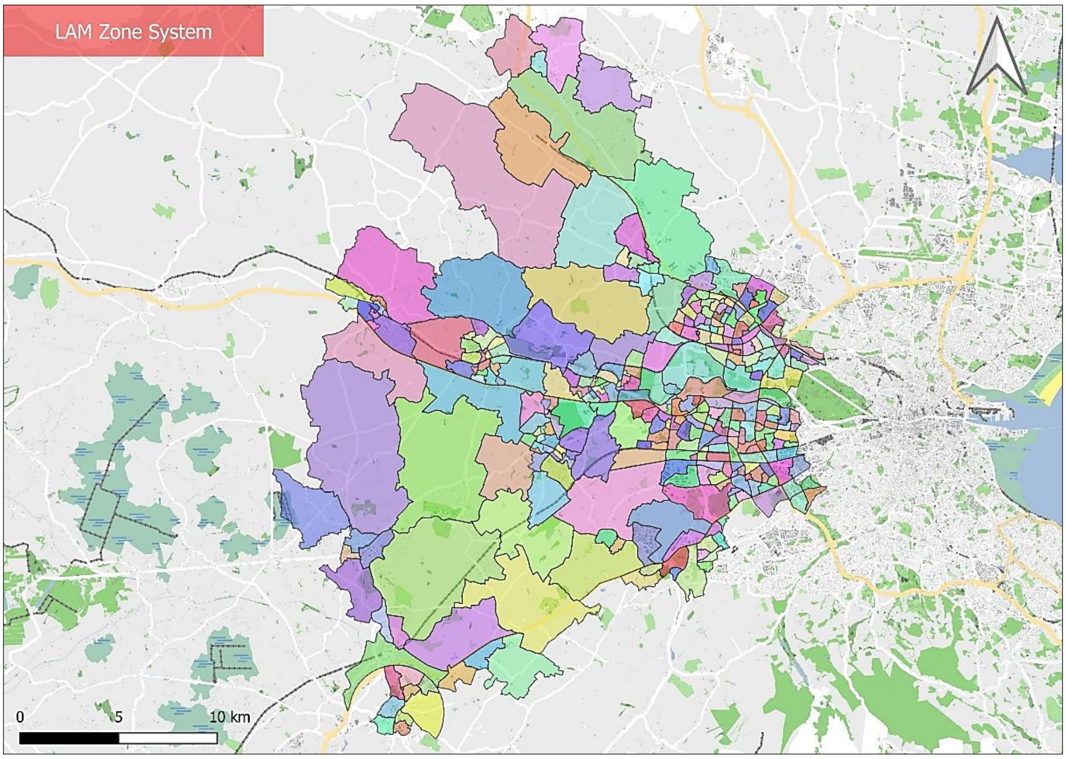


Figure 4.6: M4/N4 Refined Zone System

4.2.6 Prior Matrix Development

As noted previously, the Full Demand Model (FDM) carries out mode and trip destination choice for all zones within the ERM. The FDM has been calibrated using census data, and hence, provides a robust and accurate representation of trip distributions across the model network.

In order to generate prior matrices for the study area, a cordon was extracted from a 2021 run of the ERM. The cordon function within SATURN facilitates the extraction of trip matrices for a subset area of the ERM, whilst still maintaining route and destination choice from the full model.

A bespoke excel spreadsheet tool was created to disaggregate the cordoned ERM matrices to each of the 341 internal LAM zones. This tool used available data on populations, employment, and education places at census small area level, to split trips to/from each ERM zone between the more detailed LAM zoning system. This allowed for a consistent split of demand within the study area, whilst maintaining consistency with the ERM matrix.

4.2.7 Model Calibration and Validation

4.2.7.1 Overview of the Calibration and Validation Process

Once the base prior matrix is created, calibration is used to improve agreement in the model between observed and modelled traffic characteristics. Generally, the components of the model that may be adjusted on the demand side are trip distribution and trip production and generation levels. This adjustment usually involves trip matrix estimation.

On the supply side (network), modelled junction and link characteristics may be altered if sufficient new information is available to justify changes to the existing network.

The M4/N4 LAM was calibrated and validated in accordance with Transport Infrastructure Ireland's (TII) Project Appraisal Guidelines (PAG) for National Roads Unit 5.1 – *Construction of Transport Models (October 2016)*. This is a widely accepted standard in Ireland that provides robust calibration and validation criteria to which certain types of highway models should adhere. Additionally, the M4/N4 LAM development has followed guidance from the UK's Department for Transport's Transport Analysis Guidance (TAG) unit M3-1, particularly in terms of matrix estimation controls.

The following information is used in the calibration process undertaken to ensure that the LAM accurately reflects baseline conditions:

- Traffic Count Data;
- Calibration Steps;
- Matrix Estimation; and
- Calibration Statistics i.e. GEH[1] and Linear Regression Analysis.

Under all modelling criteria, a good calibration was achieved in the model for the morning, evening and inter peak periods, in accordance with TII PAG requirements.

4.2.8 Future Year Travel Demand Estimation

A detailed approach to forecasting travel demand has been adopted for the Maynooth to Leixlip Project in order to capture the planned growth in population and employment at a local level for all settlements along the corridor. The future growth in travel demand for the M4/N4 LAM has been carried out in accordance with the Zone Based Growth approach described in TII PAG Unit 5.3 *Travel Demand Projections* using the NTA's Future Year Eastern Regional Model (ERM).

[1] The GEH Statistic, invented by Geoffrey E. Havers, is an empirical formula used in traffic engineering to compare two sets of traffic volumes, and it is useful for traffic analysis purposes because it avoids some pitfalls that occur when using simple percentages.

The ERM future year travel demand is based on forecasts of population, employment and education data as defined by the National Transport Authority at the Census Small Area level. The National Demand Forecasting Model converts this forecast planning data to trip forecasts (in total productions and attractions per zone) for input to the Eastern Regional Model. The travel demand for the assessment years for this project (2032, 2047) have been derived by linear interpolation of the NTA's 2026 and 2040 National Planning Framework reference scenarios.

Annualised external (external to the M4/N4 LAM) growth rates have been calculated by cordoning the modelled study area from the future year ERM models. Internal (zones within the M4/N4 LAM) growth rates have been based on the ERM zonal growth rates between base year and future year. This internal growth was proportionally applied to the LAM zones based on base year proportions of employment and population, or in accordance with relevant planning information (Development Plans, Local Area Plans, etc) where appropriate.

A single growth scenario has been adopted for this phase of the project appraisal in order to compare the different options against each other on an equal basis. Once a preferred option is selected, low, medium and high growth scenarios will be prepared, and the preferred option will be tested in these additional scenarios.

4.2.8.1 Population and Employment Forecasts

The National Planning Framework (NPF) 2040 has been published as a guide to the high-level strategic planning and development of Ireland over the next 20+ years. The NPF, and newly published National Development Plan 2021-2030 (NDP), provide a single policy to guide strategic development and infrastructure investment at a national level. The NPF and NDP also set the context for each of Ireland's three regional assemblies to develop their regional and spatial strategies taking account of, and co-ordinating, local authority County and City Development Plans in a manner that will ensure National, Regional and Local plans align.

Given the statutory basis of the NPF, the population forecasts developed for this project align with those set out in the NPF.

A land use spreadsheet, including demographic (population, employment, etc.) forecasts, has been developed by the NTA for input into the National Demand Forecasting Model (NDFM).

The NDFM converts this forecast planning data to trip forecasts (in total origins and destinations per zone) for input into the ERM. During the development of these land use spreadsheets, the population targets from the NPF were distributed geographically among the Census Small Areas most likely to experience population growth under existing policy. The population forecasts developed for the model study area for the NPF growth scenario are summarised in Table 4.1.

Table 4.1: M4/N4 Study Area Population Forecasts

Area	2016	2032	2047
M4/N4 LAM Extent	74,937	79,809	88,689
Dublin City (inside M50)	35,696	40,092	47,850
Maynooth	16,234	17,756	20,626
Leixlip	17,095	18,882	22,229
Celbridge	20,812	22,659	26,150
Clane	7,600	8,035	8,840

Similar to the population forecasts, the land use spreadsheets developed by the NTA include a set of employment forecasts for each Census Small Area. These assumptions are aligned with the NPF population forecasts and also incorporate any relevant local and regional policy.

4.2.8.2 Future Year Matrix Development

As discussed above, the forecast year matrices have been based on growth between the base and future year cordons from the ERM. The cordon models have 313 zones (including externals) as per Figure 4.5 and include demand from NPF planning data forecasts. Upon producing these cordon models, the demand was disaggregated to the LAM zones (356 in total), which resulted in a set of trip end growth factors compared to the base year cordons. These growth factors were applied to existing base year matrices (which is calibrated and validated to a local level) to give future year trip ends.

4.2.8.3 Future Year Matrix Totals

A comparison of the peak hour trip matrix totals for the 2021 Base Year and 2047 Design Year scenarios are outlined in Table 4.2, in terms of PCUs (Passenger Car Units). A PCU is a unit of measurement used in transport modelling that represents the space a single car would occupy. Larger vehicles, such as busses and goods consist of several PCU depending on size (eg Car = 1 PCU, HGV = 2.5 PCU, Bus = 3 PCU).

Table 4.2: Matrix Totals 2047 Design Year

Time Period	Unit	2021	2047	% Growth
AM Peak	PCUs	82,849	109,677	32%
Inter-Peak	PCUs	58,367	79,237	36%
PM Peak	PCUs	79,633	98,743	24%

4.2.8.4 Annual Average Daily Traffic

The Annual Average Daily Traffic (AADT) flow is defined as the two-way volume of traffic using the road during a year, divided by the number of days in the year. To estimate the AADT using Peak Hour Model outputs, factors were developed that allowed extrapolation of peak hour traffic flows to AADT.

TII PAG recommends a daily flow profile is generated for the weekday for which the short period traffic counts have been collated. In this case the short period data will be peak hour model outputs. The peak hour models have been developed to represent the "average weekday", therefore, a daily profile for the average weekday was generated using data gathered from the TII traffic counter for 2021.

Data from the automatic traffic counters was then classified into Peak (comprising AM Peak and/or PM Peak) and Inter Peak periods. In performing this task, the following bands were used.

- AM Peak Period: The period from 06:00 to 10:00
- PM Peak Period: The period from 16:00 to 20:00
- Inter Peak Period: The period from 20:00 to 06:00 and 10:00 to 16:00

To estimate the flow for a defined period (e.g. the AM peak) from the short period count, the procedure is as follows:

$$AM_x = \left(\frac{Q_x}{Q_{PTC}}\right) \times AM_{PTC}$$

Where:

- AM_x = Annual Average AM Peak (06:00 – 10:00) traffic flow at location x
- AM_{PTC} = Annual Average AM Peak (06:00 – 10:00) traffic flow at Permanent Traffic Counter
- Q_x = Short Period AM Peak traffic flow
- Q_{PTC} = Short Period AM Peak traffic flow at Permanent Counter, this should relate to same Short Period as Q_x

The same process is applied to the Inter Peak (IP) and PM peaks and the result for all periods (AM Peak, PM Peak and Inter Peak) is aggregated to give a value of AADT as follows:

$$AADT_x = (AM_x) + (IP_x) + (PM_x)$$

The above calculations were performed for TII counter TMU M04 015 located between Junction 6 and 7. Similarly, this analysis provided a relationship between the short period count (i.e. Modelled Peak Hour) and the Peak Period (e.g. AM Peak of 06:00-10:00) at each site and for each time period (AM_x, IP_x and PM_x). The expansion factors calculated by time period and user class are shown in Table 4.3.

Table 4.3: AADT 2047 Expansion Factors

Time Period	Light Vehicle	Heavy Vehicle
AM	2.94	3.10
IP	6.00	6.00
PM	2.89	2.38

The forecast AADT flows on the road network extracted from the model for the 2047 Design Year are presented in Table 4.4.

Table 4.4: AADT Flows on M4/N4

Location	AADT	% HGV
M4 West of J7	53,679	8.2%
M4 Between J7 and J6	69,801	7.5%
M4 Between J6 and J5	77,656	7.0%
M4 East of J5	86,507	7.0%

4.3 Initial Intervention(s) Required

4.3.1 Overview

As a project on a busy transport corridor, a thorough understanding of the issues contributing to the existing transport operational inefficiency (across all modes) within the study area and surrounds is needed in order to identify appropriate and successful interventions. Furthermore, it is imperative that the broader objectives of the project, including the support of active travel and inter-community connectivity, remain at the forefront in shaping the solutions and achieving the desired outcomes. As such, the initial selection of interventions required for the Maynooth to Leixlip Project is dependent on many factors, as discussed in the following sections.

4.3.2 Road Type, Cross Section and Level of Service

For road/junctions based interventions, the selection of the road type and cross has traditionally been based on projected values of Annual Average Daily Traffic (AADT) flow for a future design year. Previously, Table 6.1 of *TII Standard DN-GEO-03031* presented a range of recommended rural road layouts for various AADT capacities, which in turn related to the concept of *Level of Service*.

This *Level of Service* concept, which originated from the US Highway Capacity Manual, is a quality measure describing the operational conditions within a traffic stream. The rationale behind the *Level of Service* concept is that link capacity becomes increasingly related to other factors as flows increase.

Higher volumes give rise to traffic interruptions and flow instability, with consequent loss of driver comfort and freedom to manoeuvre.

In determining the appropriate cross section and junction strategy, the intended service function must be clearly defined. Where efficient mobility is paramount, benefits have traditionally focussed on the capacity of the road cross section, related to expected traffic volumes, resulting in a level of service for vehicles.

DN-GEO-03031 advises that the appropriate cross section shall be selected with reference to the TII Project Appraisal Guidelines. Supply management (i.e. predict and provide) approaches to enhancing mobility are not conducive to delivering a sustainable and resilient network. The selection of a cross section must consider not just trip volumes, but more critically, trip purposes, durations and patterns. It is not the intended function of the national road network to serve all trips. To do so would not preserve the intended strategic mobility function of the network and may promote an over-provision of capacity.

The choice of cross section for a road/junction based intervention should be based on assessments on the following:

- Intended service function of the road;
- Traffic volume and composition;
- Safety and collision risks;
- Active travel user requirements;
- Availability of access to alternative modes of transport;
- Demand management policies and traffic control measures;
- Environmental impacts; and
- Cost.

4.3.3 Peak Factor

The traditional approach of equating *Level of Service* provision with a specified Annual Average Daily Traffic capacity presents a number of potential shortcomings. As noted above, the capacity of a road is not a fixed value, but dependent on many other factors as flow volumes increase. Moreover, the *Level of Service* concept does not take account of the distribution of traffic flows over the 24-hour period, which in practice, is not uniform. In assessing the appropriate cross section on a route such as the M4/N4, which serves a heavy commuting demand into the GDA, an understanding of capacity limitations during the defined morning and evening peaks is needed.

TII PAG Unit 16.1 – Expansion Factors for Short Period Traffic Counts, outlines the concept of daily flow profiles being described as ‘peaky’ or ‘flat’. Peaky flow profiles exhibit high traffic volumes during AM and PM peak periods, with relatively lower flow throughout the remainder of the day. Flat profiles may suggest that there is a broader range of trip purposes along a corridor, with commuting demand during the peak periods overlaid with retail, leisure or other business demands during the off-peak periods.

In order to represent the 'Peakiness' of a traffic flow profile over a particular day, the concept of a 'p-factor' has been derived. The p-factor simply describes the scale of the reduction in flow between the AM Peak and the quietest period of the afternoon (the Inter-Peak), and from the Inter-Peak back up to the PM Peak. It is defined as follows:

$p = a + b - 2c$

where:

a = the maximum hourly proportion of traffic between 0:00 and 12:00 on a weekday

b = the maximum hourly proportion of traffic between 12:00 and 24:00 on a weekday

c = the minimum hourly proportion of traffic between 08:00 and 18:00 on a weekday

To determine a 'p-factor' for the existing M4/N4, flow volumes have been extracted from the existing TII counter sited between Junction 6 Celbridge and Junction 7 Maynooth. The 'p-factor' has been calculated as 0.064 and is based on the traffic flow profile presented in Figure 4.7.

As noted in PAG Unit 16.1, the maximum 'p-factor' is 1.0, in which case all traffic flow would occur during 2 individual peak hours of the day, separated by a cessation of all traffic during the afternoon. An analysis of TII counter data across the entire network indicates a national mean value of 0.071.

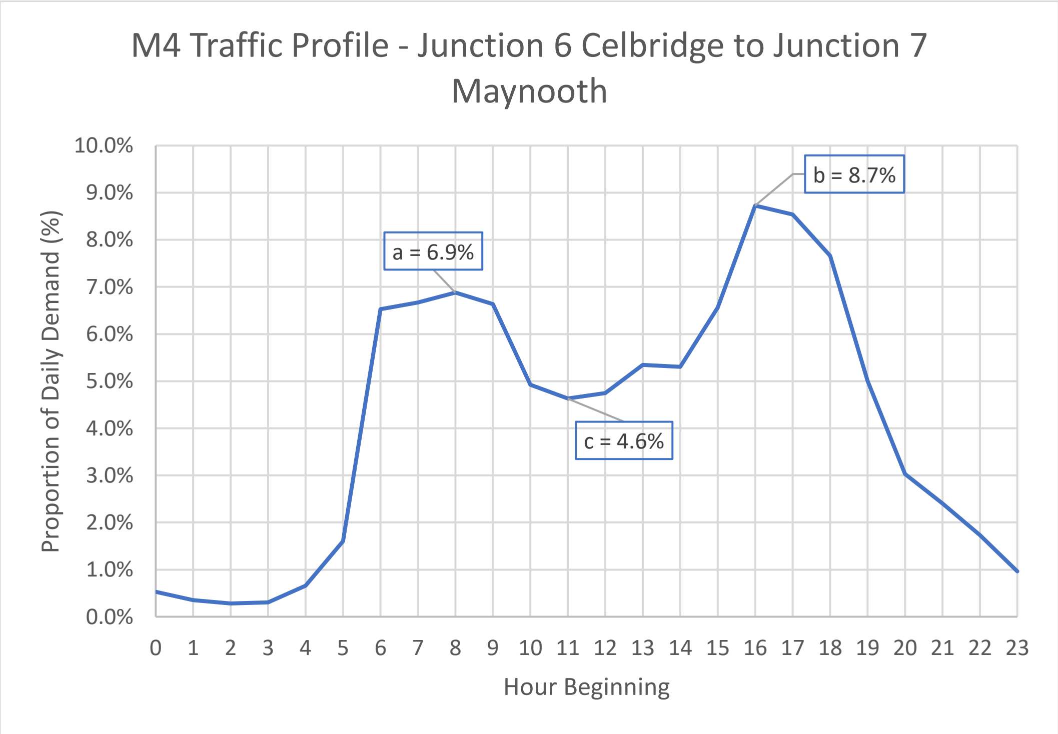


Figure 4.7: M4 Weekday Traffic Profile – Junction 6 Celbridge to Junction 7 Maynooth

The fact that the M4/N4 ‘p-factor’ is less than the national average, is indicative of high traffic volumes during both the peak and inter-peak periods. This illustrates the multi-purpose nature of the M4/N4 corridor, which acts both as a busy commuting corridor to the Greater Dublin Area, as well as serving a significant number of shorter trip purposes supporting business, freight, retail, amenity and community activities throughout the day.

The relatively low ‘p-factor’ is also indicative of a capacity constraint during peak periods, which leads to spreading of peak demand into the peak shoulders, effectively restraining the peak flow and thus extending the peak period duration.

4.3.4 Bottleneck Capacity

The mainline link capacity is dependent on the level of turbulence in a traffic stream. Increasing turbulence can frequently result in the emergence of a bottleneck, which places a further capacity constraint on upstream flow. In simple terms, bottlenecks occur where the number of vehicles arriving at a particular point is greater than the number of vehicles being discharged. Bottlenecks can be created at junction merge locations and weaving areas; lane drops or abrupt changes in speed limits – all of which are pertinent to the section of M4/N4 under consideration for improvement. Busy merge locations are particularly susceptible to flow breakdown if downstream volumes prevent merging vehicles from finding usable gaps in the traffic stream.

The existing M4/N4 exhibits bottleneck conditions in both the AM and PM peaks,. This routinely results in shockwaves being induced upstream of the bottleneck, generating ‘oversaturated’ conditions for traffic approaching the obstruction, whereby the arrival rate of vehicles is greater than the discharge rate through the bottleneck. In practice, this manifests itself as start-stop flow conditions with queues often extending for several kilometres upstream of the bottleneck. As traffic arrives slowly to the front of the queue, it then begins to accelerate away from that point, increasing speed as it passes through the bottleneck. Such conditions are observed on the M4 in the AM peak eastbound, as a succession of interruptions (i.e. merging, weaving, speed restrictions etc.) constrains the operational efficiency. The resulting shockwaves induce queuing which can extend beyond Junction 6 Celbridge as far as Junction 7 Maynooth. The reverse conditions occur in the PM peak, with bottleneck induced shockwaves along the same section generating upstream queuing in the westbound direction as far back as Junction 3 Newcastle on the N4 and beyond. Speed increases directly after the Junction 5 Leixlip bottleneck.

Figure 4.8: Typical AM peak queuing eastbound towards the M50 at Junction 5 Leixlip

Figure 4.9: Typical PM peak queuing westbound approaching Junction 5 Leixlip

Understanding the concept of bottleneck capacity and how it generates turbulence along the M4/N4, is that traffic congestion and the operational efficiency of the route can be improved if interventions are targeted to address the root causes of the problem.

4.3.5 Alternative Modes and Demand Management

The future capacity needs for the M4/N4 road are also intrinsically linked to the concurrent and future delivery of public transport and active travel projects and improvements within the study area. In spite of its location within the Greater Dublin Area, existing access to public transport services remains limited throughout much of the study area. A number of major transportation proposals outlined within the NTA's *GDA Strategy* have the potential, if delivered, to significantly impact on the future road demand and consequent level of intervention required by the Maynooth to Leixlip Project. In addition to BusConnects, DART+ West and improvements to light rail, the GDA Strategy also includes complementary demand management proposals aimed at discouraging private car use and incentivising mode shift to sustainable alternatives. This includes provision for active travel, which is a key consideration in terms of identifying the optimal usage of both the existing road space and the precise nature and design of any proposed interventions. It is therefore evident that the determination of future transport requirements on the M4/N4 must take cognisance of public transport improvements within the wider area and crucially, must support and consider investment in alternative modes and demand management.

4.3.6 Initial Selection of Interventions Required

In consideration of the future operational efficiency needs of the M4/N4, it is evident from the paragraphs above that the appropriate transport infrastructure type will be influenced by a multitude of factors, including:

- Annual Average Daily Traffic (AADT);
- Junction capacity;
- Peak hour flows;
- Level of turbulence in the traffic stream (and presence of bottlenecks);
- Availability of access to alternative modes of transport and provision for active travel; and
- Demand management policies and traffic control measures.

Consequently, the selection of appropriate future transport infrastructure needs to consider a much broader range of criteria and influences, as opposed to adopting a traditional predict and provide or supply management approach. Instead, future design needs will be developed incrementally in consideration of the above factors. The optimisation of the M4/N4 is not necessarily contingent on the addition of road space (i.e. extra traffic lanes) but may equally be delivered as a consequence of more targeted interventions to incentivise a shift to alternative modes of travel.

4.4 Preliminary Junction and Access Strategy

The junction strategy objectives for the Maynooth to Leixlip Project will seek to align with the following basic principles, irrespective of the corridor options:

- Provide junction layouts which are consistent, intuitive and that better manage operational needs;
- Improve weaving conditions on the M4/N4 and manage the effects of junction-induced turbulence on mainline traffic flow;
- Provide junctions which are safer for both motorised and non-motorised users;
- Ensure junction strategy provides good connectivity to the regional network and population centres; and
- Ensure an overall junction and access provision which achieves the wider objectives of the project, enhancing cross-community connectivity where presently severed by the M4/N4 road.

4.5 Cost Benefit Analysis Tools

The cost benefit analysis (CBA) assessment for Phase 2 (Options Selection) of the Maynooth to Leixlip Project was undertaken using the TUBA v1.9.8 cost benefit analysis programme. The latest TII economic parameters file was used, with all figures discounted back to a base year of 2011. A variable discount rate was used, with 4% applied for appraisal years 1-30 (and 3.5% for years 31-60 – which were assessed in order to calculate a residual value for the main 30-year appraisal). As such, the analysis has been carried out in accordance with TII PAG Unit 6.3: Guidance on Using TUBA (September 2017) and with reference to TII PAG Unit 6.11 National Parameter Values Sheets (March 2021).

4.6 Safety Analysis Tools

TUBA software does not calculate costs associated with collisions and casualty severity. Therefore, the assessment of potential safety benefits was undertaken using the COBALT-Ireland (COst and Benefit to Accidents – Light Touch), a computer program designed to undertake the analysis of the impact on accidents as part of economic appraisal for a transport project. The COBALT-Ireland assessment is based on a comparison of collisions by severity and associated costs across an identified network in ‘Without-Scheme’ and ‘With-Scheme’ forecasts, using details of link characteristics, collision rates, casualty costs and projected traffic volumes. This process was undertaken using the opening year (2032) and the design year (2047) traffic models and collision costs for the entire 30-year appraisal period from 2032 to 2062 were calculated. The latest available COBALT-Ireland version has been used to undertake the safety appraisal and the input parameters are aligned with TII PAG Unit 6.11 (March 2021).

5 Stage 1 Preliminary Options Assessment

5.1 Introduction

The Stage 1 Preliminary Options Assessment has been undertaken in accordance with the TII Project Manager's Manual for Major National Roads Projects (PE-PMG-02042) and the TII Project Appraisal Guidelines (PAG) Unit 7.0 Multi-Criteria Analysis (PE-PAG-02031).

This Stage 1 Preliminary Options Assessment is the third sift in Stage 1, with the previous two sifts already outlined in Chapter 3. For Stage 1, the headline criteria against which each of the options were assessed are:

- Engineering;
- Environment; and
- Economy.

Within the Engineering and Environment headline criteria, a further range of sub-criteria are used to input into the overall assessment. Under the headline criterion of Economy, the assessment considers the preliminary cost estimate range and preliminary benefits of each option in accordance with the TII Project Management Guidelines.

5.2 Description of Options taken through to Preliminary Options Assessment (Stage 1 Sift 3)

The options taken through to Preliminary Options Assessment (Stage 1 Sift 3) are as follows:

- 6 Corridor Options (Corridors contain Bus and Road-based Options). This includes 3 core corridor options with an option to provide a parallel road option on each;
- 1 Enhanced Bus Infrastructure (Junctions and Overbridges);
- 14 Junctions/Bridges Options;
- 11 Demand Management Options;
- 6 Park and Ride Options;
- 6 Active Travel Options; and
- 2 Test Rail Options.

These are discussed hereunder. High-level graphics of the options are included in Appendix 5.1 and detailed graphics of the options are included in Appendix 5.2.

5.2.1 Corridor Options

5.2.1.1 Existing Corridor

The existing corridor under consideration extends from Junction 7 Maynooth to Junction 5 Leixlip. The existing M4/N4 cross section varies minimally over its length. The cross section broadly complies with TII detail CC-SCD-00008 as presented in Figure 5.1.

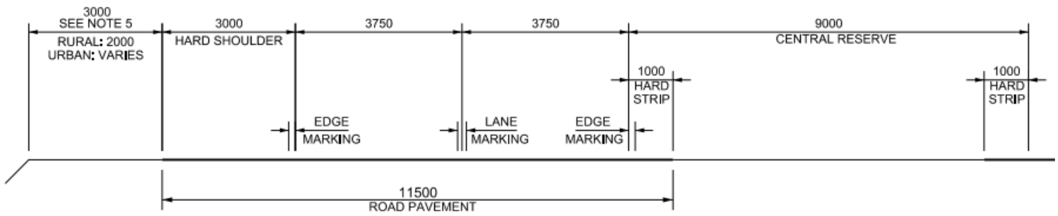


Figure 5.1: TII Cross Section

Initial investigation indicates that the M4/N4 cross section generally comprises of the above TII detail with a central reserve of 7m and lane widths between 3.65m and 3.75m. Refer to Figure 5.2.

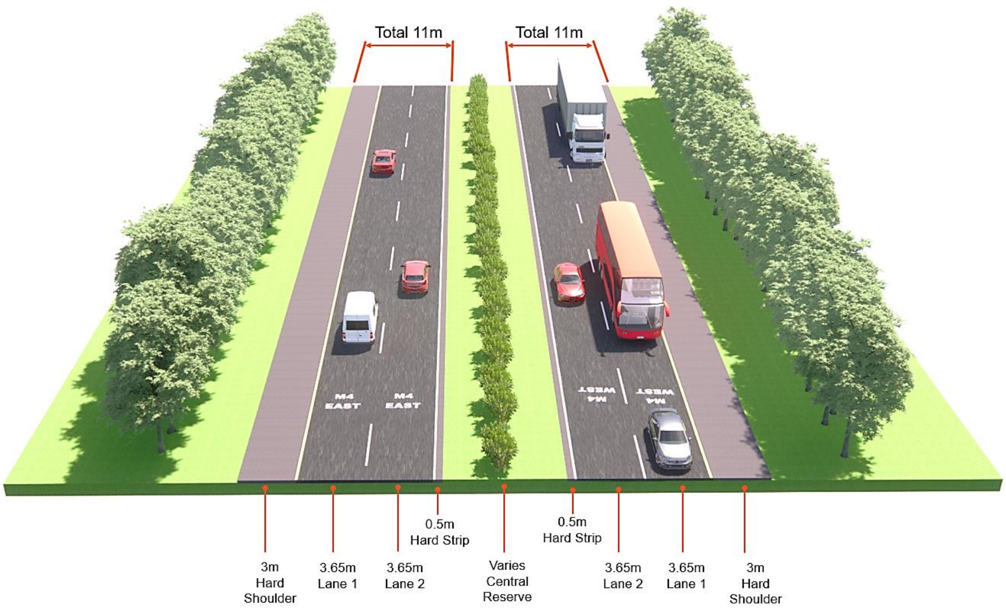


Figure 5.2: Existing Cross Section Graphic

5.2.1.2 Corridor Options Overview

Corridor options include both bus and road-based options. Three core corridor options were identified as part of the Phase 2 Stage 1 process. The bus priority measures, which are integral to all corridor options, have the following key parameters:

- Non-physically segregated permanent (full-time) that can be used by buses and coaches;

- Primarily accommodate long-distance point-to-point services, commensurate with the delivery of a core bus corridor as envisaged within the GDA Strategy;
- Commence at Junction 7 Maynooth as eastbound peak time congestion can extend to this location. Additionally, the Average Annual Daily Traffic (AADT) between Junction 7 and Junction 5 is between 59,000 and 70,000. The AADT west of Junction 7 is significantly lower at 46,000;
- Terminate at Junction 5 Leixlip/Junction 4A because there is an existing eastbound bus lane from this location to the M50;
- The bus priority measures would be in an upgraded hard shoulder, forming "hard shoulder bus priority measures" in accordance with bus priority measures in a motorway environment per the TII Standard on Hard Shoulder Bus Priority Measures on Motorways and Type 1 Dual Carriageways;
- It would function as a hard shoulder at all times and be accessible to any vehicle which may become disabled or requires to leave the mainline in an emergency; and
- The existing operating speed for the M4 motorway is 120km/h. The motorway ends immediately east of the Junction 5 Leixlip diverge and then reduces to 80km/h and transitions to the N4 dual carriageway. It is proposed to reduce the speed limit to 100km/h along the section of M4 from Junction 7 Maynooth to Junction 5 Leixlip and design for a 100km/h motorway.

Junction/Overbridge options, park and ride infrastructure, active travel and demand management will be considered and applied equally on all corridor options when the preferred option is established for each.

5.2.1.3 Corridor Option 1

Corridor Option 1 consists of proposed bus priority measures within the hard shoulder in both the eastbound and westbound directions. The typical width of this option is circa 29m. Refer to Figure 5.3 and Figure 5.4.

Figure 5.3: Corridor Option 1 – Plan

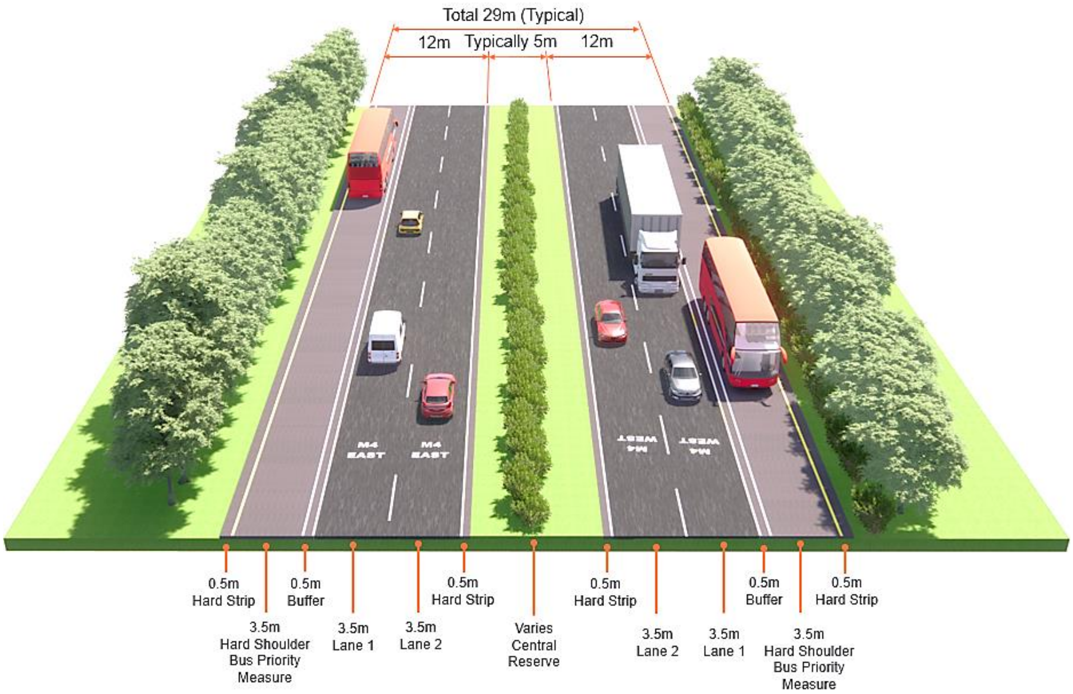


Figure 5.4: Corridor Option 1 – Cross Section

5.2.1.4 Corridor Option 2

Similar to Corridor Option 1, Corridor Option 2 consists of proposed bus priority measures within the hard shoulder in both the eastbound and westbound directions. However, it differs in that it includes an additional third traffic lane in the westbound direction therefore it has a wider extents. The typical width of this option is circa 30.5m. Refer to Figure 5.5 and Figure 5.6.

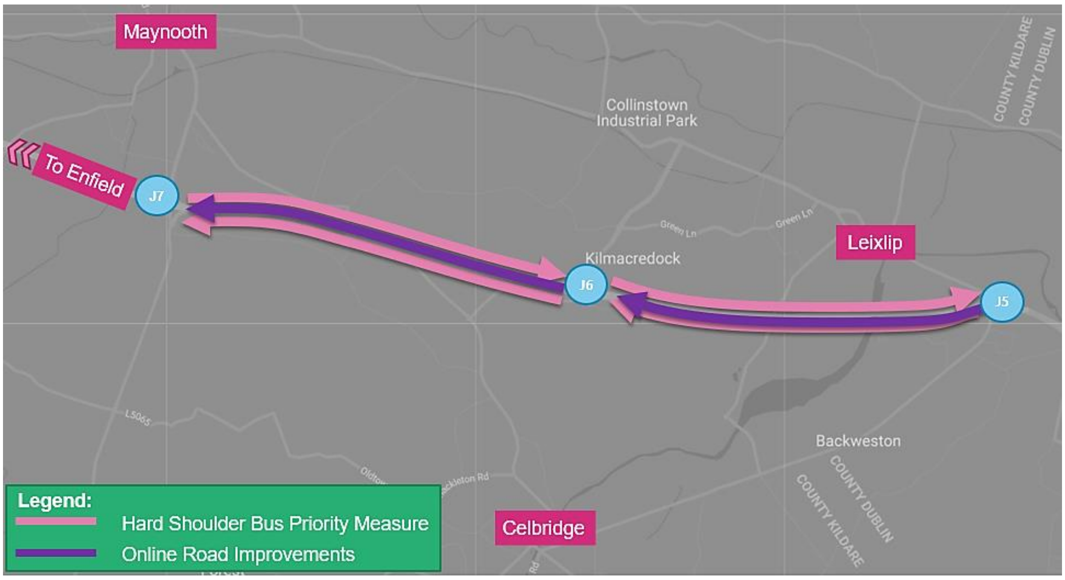


Figure 5.5: Corridor Option 2 – Plan

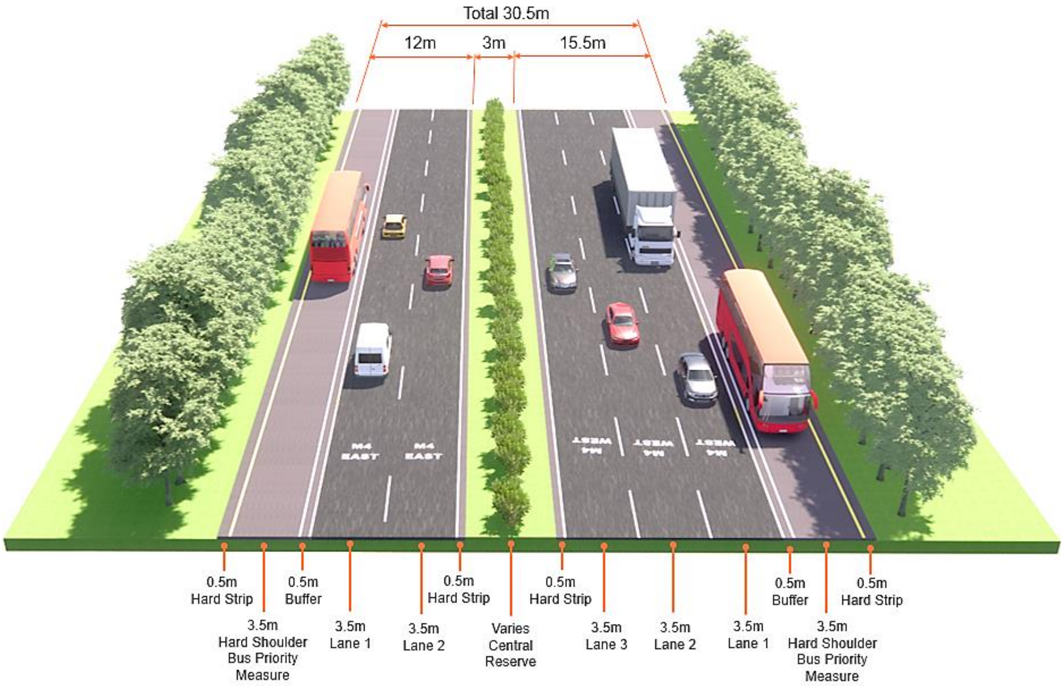


Figure 5.6: Corridor Option 2 – Cross Section

5.2.1.5 Corridor Option 3

Similar to Corridor Option 1 and 2, Corridor Option 3 consists of proposed bus priority measures within the hard shoulder in both the eastbound and westbound directions. However, it differs in that it includes an additional third traffic lane in both the eastbound and westbound directions. Therefore, it has a wider extent than Corridor Option 1 and Corridor Option 2. The typical width of this option is circa 34m. Refer to Figure 5.7 and Figure 5.8.

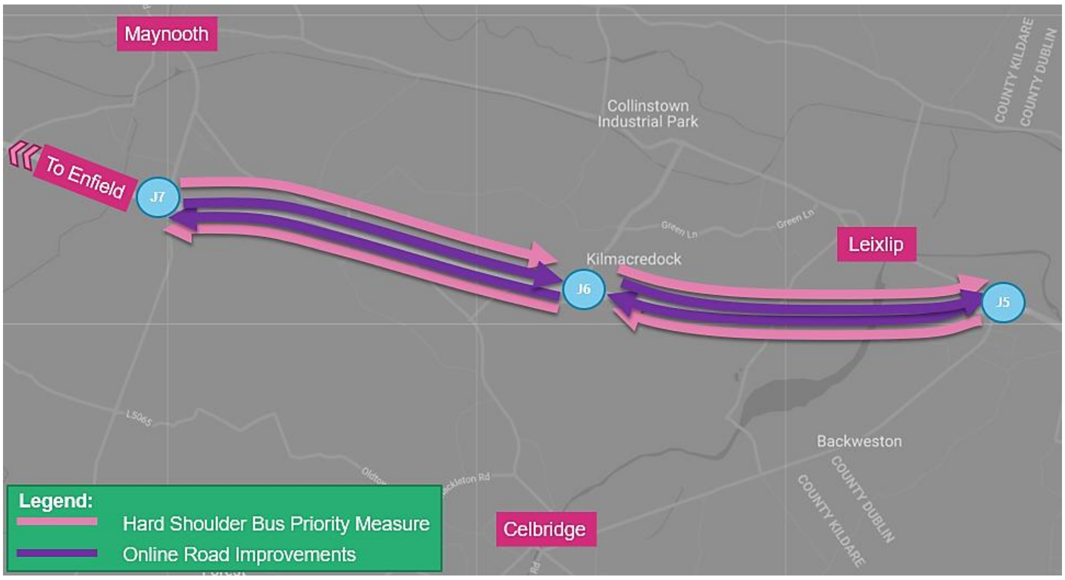


Figure 5.7: Corridor Option 3 – Plan

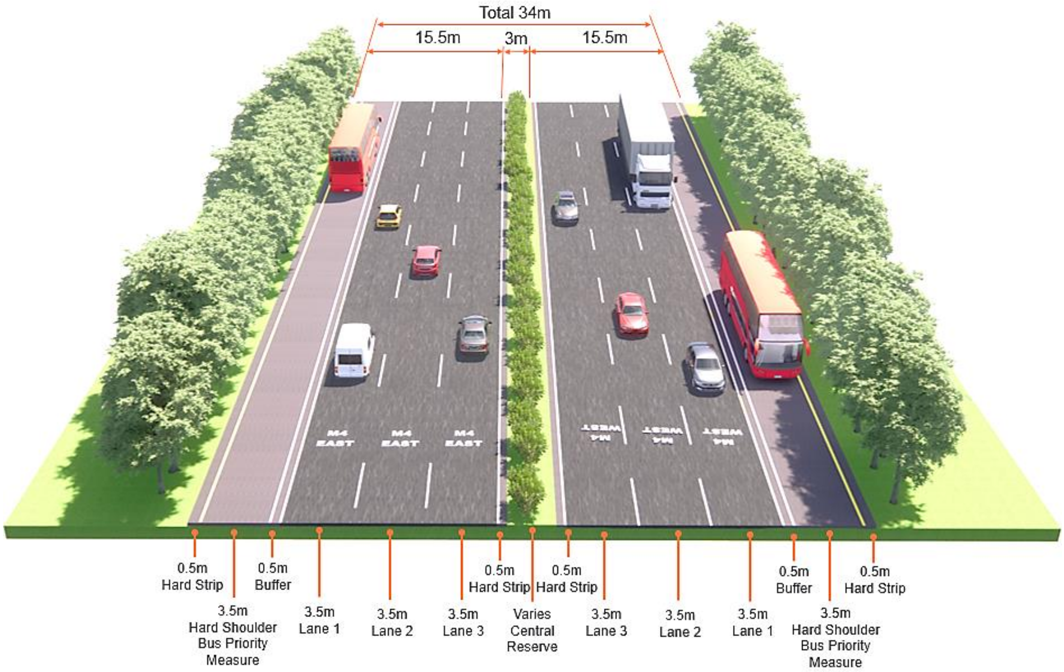


Figure 5.8: Corridor Option 3 – Cross Section

5.2.1.6 Corridor Options Assessment Summary

A summary of the corridor options Stage 1 Preliminary Options Assessment outcome is as follows:

- Corridor Option 1: Taken forward to Stage 2 Project Appraisal Matrix;
- Corridor Option 2: Taken forward to Stage 2 Project Appraisal Matrix; and
- Corridor Option 3: Excluded, not taken forward.

For more details on the assessment findings, please refer to Section 5.7.

5.2.1.7 Parallel Road Options

The three Corridor Options all include a 'B' option which represents the option with a parallel road, i.e. Corridor Option 1B.

Overview

A southern parallel road was assessed in the Local Area Model and it was determined that the benefit generated (vehicle trips) was not significant and therefore would not represent value for money to invest in new infrastructure for the full length of this parallel road option from the R406 Straffan Road to the R404 Celbridge Road.

The lack of vehicle trips generated was due to a number of factors, including:

- The speed of the M4/N4 mainline (proposed 100km/h) versus the speed of the parallel roads (80km/h);
- The directness of the M4/N4 mainline;

- The low number of on-off trips between Junction 7 and Junction 6; and
- The high standard of existing sections of the existing regional and local road network.

Refer to Appendix 5.5 for further details.

Assessment Summary

The parallel road options were not taken forward to Stage 2 Project Appraisal Matrix.

5.2.2 Enhanced Bus Infrastructure (Junctions and Overbridges)

5.2.2.1 Overview

This option would have the potential to support the existing bus infrastructure on the local and regional road network. The proposed Bus Connects network would provide both a radial service to Lucan and Dublin City Centre from Maynooth and an orbital service to Celbridge. Refer to Figure 5.9 which shows the proposed BusConnects network.

There is no existing bus infrastructure at Junction 7 Maynooth, Junction 6 Celbridge or Junction 5 Leixlip.

Junction 7 Maynooth

The proposed BusConnects spine route (C3) on the R406 Staffan Road at Junction 7 Maynooth does not extend to the junction and terminates north of the junction. Therefore, there is no requirement for bus infrastructure on the structure.

Junction 6 Celbridge

At Junction 6 Celbridge, there is a proposed local route (259) on the R449 extending through the junction. However, this is a local route and no dedicated bus lanes or proposals for bus lanes proposed on approach to the structure on either side. Therefore, there is no requirement to include bus lanes on the structure.

Junction 5 Leixlip

At Junction 5 Leixlip, there is a proposed spine route to Maynooth (C3) and to Celbridge (C4). However, there are no dedicated bus lanes or proposals for bus lanes on the R148 or the R403 on approach to either side of the structure. Therefore, there is no requirement to include bus lanes on the structure.

Based on a review of BusConnects, at present, there is no requirement for enhanced bus infrastructure at Junctions and Overbridges.

However, there may be a requirement to support park and ride facilitates. Pending a finalised location for a park and ride location, it may be prudent to further examine enhanced bus infrastructure in the proximity of proposed park and ride locations.

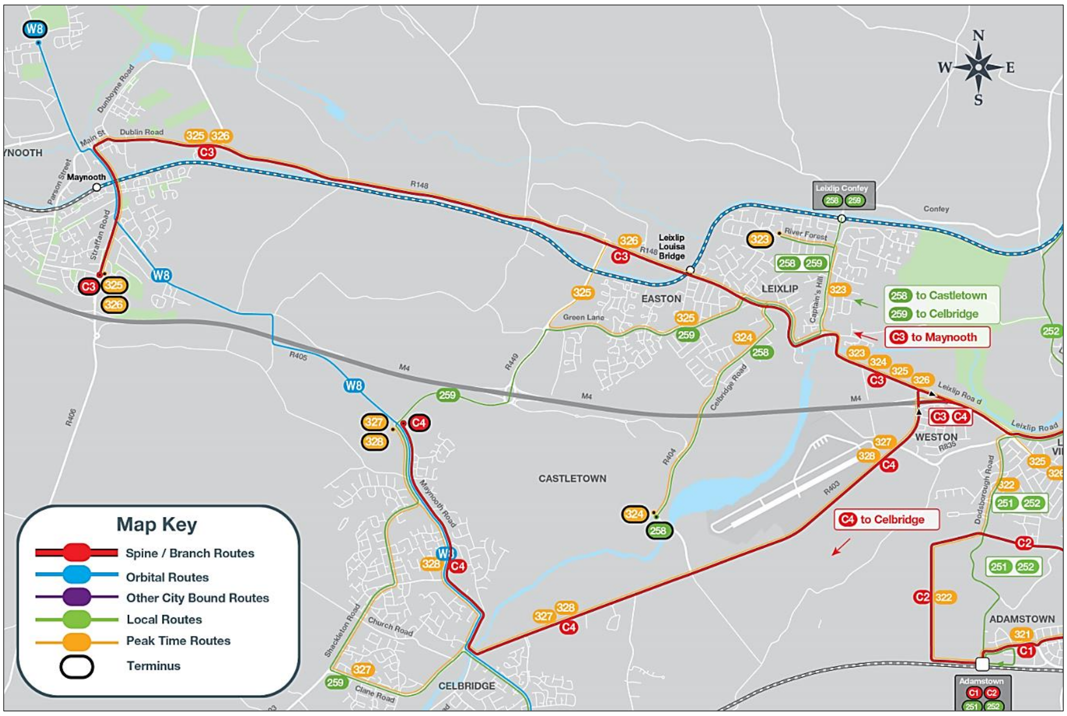


Figure 5.9: Enhanced Bus Infrastructure (Junctions and Overbridges)

5.2.2.2 Assessment Summary

This option would be considered on the preferred option in consultation with the National Transport Authority.

5.2.3 Junction and Bridges Options Description

5.2.3.1 Junction 7 Maynooth Options

Overview

Junction options for Maynooth include both road and active travel-based options. It has eight options in the following 4 categories:

1. Improve the existing junction (1 option);
2. Provide one new junction and convert the existing to an overbridge (1 option).
3. Improve the existing junction and provide a second junction (2 options); and
4. Provide two new junctions and convert the existing to an overbridge (4 options).

The junction locations shown below represent all the locations required to create the eight Junction 7 options, when combined in various permutations.

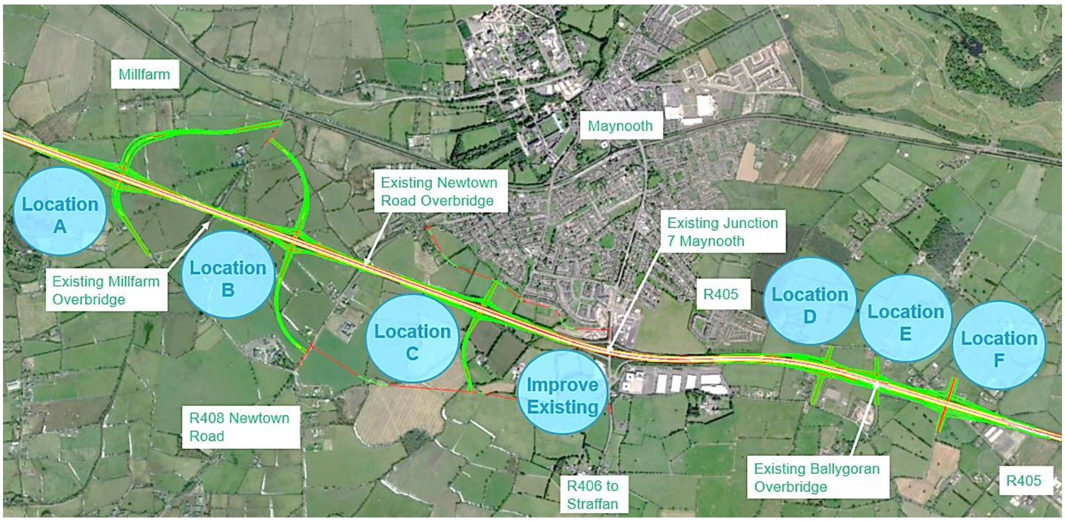


Figure 5.10: Junction 7 Maynooth Options Overview

Improve Existing Junction

This option would include improving the operational efficiency of the existing junction along with active travel measures, with the inclusion of safety improvements for vulnerable road users.

Location A – Junction West of Millfarm

Location A is a new grade separated junction located west of the existing Millfarm Overbridge. To the south, it will connect to the R408 Newtown Road via the L5042 local road. To the north, it will connect to the R148 via the L5041 local road, in the vicinity of Jackson's Bridge.

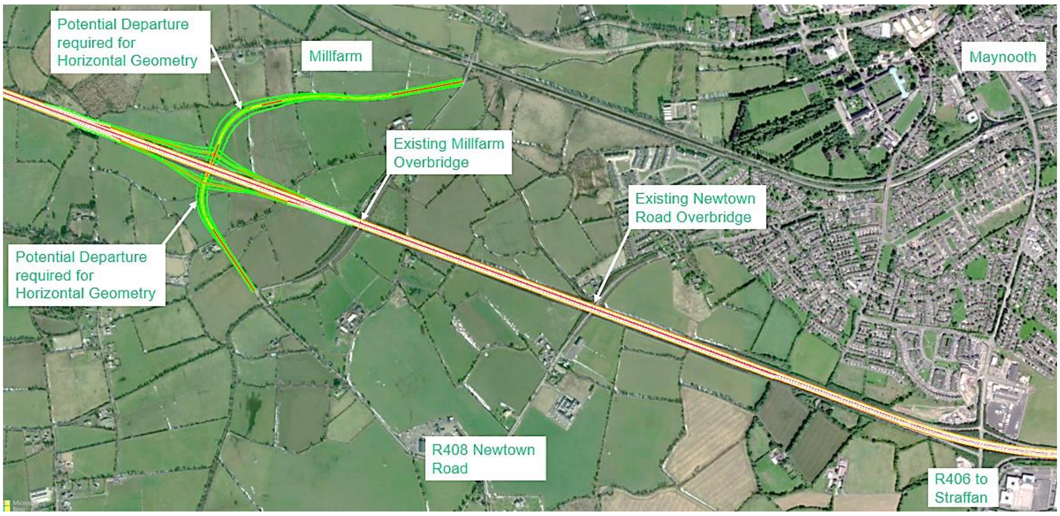


Figure 5.11: Location A - Junction West of Millfarm

Location B – Junction between Millfarm and Newtown Road

Location B is a new grade separated junction located between the existing Millfarm Overbridge and the R408 Newtown Road Overbridge. To the south, it will connect directly to the R408 Newtown Road. To the north, it will connect to the R148 via the L5041 local road, in the vicinity of Jackson's Bridge.

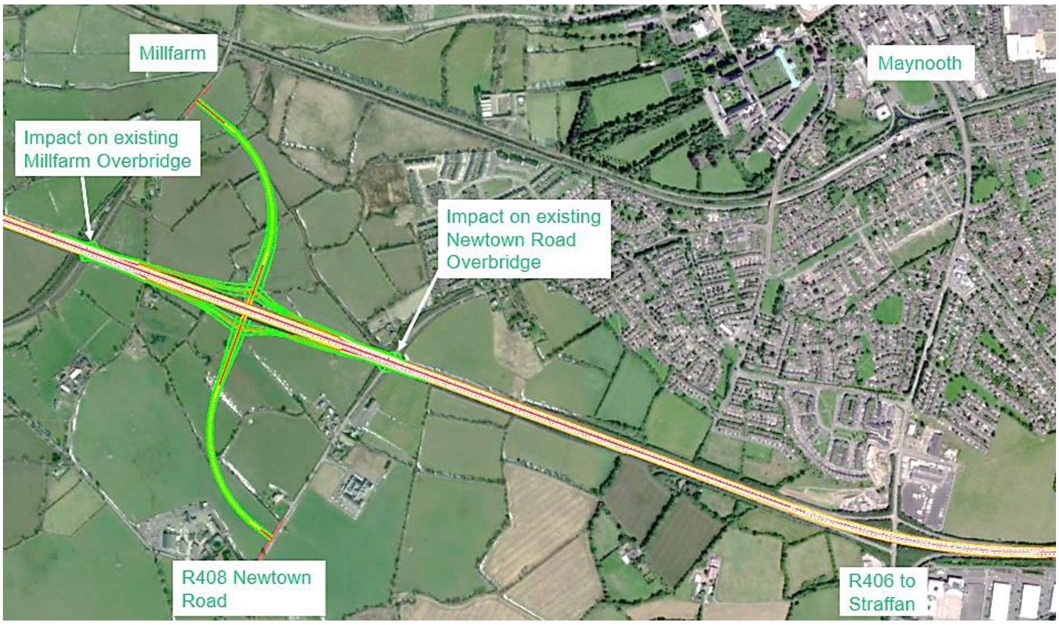


Figure 5.12: Location B - Junction between Millfarm and Newtown Road

Location C – Junction between Newtown Road and R406 Straffan Road

Location C is a new grade separated junction located between the R408 Newtown Road and the R406 Straffan Road. To the south, it would connect to the R408 Newtown Road south of Maynooth Lodge Nursing Home and the R406 Straffan Road south of the Straffan Road Roundabout via a new connector road.

To the north, it would connect to the R408 Newtown Road (exact location to be determined) and the R406 Straffan Road near Bartons Transport via a new connector road, as part of a potential western orbital (refer to Maynooth Local Area Plan).

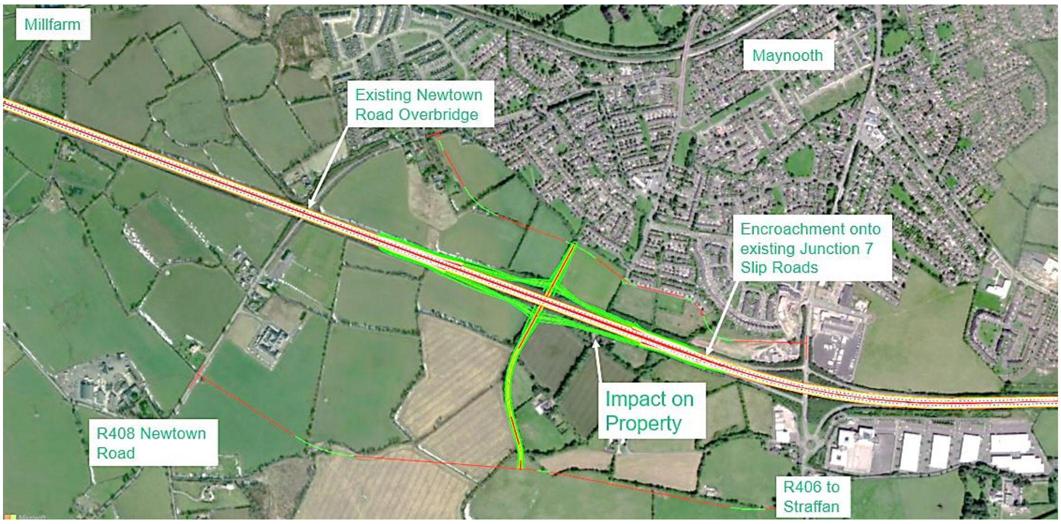


Figure 5.13: Location C - Junction between Newtown Road and R406 Straffan Road

Location D – Junction West of Existing Ballygoran Overbridge

Location D is a new grade separated junction located west of the existing Ballygoran Overbridge. To the south, it would connect to the Ballygoran Road via a new link adjacent to the Ballygoran Reservoir. To the north, it would connect to the R405 Ballygoran Road.

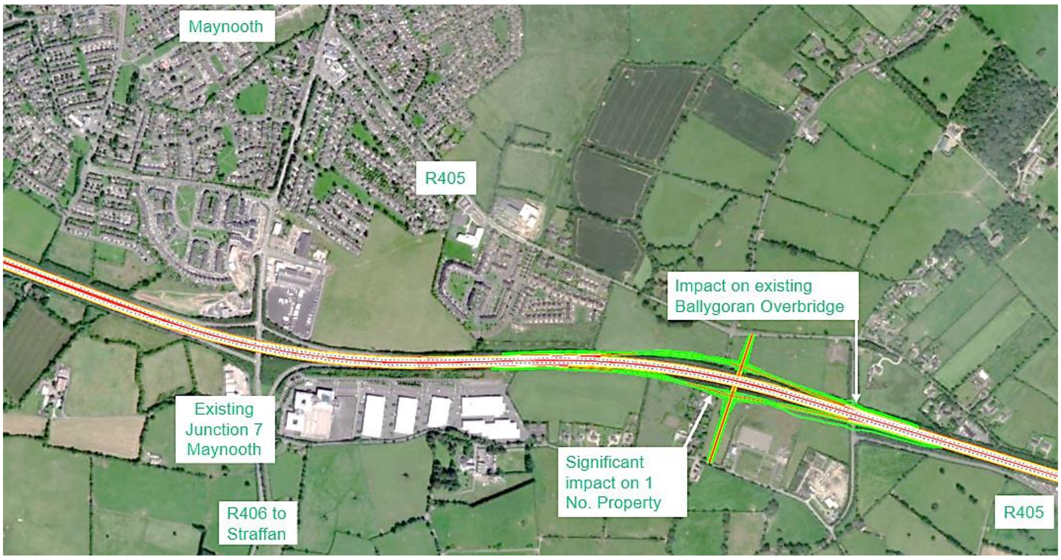


Figure 5.14: Location D - Junction West of Existing Ballygoran Overbridge

Location E – Junction reusing Existing Ballygoran Overbridge

Location E is a new grade separated junction whereby the existing overbridge is reused, utilising the existing infrastructure. To the south, it would connect to the Ballygoran View. To the north, it would connect directly to the R405 Ballygoran Road.

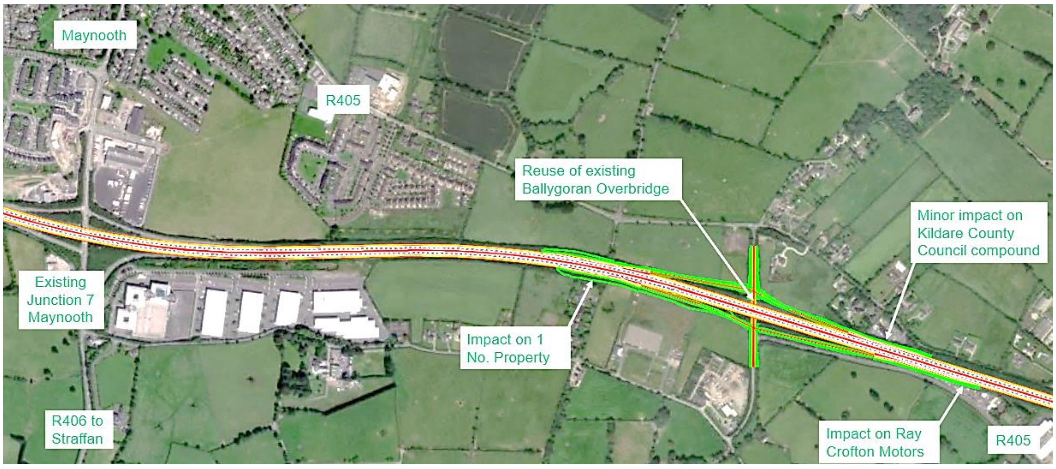


Figure 5.15: Location E - Junction reusing Existing Ballygoran Overbridge

Location F – Junction East of Existing Ballygoran Overbridge

Location F is a new grade separated junction located east of the existing Ballygoran Overbridge. To the south, it would connect to Ballygoran View and the R405 Ballygoran Road via a new link (not shown in image). To the north, it would connect to R405 Ballygoran Road via a new link road (not shown in image).

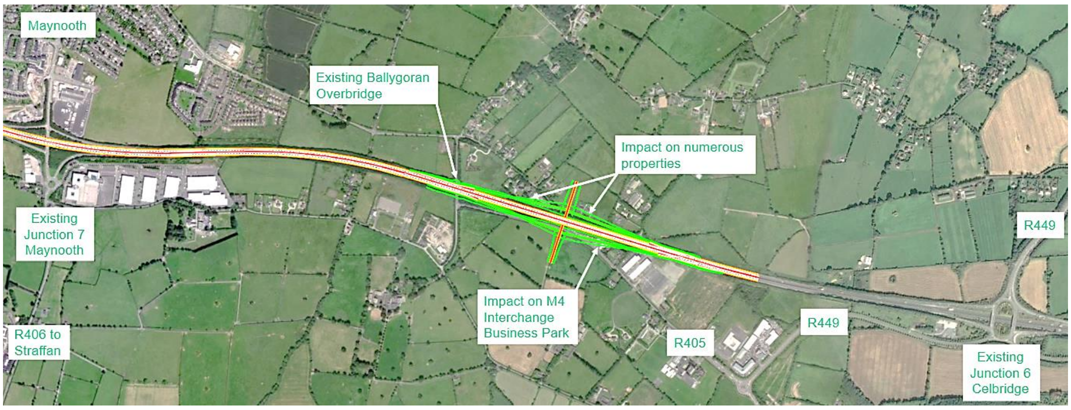


Figure 5.16: Location F - Junction East of Existing Ballygoran Overbridge

Junction 7 Assessment Summary

The preferred option from each of the four categories is outlined in 5.1.

Table 5.1: Junction 7 Assessment Summary (Preferred in each Category)

Category / Option	Category Description	Sift 1 and 2 Referencing	Sift 3 Location Reference	Result	Comments
Category/ Option 1	Improve Existing Junction	Improve Existing	Improve Existing	Category/ Option 1 Preferred	Taken forward to Category 1 to 4 assessment
Category/ Option 2	Provide 1 New Junction and Convert Existing to an Overbridge	4.1.1	C	Category/ Option 2 Preferred	Taken forward to Category 1 to 4 assessment
Category/ Option 3	Improve Existing Junction and Provide a 2nd Junction	2.1.1	Improve Existing + A	Discounted	Location B preferred to Location A
		2.1.2	Improve Existing + B	Category/ Option 3 Preferred	Taken forward to Category 1 to 4 assessment
Category/ Option 4	Provide 2 New Junctions and Convert Existing to an Overbridge	3.1.2	(A or B) + F	Discounted	Location E preferred to Location F
		3.2.2	(A or B) + E	Category/ Option 4 (B + E) Preferred	Taken forward to Category 1 to 4 assessment.
		3.3.1	(A or B) + D	Discounted	Location E preferred to Location D
		3.4.1	A + C	Discounted	Location B preferred to Location A

The preferred option in each category was then assessed against each other. A summary of this assessment is as follows:

- Option 1 – taken forward to Stage 2 Project Appraisal Matrix

Figure 5.17: Option 1 – Improve Existing Junction (1 Junction Option)

- Option 2 – taken forward to Stage 2 Project Appraisal Matrix

Figure 5.18: Option 2 - Provide 1 New Junction and Convert Existing to an Overbridge (1 Junction Option)

- Option 3 – discounted; and
- Option 4 – discounted.

Refer to Section 5.8.1.1 for further details.

5.2.3.2 R405 Ballygoran Road Overbridge

This option includes improving the existing overbridge to include active travel measures and safety improvements for vulnerable road users. This overbridge is on the BusConnects network and is a potential key active travel connection.

Figure 5.19: R405 Ballygoran Road Overbridge – Improve Existing Overbridge

Assessment Summary

The option of improving the existing R405 Ballygoran Road Overbridge is taken forward to Stage 2 Project Appraisal Matrix.

5.2.3.3 Junction 6 Celbridge

This option includes improving the operational efficiency of the existing junction along with active travel measures, with the inclusion of safety improvements for vulnerable road users.

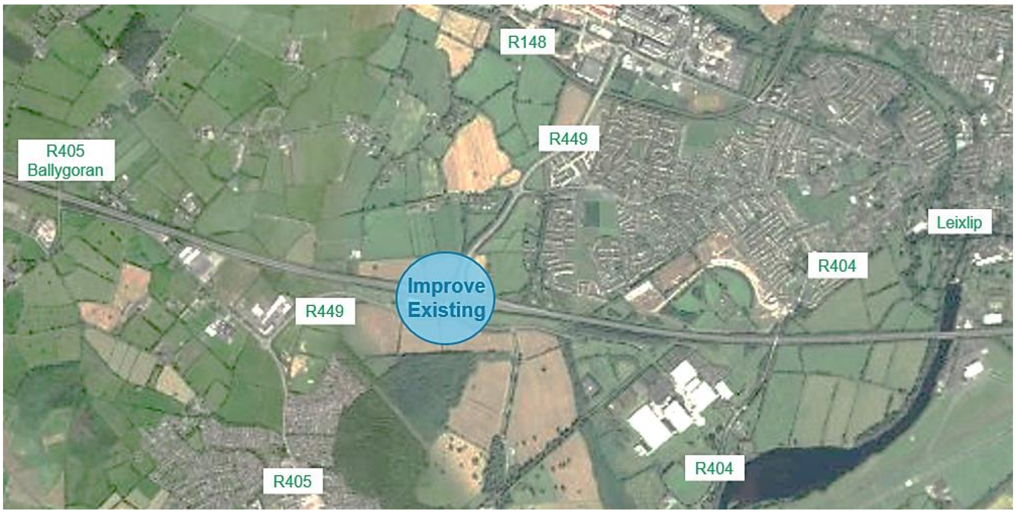


Figure 5.20: Junction 6 Celbridge – Improve Existing Junction

Assessment Summary

Given its existing condition, demand and strategic importance, the option of improving the existing Junction 6 Celbridge is taken forward to Stage 2 Project Appraisal Matrix.

5.2.3.4 R404 Celbridge Road Overbridge

This option includes improving the existing overbridge to include active travel measures and safety improvements for vulnerable road users. This overbridge is a potential key active travel connection.

Figure 5.21: R404 Celbridge Road Overbridge – Improve Existing Overbridge

Assessment Summary

The option of improving the existing R404 Celbridge Road Overbridge is taken forward to Stage 2 Project Appraisal Matrix.

5.2.3.5 Junction 5 Leixlip Options

Overview

Junction options for Leixlip include both road and active travel-based options. The three options included in the Preliminary Options Assessment are:

- Improve the existing junction;
- New junction located on the R404, and convert the existing to an overbridge; and
- New junction located between the Liffey River Bridge and the existing junction and convert the existing to an overbridge.

The options are shown below.

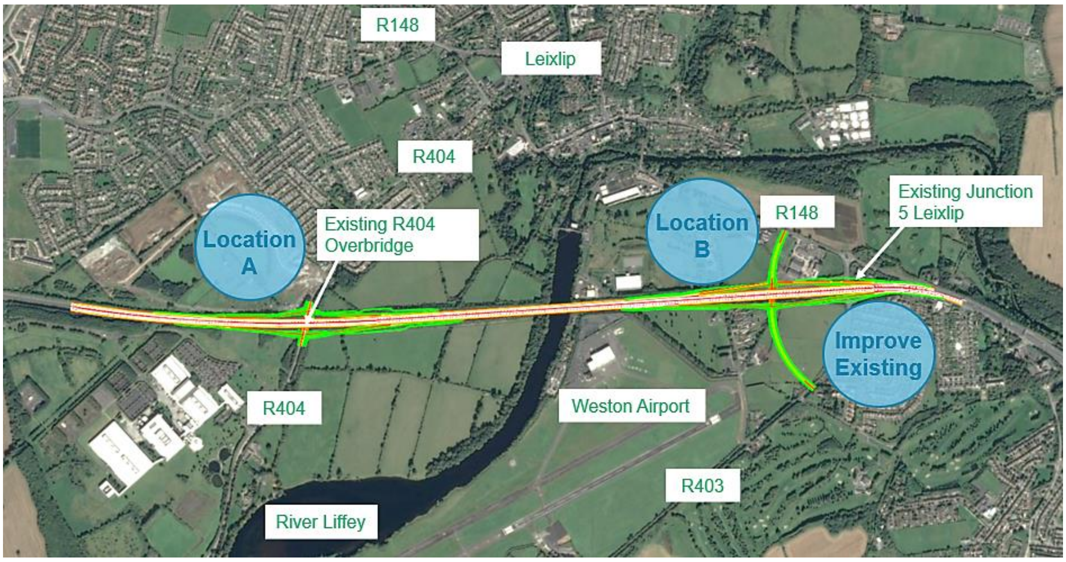


Figure 5.22: Junction 5 Leixlip Options Overview

Improve Existing Junction

This option includes improving the operational efficiency of the existing junction along with active travel measures, with the inclusion of safety improvements for vulnerable road users.

Assessment Summary

Given its existing condition, demand and strategic importance, the option of improving the existing Junction 5 Leixlip is taken forward to Stage 2 Project Appraisal Matrix.

Location A – New Junction reusing existing R404 Overbridge

Location A is a new grade separated junction whereby the existing R404 Overbridge is reused, utilising existing infrastructure. It would connect to the R404 to the north and south. This option includes converting the existing Junction 5 to an overbridge.

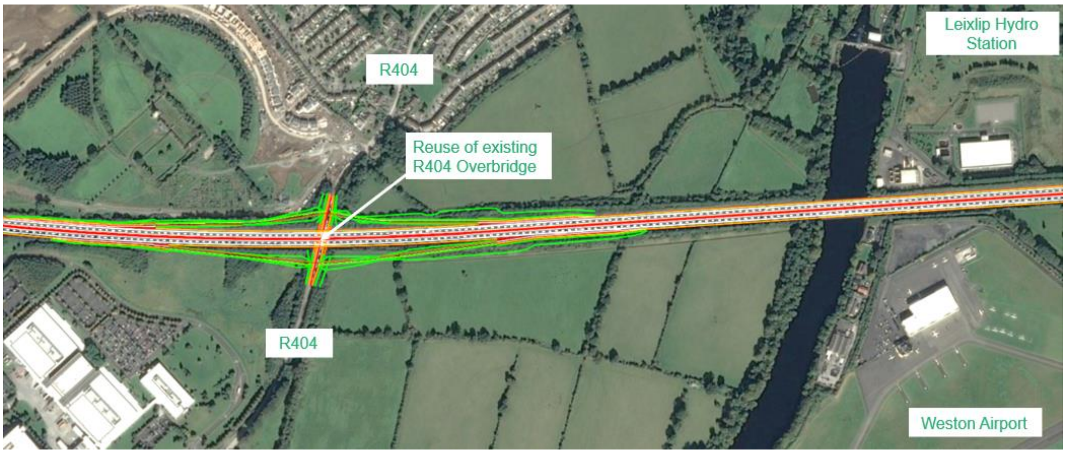


Figure 5.23: Junction 5 Location A – New Junction reusing existing R404 Overbridge

Location B – Junction between Liffey River Bridge and Existing Junction 5

Location B is a new grade separated junction located between the Liffey River Bridge and the existing Junction 5. To the south, it would connect directly to the R403. To the north, it would connect to the R148. This option includes converting the existing Junction 5 to an overbridge.

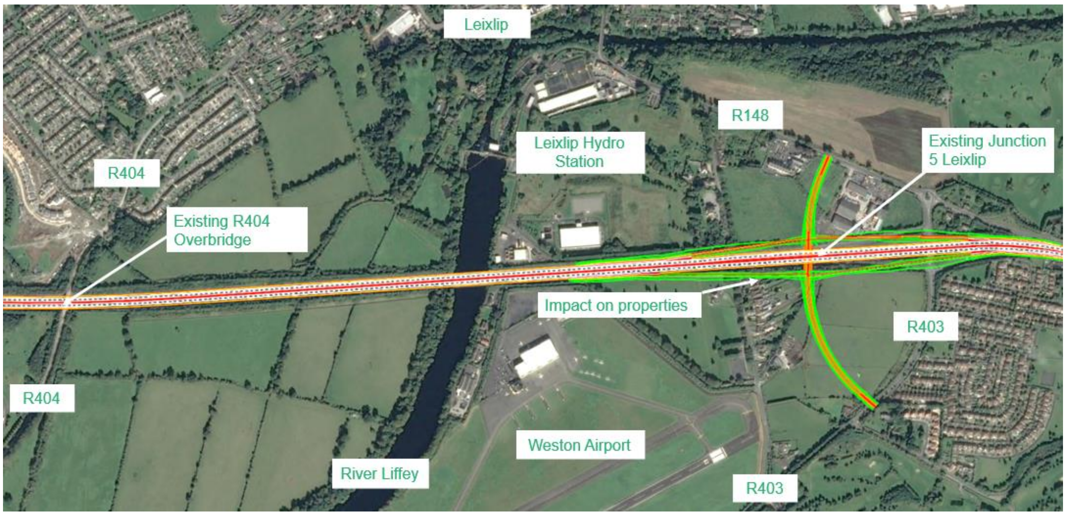


Figure 5.24: Junction 5 – Location B - New Junction between Liffey River Bridge and Existing Junction 5

Junction 5 Assessment Summary

The option of improving the existing junction is taken forward to Stage 2 Project Appraisal Matrix. Refer to Table 5.2.

Table 5.2: Junction 5 Summary

Option	Category Description	Sift 1 and 2 Referencing	Sift 3 Location Reference	Comments	Result
Option 1	Improve Existing Junction	Improve Existing	Improve Existing	Taken forward to Stage 2 PAM	Preferred
Option 2	Provide 1 New Junction and Convert Existing to an Overbridge	2.1	Option 2 Location A	Preferred over Option 2 Location B. Taken forward for assessment against Option 1	Discounted when compared against Option 1
		2.2	Option 2 Location B	Option 2 Location A preferred against Option 2 Location B	Discounted

Refer to Section 5.8.2.1 for further details.

5.2.4 Demand Management Options

5.2.4.1 Overview

11 demand management options were taken through to the Preliminary Options Assessment (Stage 1 Sift 3). Refer to Table 5.3.

Table 5.3: Demand Management Options Overview

Option Number	Description
1	Test Transit Oriented Development
2	Test the mix of Land Uses in close proximity to each other
3	Test alternative Demand Sensitivity Analysis
4	Congestion Charges, Road Pricing and Tolling
5	Reduced Speed Limits
6	Variable Speed Limits
7	Ramp Metering/ Junction Access Control Signals
8	Interchange Facilities Consideration
9	Integrated Ticketing and Fares Structures Consideration
10	Public Realm and Urban Design Consideration
11	Test existing orbital routes for potential redistribution from M4/N4 corridor

5.2.4.2 Test Transit Oriented Development

This option is aligned with national policy. It involves increased density around transit stops and has the potential to significantly increase patronage. Liaison with the relevant local authority planning departments regarding the Local Area Plans for Maynooth, Leixlip and Celbridge will be progressed to test this option.

Assessment Summary

This option will be a consideration on the preferred option in consultation with the relevant local authority planning departments.

5.2.4.3 Test the mix of Land Uses in close proximity to each other

This option is aligned with national policy. It is designed to minimize the distance between residential, commercial and employment zones, by providing mixed use developments. This would act to reduce the overall use of non-active travel modes. Liaison with the relevant local authority planning departments regarding the Local Area Plans for Maynooth, Leixlip and Celbridge will be progressed to test this option.

Assessment Summary

This option will be a consideration on the preferred option in consultation with the relevant local authority planning departments.

5.2.4.4 Test alternative Demand Sensitivity Analysis

This option is a sensitivity analysis in response to the Covid-19 pandemic and increased working from home practices, which is likely to continue into the future.

Assessment Summary

This option will be tested on the preferred option.

5.2.4.5 Congestion Charges, Road Pricing and Tolling

This option would align with current policy and would be an effective measure in changing trip making patterns. This may include amendment to the tolling strategy of the existing toll. In addition, this may include the introduction of congestion charges and/or tolls on more congested section(s) of the Greater Dublin Area road network to support trip reduction. Given the proximity of the existing M4 Eurolink Toll, located approximately 8km west at Killickaweeny, Co. Kildare, it is not deemed viable to introduce an additional toll on the M4 within the Maynooth to Leixlip Project study area.

Assessment Summary

The congestion charges, road pricing and tolling option will be a consideration on the preferred option.

5.2.4.6 Reduced Speed Limits

This option involves the reduction of speed limits along the M4/N4 corridor. Though feasible, consideration will be paid to the likely redistribution of trips and whether such a move would be desirable.

Assessment Summary

The reduced speed limits option will be a consideration on the preferred option.

5.2.4.7 Variable Speed Limits

Variable speed limits may be applied to enact restrictions at peak times, primarily in the AM and PM peak times. Though feasible, consideration will be paid to the likely redistribution of trips and whether such a move would be desirable.

Assessment Summary

The variable speed limits option will be a consideration on the preferred option.

5.2.4.8 Ramp Metering/Junction Access Control Signals

This option would provide benefits for strategic traffic and be used to manage congestion. It includes alterations and the introduction of signals aimed at penalising more local trips and improving journey times for strategic movements. This option would take cognisance of its wider impacts.

Assessment Summary

The ramp metering/junction access control signals option will be a consideration on the preferred option.

5.2.4.9 Interchange Facilities Considerations

This option may consider the introduction of mobility hubs for key public transport services in Maynooth, Leixlip and Celbridge. It has the potential to improve the attractiveness of public transport and the overall public transport offering. A hub is already proposed at Liffey Valley as part of BusConnects.

Assessment Summary

This option will be a consideration on the preferred option in consultation with the NTA and Kildare County Council planning departments.

5.2.4.10 Integrated Ticketing and Fares Structures Considerations

This option includes the consideration of the integration of ticketing and fares for public transport in vicinity of Maynooth, Leixlip and Celbridge and the wider Greater Dublin Area. This option falls under the remit of the NTA and forms part of the BusConnects proposals which is underway. The integrated ticketing programme of measures is aimed at improving public transport mode share.

Assessment Summary

Included in the Do-Minimum, therefore is no longer a demand management option.

5.2.4.11 Public Realm and Urban Design Considerations

This option would be part of a broader transportation strategy and as such this is not a standalone option. Consideration of improved Public Realm within the town centres of Maynooth, Leixlip and Celbridge may encourage people to make trips by active modes as opposed to private vehicles.

Assessment Summary

This option will be tested on the preferred option.

5.2.4.12 Test Existing Orbital Routes for Potential Redistribution from M4/N4 Corridor

This option includes testing existing orbital routes for potential redistribution of traffic from the M4/N4 corridor. It examines the potential redistribution of traffic to existing orbital routes if traffic was capable of travelling at the optimum design speed.

Assessment Summary

Preliminary testing has been carried out to determine the viability of this option, with results indicating that utilising existing orbital routes for potential redistribution of traffic from the M4/N4 corridor would not generate the required benefits to meet the objectives of this project.

5.2.4.13 Demand Management Options Assessment Summary

A summary of the demand management options is shown in Table 5.4.

Table 5.4: Demand Management Options Overview

Option Number	Description	Summary
1	Test Transit Oriented Development	Will be a consideration on the preferred option in consultation with the relevant local authority planning departments.
2	Test the mix of Land Uses in close proximity to each other	Will be a consideration on the preferred option in consultation with the relevant local authority planning departments.
3	Test Alternative Demand Sensitivity Analysis	Will be tested on the preferred option
4	Congestion Charges, Road Pricing and Tolling	Will be a consideration on the preferred option
5	Reduced Speed Limits	Will be a consideration on the preferred option
6	Variable Speed Limits	Will be a consideration on the preferred option
7	Ramp Metering/Junction Access Control Signals	Will be a consideration on the preferred option
8	Interchange Facilities Considerations	Will be a consideration on the preferred option in consultation with the NTA and relevant local authority planning departments.
9	Integrated Ticketing and Fares Structures Considerations	Included in the Do-Minimum, therefore is no longer a demand management option
10	Public Realm and Urban Design Considerations	Will be tested on the preferred option
11	Test existing orbital routes for potential redistribution from M4/N4 corridor	Discounted. Not taken forward.

As above, there are no demand management options taken forward to Stage 2 Project Appraisal Matrix. A number of the above options will be tested or a consideration on the preferred option. Refer to Chapter 7 Stage 3 Preferred Option and Project Appraisal Balance Sheet (PABS) for further details.

5.2.5 Park and Ride Considerations

5.2.5.1 Park and Ride Options Overview

Six park and ride options have been taken through to the Preliminary Options Assessment (Stage 1 Sift 3). These are as follows:

- Strategic Park and Ride options at the following locations:
  - Combined Rail and Bus-based Park and Ride at West Maynooth;
  - Rail-based Park and Ride at Collinstown;
  - Bus-based Park and Ride at Junction 6 Celbridge; and
  - Bus-based Park and Ride at Junction 5 Leixlip.
- Local Mobility Hubs; and
- Local Park and Ride.

5.2.5.2 Combined Rail and Bus based Park and Ride at West Maynooth

This option consists of a combined rail and bus-based park and ride at West Maynooth, in the vicinity of the Dart+ West depot. Refer to Figure 5.25.

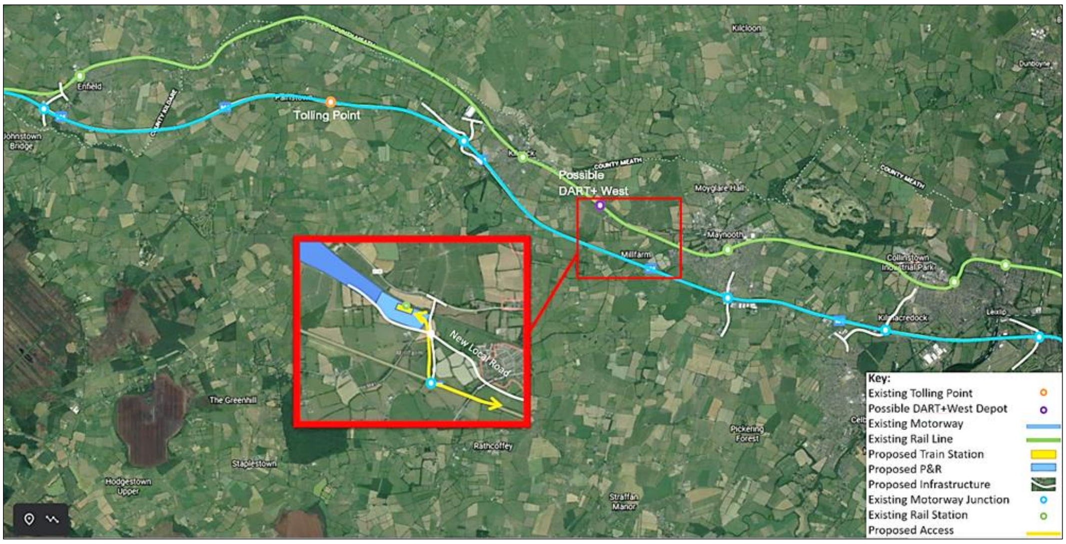


Figure 5.25: Combined Rail and Bus based Park and Ride at West Maynooth

5.2.5.3 Rail-based Park and Ride at Collinstown

This option consists of a rail-based park and ride at Collinstown, located north of Junction 6 Celbridge adjacent to the R449. It would also include a new station at this location. Refer to Figure 5.26.

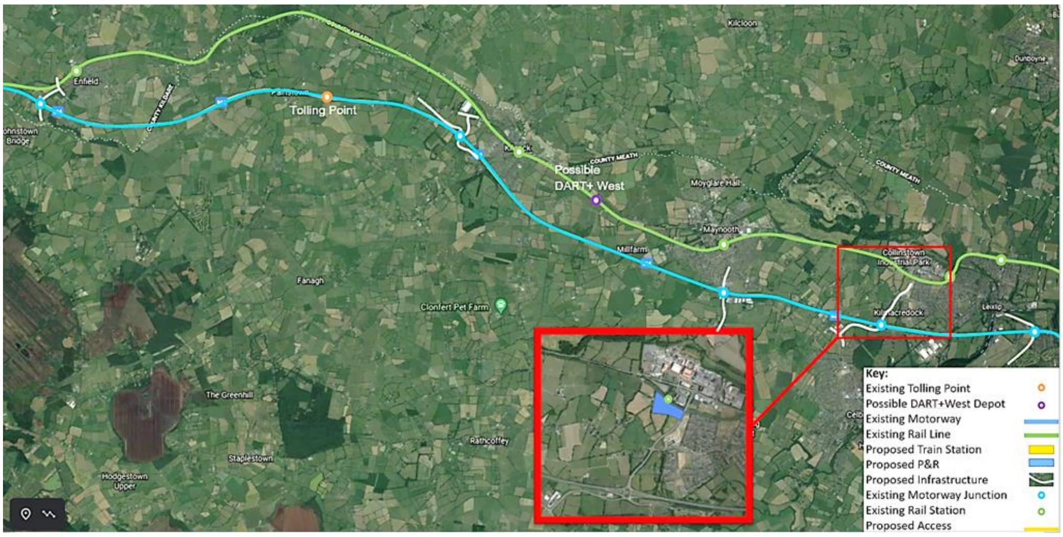


Figure 5.26: Rail-based Park and Ride at Collinstown

5.2.5.4 Bus-based Park and Ride at Junction 6 Celbridge

This option consists of a bus-based park and ride located immediately south of Junction 6 Celbridge, adjacent to the R449. Refer to Figure 5.27.

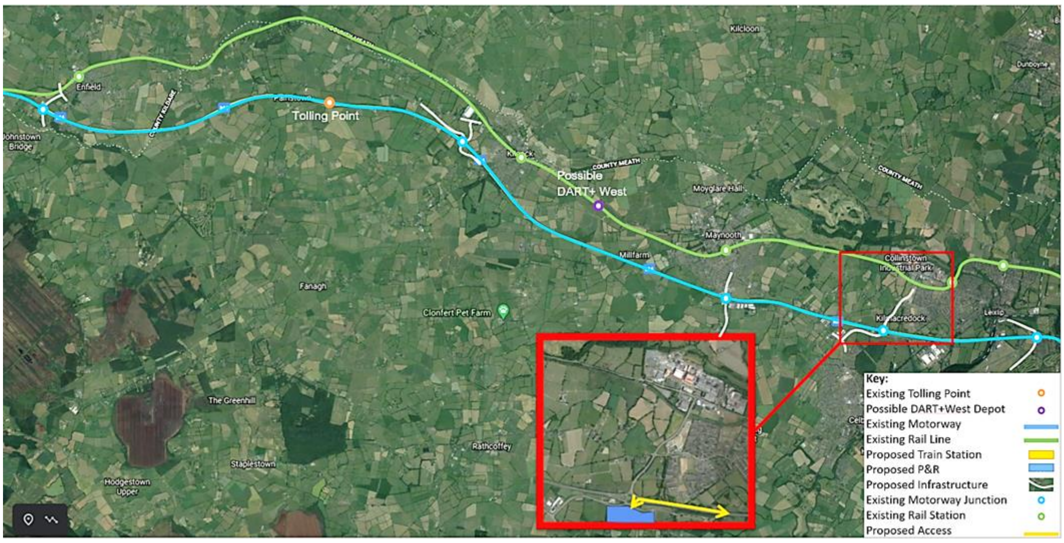


Figure 5.27: Bus-based Park and Ride at Junction 6 Celbridge

5.2.5.5 Bus-based Park and Ride at Junction 5 Leixlip

This option consists of a bus-based park and ride located immediately north of Junction 5 Leixlip, adjacent to the R148. Refer to Figure 5.28.

Figure 5.28: Bus-based Park and Ride at Junction 5 Leixlip

5.2.5.6 Local Mobility Hub

The function of local mobility hubs is to serve urban and suburban areas. They seek to expand the local catchment of public transport services by catering for access to stops/stations for a range of mobility options. They also provide the opportunity to interchange between the car and public transport modes as well as between sustainable transport modes.

5.2.5.7 Local Park and Ride

The function of local park and rides is to provide facilities at transport nodes such as railway stations and bus stations servicing smaller towns and villages on the regional public transport network.

5.2.5.8 Park and Ride Considerations Summary

The NTA Park and Ride Development Office are developing a strategy for the M4/N4 corridor which will be considered on the preferred option. Based on the NTA strategy and the Stage 1 assessments, the following four options will be considered on the preferred option in consultation with the National Transport Authority:

- Rail-based Park and Ride at Collinstown;
- Bus-based Park and Ride at Junction 6 Celbridge;
- Local Mobility Hubs; and
- Local Park and Rides.

5.2.6 Active Travel Options

5.2.6.1 Active Travel Options Overview

The following options have been taken through to Preliminary Options Assessment (Stage 1 Sift 3).

- Active travel enhancements would typically include a 2m wide footway and 2m wide cycleway (4m in total) on each side of overbridges. Thus the total proposed width for active travel, including both sides, at each location is 8m. Options are included at the following locations:
  - Junction 7 Maynooth on the R406;
  - R405 Overbridge;
  - Junction 6 Celbridge on the R449;
  - R404 Celbridge Road Overbridge; and
  - Junction 5 Leixlip.
- Support the provision for cycle parking and infrastructure at key public transport nodes and destinations consideration.

5.2.6.2 Enhancements at Junction 7 Maynooth

This option consists of active travel enhancements at Junction 7 Maynooth and is shown on Figure 5.29.

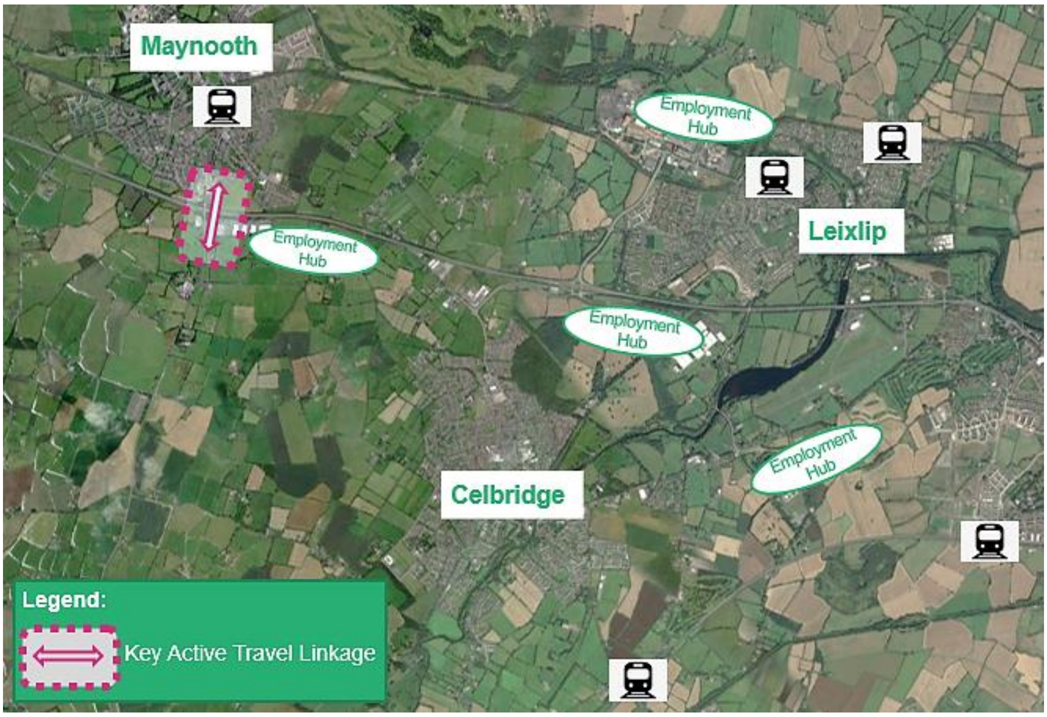


Figure 5.29: Active Travel Enhancement at Junction 7 Maynooth

5.2.6.3 Enhancements at R405 Ballygoran Overbridge

This option consists of active travel enhancements at the R405 Ballygoran Overbridge and is shown on Figure 5.30.

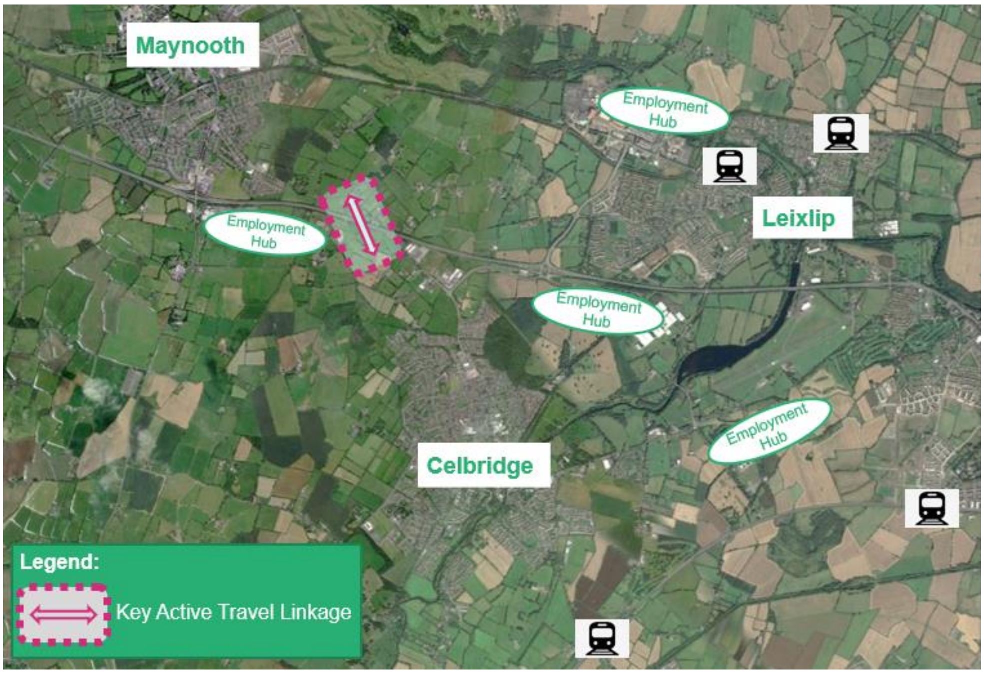


Figure 5.30: Active Travel Enhancement at the R405 Ballygoran Overbridge

5.2.6.4 Enhancements at Junction 6 Celbridge

This option consists of active travel enhancements at Junction 6 Celbridge and is shown on Figure 5.31.

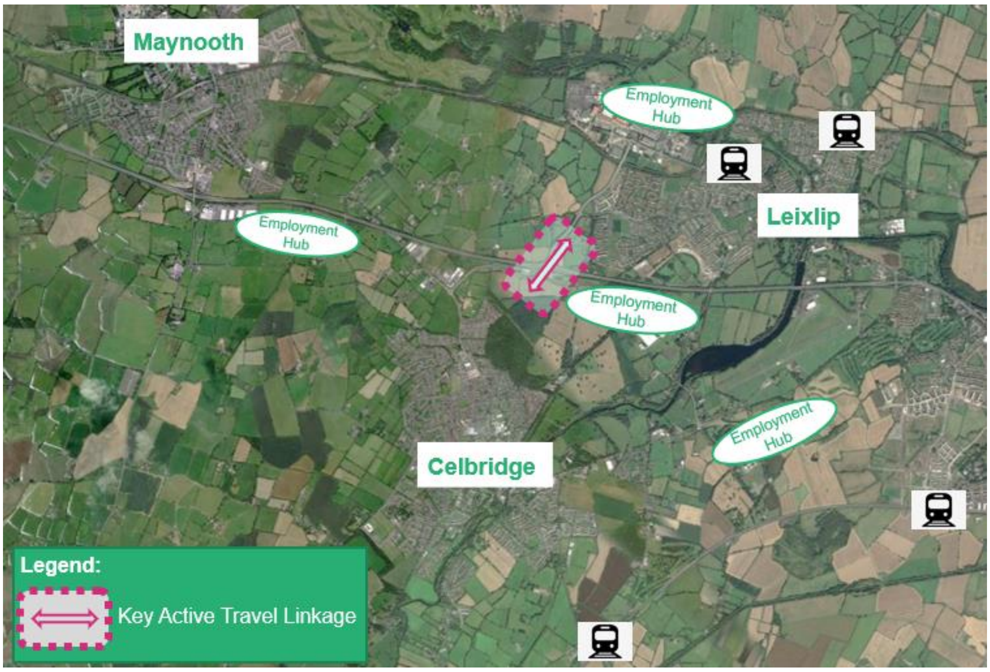


Figure 5.31: Active Travel Enhancement at Junction 6 Celbridge

5.2.6.5 Enhancements at R404 Celbridge Road Overbridge

This option consists of active travel enhancements at the R404 Celbridge Road Overbridge and is shown on Figure 5.32.

Figure 5.32: Active Travel Enhancement at the R404 Celbridge Road Overbridge

5.2.6.6 Enhancements at Junction 5 Leixlip

This option consists of active travel enhancements at Junction 5 Leixlip and is shown on Figure 5.33.

Figure 5.33: Active Travel Enhancement at Junction 5 Leixlip

5.2.6.7 Provision for Cycle Parking and Infrastructure Consideration

This option would consider supporting the provision for cycle parking and infrastructure at key public transport nodes and destinations in the vicinity of the study area.

The option would include the completion of cycle parking surveys at key locations, identifying utilisation, barriers to use and recommendations on improvements. At key public transport hubs, cycle parking surveys would also be completed, identifying utilisation, barriers to use and recommendations on improvements. Refer to Figure 5.34.

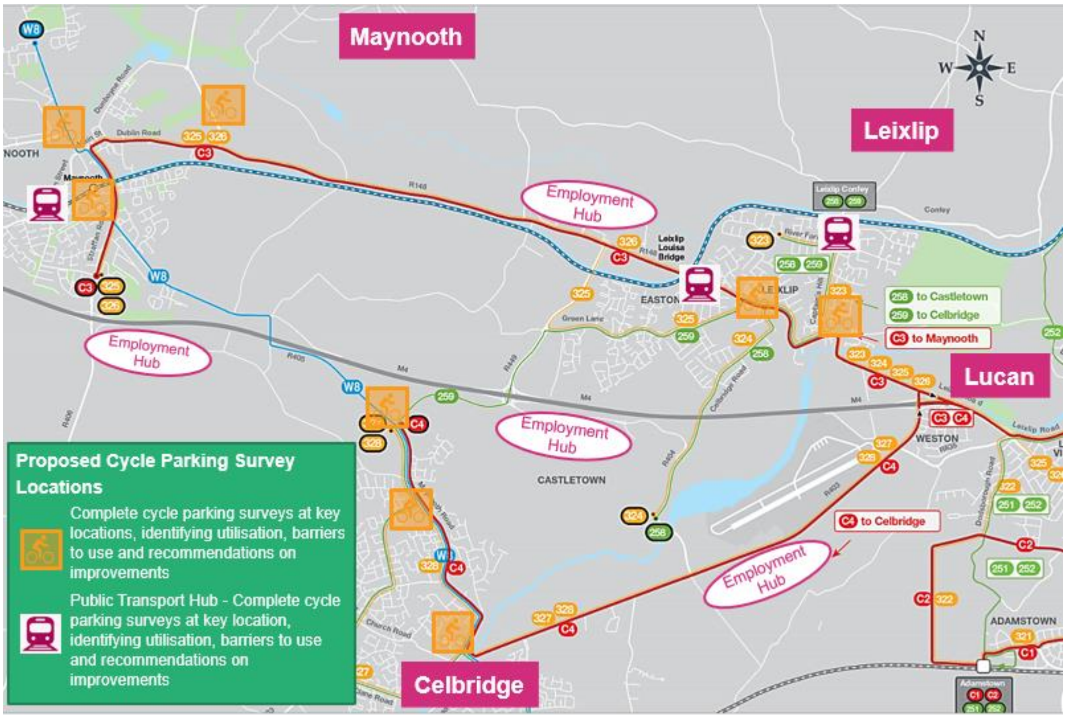


Figure 5.34: Provision for Cycle Parking and Infrastructure

5.2.6.8 Active Travel Options Assessment Summary

- Active travel options at each of the locations outlined above will be developed and assessed as part of the Stage 2 Project Appraisal Matrix.
- Provision for cycle parking and infrastructure will be a consideration on the preferred option.

5.2.7 Test Rail Options

5.2.7.1 Test Rail Options Overview

Two test rail options have been taken through to the Preliminary Options Assessment (Stage 1 Sift 3). These include:

- DART+ West Programme (Committed Project); and

- Test Regional Rail Improvements.

5.2.7.2 DART+ West Programme

The DART+ West Programme includes proposals for up to 12 trains per hour per direction during peak periods, doubling the existing frequencies. It also includes plans to remove several level crossings which will result in journey time savings. This is included in the Do-Minimum Transport Model and thus included in all options. Refer to Figure 5.35.

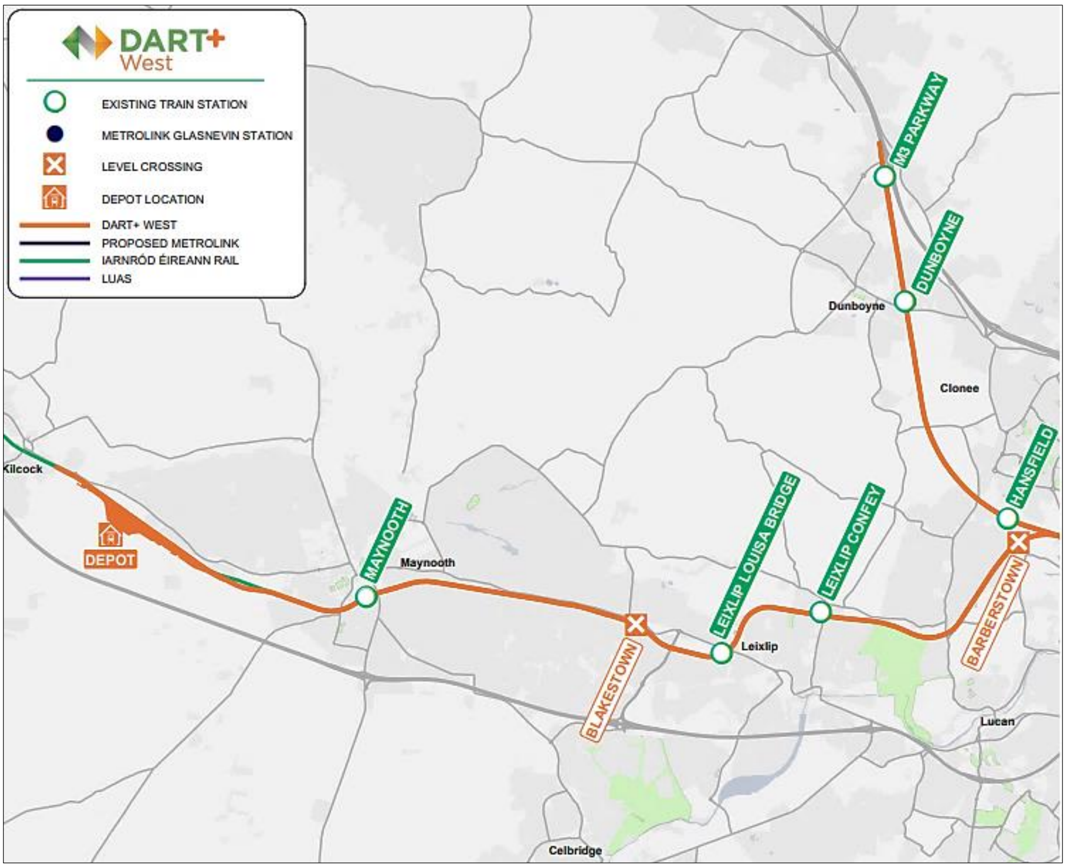


Figure 5.35: DART+ West Programme – Draft Proposal, subject to change

5.2.7.3 Test Regional Rail Improvements

Regional rail improvements include testing enhanced strategic rail services to the west of the study area. The rail improvements test would include:

- Frequency;
- Speed; and
- Reliability.

The above items would be enhanced and tested in an improved regional rail infrastructure and service. This represents a practicable regional rail improvement within the existing rail corridor constraints and would be in addition to the scope of the Dart + West Project.

The limitations of the improvement include that:

- Services would operate within the current rail corridor boundary, meaning using the existing track;
- Services would operate at a speed possible on the existing track; and
- Services would operate at a frequency that is practical based on the existing/proposed service on the rail line.

Preliminary testing has been carried out to determine the viability of this option, with results indicating that rail improvements would not generate the required benefits to meet the objectives of this project.

A Regional Rail Improvements Assessment Report was prepared by Systra and is included in Appendix 5.3.

5.2.7.4 Test Rail Options – Assessment Summary

- The DART+West will be considered on the preferred options in consultation with the National Transport Authority.
- The regional rail improvements option is discounted.

5.3 Stage 1 Preliminary Options Assessment Criteria

5.3.1 Ranking and Scoring

Using the Multi Criteria Analysis (MCA) from the Transport Infrastructure Ireland (TII) Project Appraisal Guidelines (PAG) for National Roads Unit 7.0 - Multi-Criteria Analysis, 2016 (hereafter referred to as the TII PAG)[1], a performance matrix for each option was compiled which includes both quantitative and qualitative assessments. Each option was scored against the seven-point scale below.

- 7 – Major or highly positive;
- 6 – Moderately positive;
- 5 – Minor or slightly positive;
- 4 – Not significant or neutral;
- 3 – Minor or slightly negative;
- 2 – Moderately negative; or
- 1 – Major or highly negative.

Using the scores and professional judgement, a determination was made as to whether each option assessed is *Preferred, Intermediate* or *Least Preferred.* However, in some cases the effects of multiple options were comparable, and an objective determination could not be made between options on balance. As such, there are instances where more than one option may be identified as preferred, intermediate or least preferred for a particular discipline.

The assessment may also judge that all options are intermediate on balance, given the magnitude and severity of effects.

5.3.2 Sub-criteria Determination

The following sources of information have been utilised to determine the most appropriate sub-criteria:

- TII PAG (PE – PAG-0231); and
- Project Objectives.

Using the sources of data above, the sub-criteria was developed using the following approach:

[1] Transport Infrastructure Ireland (TII) Project Appraisal Guidelines for National Roads Unit 7.0 - Multi-Criteria Analysis, 2016. Available from: https://www.tiipublications.ie/library/PE-PAG-02031-01.pdf

- **Context** – the assessments at Stage 1 are at a macro level. Therefore, a clear difference is required at a macro level. If it is established that it is not possible to determine a clear difference at a macro level, this is noted, and the option is assessed at Stage 2 Project Appraisal Matrix when further detail is available, and more detail assessments can be undertaken.
- **Balance of Heading** – the assessment aimed to provide a balance of headings for a standard transport project.
- **Duplication** – the assessment aimed to avoid duplication to prevent double counting/scoring.
- **Balance Scoring** – the assessment aimed to obtain a balance in scoring, for example balance construction impact, with operations and maintenance impacts.

5.3.3 Headline Criteria

For Stage 1, the headline criteria against which each of the options were assessed are:

- Economy;
- Engineering; and
- Environment.

These are discussed in the following sections.

5.4 Economic Evaluation

5.4.1 Cost

The economy assessment as part of the Stage 1 Preliminary Options Assessment includes the preparation of Option Comparison Estimates (OCEs) ranges in accordance with the requirements of the TII Cost Management Manual.

The total figures are an aggregate cost for each option under the following headings:

- Planning and Design;
- Land and Property;
- Archaeology;
- Advance Works and Other Contracts;
- Main Contract Construction;
- Main Contract Supervision (Employer's Costs); and
- Walking/Cycling/Asset Renewal.

Provisions for operation, maintenance and capital interventions required during the operational life of the project are excluded from the cost estimates.

The Stage 1 Option Comparison Estimates (OCEs) are included in Appendix 5.4**.**

5.4.2 Preliminary Economic Benefit

A high level preliminary qualitative economic benefit is also included in the assessment. This provides context to ensure that cost is not the sole criteria, as value for money is also a key consideration, in addition to the cost.

5.5 Engineering Evaluation

The Engineering assessment for corridors and junctions/overbridges is included in Sections 5.7 and 5.8, respectively.

The criteria which have been considered for this assessment are as follows:

- Traffic Assessments;
- Geometry and Safety;
- Integration and Consistency;
- Modes;
- Construction (Constraints); and
- Operation and Maintenance.

5.5.1 Traffic Assessment

5.5.1.1 Overview

Transport modelling on the Corridor, Junction 5 and Junction 7 options was undertaken using the NTA's Eastern Regional Model (ERM) in combination with the Maynooth to Leixlip Project Local Area Model (LAM) developed specifically for the project. This section provides an overview of the performance of each option tested. The option (impact measure) thresholds included the following:

- Actual Flow (% change);
- Volume over Capacity (v/c) Threshold Change;
- Volume over Capacity (% point change); and
- Total Vehicle Hours Delay (% change).

The model links resulting in a change under the following heading were reviewed for the AM and PM peaks, with the following indicators determined and assessed.

- Total number of unique links exhibiting a major, moderate or minor impact;
- Network Summary Statistics (whole model) versus Do-Minimum and Total Travel Distance (PCU - Kms);
- Actual Flow (PCU) Difference versus Do-Minimum; and
- Delay (secs) Difference versus Do-Minimum.

5.5.1.2 Junction 7 Maynooth

A number of key performance indicators (KPI) were determined for the Junction 7 options. These included the following:

- Corridor Flows and Junction Performance;
- Network Performance (Volume over Capacity Delays);

- Traffic flows and delays in Maynooth town;
- Traffic flows on the R406 Straffan Road; and
- HGV flows.

5.5.1.3 Other Items

Other items discussed in this sub-criteria include traffic, buses, HGV volumes and the proposed cross sections.

Refer to Appendix 5.5 for more details. Further details on the Stage 1 transport assessment is contained in the Transport Modelling Report which is included in Appendix 6.4C.

5.5.2 Geometry and Safety

Items discussed in this sub-criteria include horizontal alignment, vertical alignment, stopping sight distance, departures and safety of road users and vulnerable road users.

5.5.3 Integration and Consistency

Items discussed in this sub-criteria include integration of the transport network with the surrounding transport network and land use of the population centres within the study area.

5.5.4 Modes

Items discussed in this sub-criteria include how the proposed options provide the infrastructure to support an improved balance of transport modes within the study area and wider Greater Dublin Area.

5.5.5 Construction (including Constraints)

Items discussed in this sub-criteria include the impact on land use, constructability and impact on structures.

5.5.6 Operation and Maintenance

Items discussed in this sub-criteria include the operational efficiency of options, in particular at junction merges and diverges. Maintenance requirements and constraints are also considered.

5.6 Environmental Evaluation

In accordance with the TII PAG[1], the environmental disciplines under which the corridor and junction options and were assessed are as follows:

- Biodiversity;
- Soils and geology;
- Hydrogeology;
- Hydrology;
- Landscape and visual;
- Air Quality and climate;
- Noise and vibration;
- Population;
- Archaeology, architectural and cultural heritage;
- Material assets – agriculture; and
- Material assets – non-agricultural.

The Environmental assessment for corridor options is outlined in Section 5.7. Refer to Appendix 5.6A for more detailed assessments.

The Environmental assessment for junction options is included in Section 5.8. Refer to Appendix 5.6B for more detailed assessments.

5.7 Stage 1 POA Matrix (Economy, Engineering and Environmental) for Corridors

The Stage 1 Preliminary Options Assessment Matrix (Economy, Engineering and Environmental) for the three core corridor options is included in Table 5.5.

Table 5.5: Stage 1 Preliminary Options Matrix (Economy, Engineering and Environmental) for Corridor Options

Economy Criteria	Scoring	Corridor Option 1	Corridor Option 2	Corridor Option 3
Cost	Summary	€25 - €35 million	€40 - €50 million	€55 - €65 million
	Score/Impact Level	3	2	1
	Preference	Preferred	Intermediate	Least Preferred
Preliminary Economic Benefit	Summary	All corridor options provide hard shoulder bus priority measures in both the eastbound and westbound directions, which would provide economic benefits. These benefits would be realised with an increase in modal shift towards more sustainable transport modes, supporting reduced journey times for buses, more reliability for timetables and schedules, opportunities for schedule improvements, environmental benefits and associated economic benefits. More detailed assessments are included in the Stage 2 PAM.		
		This option provides bus priority measures only.	In addition to the bus priority measures associated with Corridor Option 1, this option provides a westbound journey time saving of circa 100 seconds in the PM peak and 16 seconds in the AM peak, giving a total journey time saving of 116 seconds.	In addition to the bus priority measures and westbound journey time savings associated with Corridor Option 2, this option also provides an eastbound journey time saving of circa 34 seconds in the AM peak and 10 seconds in the PM peak, giving a total additional journey time saving of 44 seconds over Corridor Option 2.
	Score/Impact Level	4	5	6
	Preference	Least Preferred	Intermediate	Preferred

Economy Criteria	**Scoring**	**Corridor Option 1**	**Corridor Option 2**	**Corridor Option 3**
Economy Summary		The three corridor options provide hard shoulder bus priority measures in both the eastbound and westbound directions, which would provide economic benefits. Corridor Option 2 and Corridor Option 3 would provide journey time savings which Corridor Option 1 would not provide. Corridor Option 3 would provide an additional eastbound journey time saving of 44 seconds, when compared to Corridor Option 2. However, this journey time savings would have an additional cost of circa €15 million. This is a significant cost for an additional eastbound journey time saving of 44 seconds. On balance, taking into account both cost and preliminary economic benefits, Corridor Option 2 is preferred.		
Economy Result		**Intermediate**	**Preferred**	**Intermediate**

Economy Criteria	Scoring	Corridor Option 1	Corridor Option 2	Corridor Option 3
Traffic Assessment – Including Cross Section	Summary	Traffic volumes expected are the same as per the Do-Minimum. There is no change in the % HGV's from the Do-Minimum. The proposed hard shoulder bus priority measures do not alter the AADT or % HGVs, comparatively with Corridor Option 2 and 3.	Traffic volumes between Junction 7 Maynooth and Junction 5 Leixlip are expected to be 1.2% higher than Corridor Option 1. This increase is due to the additional westbound traffic lane. There is no change in the % HGV's from the Do-Minimum. Currently, the westbound carriageway transitions from 3 lanes to 2 lanes at Junction 5 Leixlip, which effectively acts as a funnel at this location. The additional westbound traffic lane would improve the operational efficiency of the westbound carriageway by supporting the flushing of westbound traffic in both the AM and PM peaks.	Traffic volumes between Junction 7 Maynooth and Junction 5 Leixlip are expected to be 1.8% higher than Corridor Option 1. This increase is due to the additional westbound and eastbound traffic lane. There is no change in the % HGV's from the Do-Minimum. Currently, the westbound carriageway transitions from 3 lanes to 2 lanes at Junction 5 Leixlip, which effectively acts as a funnel at this location. The additional westbound traffic lane would improve the operational efficiency of the westbound carriageway by supporting the flushing of westbound traffic in both the AM and PM peaks. Currently, the eastbound carriageway transitions from 2 lanes to 3 lanes at Junction 5 Leixlip, via a lane gain. There is also the introduction of a bus facility at this location, which continues towards the M50.
	Qualitative Assessment	Not significant or neutral	Minor or slightly positive	Minor or slightly positive
	Score/Impact Level	4	5	5
	Preference	Least Preferred	Intermediate	Preferred

<table>
<tr><th>Economy Criteria</th><th>Scoring</th><th>Corridor Option 1</th><th>Corridor Option 2</th><th>Corridor Option 3</th></tr>
<tr><td rowspan="4">Geometry & Safety</td><td>Summary</td><td colspan="3">All corridor options perform similar at a macro level and therefore this sub-criterion is not a key differentiator. More departures may be required for particular corridors; however this is not taken into account for Stage 1. This sub-criteria will be examined in greater detail in Stage 2 PAM.</td></tr>
<tr><td>Qualitative Assessment</td><td>Minor or slightly positive</td><td>Minor or slightly positive</td><td>Minor or slightly positive</td></tr>
<tr><td>Score/Impact Level</td><td>5</td><td>5</td><td>5</td></tr>
<tr><td>Preference</td><td>Preferred</td><td>Preferred</td><td>Preferred</td></tr>
<tr><td rowspan="4">Integration & Consistency</td><td>Summary</td><td colspan="3">All corridor options perform similar at a macro level and therefore this sub-criterion is not a key differentiator. This sub-criteria will be examined in greater detail in Stage 2 PAM.</td></tr>
<tr><td>Qualitative Assessment</td><td>Not significant or neutral</td><td>Not significant or neutral</td><td>Not significant or neutral</td></tr>
<tr><td>Score/Impact Level</td><td>4</td><td>4</td><td>4</td></tr>
<tr><td>Preference</td><td>Preferred</td><td>Preferred</td><td>Preferred</td></tr>
<tr><td rowspan="4">Modes</td><td>Summary</td><td colspan="3">All corridor options provide bus priority measures in both the eastbound and westbound directions. Therefore, at macro level, this sub-criterion is not a key differentiator. This sub-criteria will be examined in greater detail in Stage 2 PAM.</td></tr>
<tr><td>Qualitative Assessment</td><td>Minor or slightly positive</td><td>Minor or slightly positive</td><td>Minor or slightly positive</td></tr>
<tr><td>Score/Impact Level</td><td>5</td><td>5</td><td>5</td></tr>
<tr><td>Preference</td><td>Preferred</td><td>Preferred</td><td>Preferred</td></tr>
<tr><td>Construction (including Constraints)</td><td>Summary</td><td>Corridor Option 1 would have an overall width of circa 29m. It would have the least impact on land use as widening would essentially be within the existing M4/N4 corridor, either into the existing central reserve or verges.</td><td>Corridor Option 2 would have an overall width of circa 30.5m. It would have a marginally increased impact on land use as widening would essentially be within the existing M4/N4 corridor, either into the existing central reserve or verges.</td><td>Corridor Option 3 would have an overall width of circa 34m. It would have the greatest impact on land use as there would be additional widening to accommodate the new westbound and eastbound traffic lanes.</td></tr>
</table>

<table>
<tr><th>Economy Criteria</th><th>Scoring</th><th>Corridor Option 1</th><th>Corridor Option 2</th><th>Corridor Option 3</th></tr>
<tr><td rowspan="4"></td><td></td><td>It would also have the least impact on existing overbridges. The River Liffey Bridge would essentially remain as it, with only minor amendments.</td><td>It would also have a marginally increased impact on existing overbridges. The River Liffey Bridge would require amendments to incorporate the new westbound traffic lane, or alternatively a new parallel bridge adjacent to the existing bridge. The existing bridge would also require amendments to accommodate the hard shoulder bus priority measures.</td><td>It would also have the greatest impact on existing overbridges. The River Liffey Bridge would require amendments to incorporate the new westbound and eastbound traffic lanes, or alternatively new parallel bridges adjacent to the existing bridge. The existing bridge would also require amendments to accommodate the hard shoulder bus priority measures.</td></tr>
<tr><td>Qualitative Assessment</td><td>Minor or slightly negative</td><td>Minor or slightly negative</td><td>Moderately negative</td></tr>
<tr><td>Score/Impact Level</td><td>3</td><td>3</td><td>2</td></tr>
<tr><td>Preference</td><td>Preferred</td><td>Intermediate</td><td>Least Preferred</td></tr>
<tr><td rowspan="3">Operation & Maintenance</td><td rowspan="2">Summary</td><td colspan="3">From an operations perspective, all three corridor options would aim to provide a transport solution that allows public transport to move more efficiently during peak times. The hard shoulder bus priority measures, junction merges and diverges would be designed using current TII Standards, with the bus priority measures being clearly delineated and understood by road users in a motorway environment.

The bus priority measures would use the hard shoulder and the hard shoulder would remain at all times and be accessible to vehicles which may become disabled or required to leave the mainline in an emergency. In addition, the proposed emergency refuge areas would aim to improve commuter comfort levels. The wider cross section would not impact significantly on maintenance programmes.</td></tr>
<tr><td></td><td>The ratio of traffic lanes to a hard shoulder is less advantageous than Option 1.</td><td>The ratio of traffic lanes to a hard shoulder is less advantageous than Option 1 and Option 2.</td></tr>
<tr><td>Qualitative Assessment</td><td>Minor or slightly positive</td><td>Minor or slightly positive</td><td>Minor or slightly positive</td></tr>
</table>

Economy Criteria	**Scoring**	**Corridor Option 1**	**Corridor Option 2**	**Corridor Option 3**
	Score/Impact Level	5	5	5
	Preference	Preferred	Intermediate	Least Preferred
Engineering Result		**Preferred**	**Intermediate**	**Least Preferred**
Biodiversity	Summary	11 minor or slightly negative impacts on ecological sites	12 minor or slightly negative impacts on ecological sites	13 minor or slightly negative impacts on ecological sites
	Qualitative Assessment	Minor or slightly negative	Minor or slightly negative	Minor or slightly negative
	Score/Impact Level	3	3	3
	Preference	Preferred	Intermediate	Least Preferred
Soils and Geology	Summary	Least impact as it follows the footprint of the existing M4/N4	Greater impact due to the addition of a westbound traffic lane	Greatest impact due to the addition of westbound and eastbound traffic lanes
	Qualitative Assessment	Minor or slightly negative	Minor or slightly negative	Minor or slightly negative
	Score/ Impact Level	3	3	3
	Preference	Preferred	Intermediate	Least Preferred
Hydrogeology	Summary	All corridor options perform similar at a macro level and therefore this sub-criterion is not a key differentiator.		
	Qualitative Assessment	Not significant or neutral	Not significant or neutral	Not significant or neutral
	Score/ Impact Level	4	4	4
	Preference	Preferred	Preferred	Preferred
Hydrology	Summary	All corridor options perform similar at a macro level and therefore this sub-criterion is not a key differentiator. Corridor Option 1 has the narrowest impermeable surface, Corridor Option 2 has a marginally wider impermeable surface and Corridor Option 3 has the widest impermeable surface.		

Economy Criteria	Scoring	Corridor Option 1	Corridor Option 2	Corridor Option 3
	Qualitative Assessment	Not significant or neutral	Not significant or neutral	Not significant or neutral
	Score/ Impact Level	4	4	4
	Preference	Preferred	Intermediate	Least Preferred
Landscape and Visual	Summary	Some loss of vegetation/hedgerows with resulting impacts on surrounding landscape and visual receptors	Marginally greater loss of vegetation/hedgerows with resulting impacts on surrounding landscape and visual receptors	Greatest loss of vegetation/hedgerows with resulting highest impacts on landscape and visual receptors
	Qualitative Assessment	Moderately negative	Moderately negative	Major or highly negative
	Score/ Impact Level	2	2	1
	Preference	Preferred	Intermediate	Least Preferred
Archaeological, Architectural and Cultural Heritage	Summary	No direct or indirect impacts are predicted upon the surrounding recorded archaeological, architectural or cultural heritage resource		
	Qualitative Assessment	Not significant or neutral	Not significant or neutral	Not significant or neutral
	Score / Impact Level	4	4	4
	Preference	Preferred	Preferred	Preferred
Air Quality	Summary	No additional traffic volumes expected. Least amount of construction works required.	Some additional traffic volumes expected. Increased amount of construction works required.	Highest traffic volumes expected. Substantial construction works required.
	Qualitative Assessment	Minor or slightly negative	Minor or slightly negative	Moderately negative

Economy Criteria	**Scoring**	**Corridor Option 1**	**Corridor Option 2**	**Corridor Option 3**
	Score/ Impact Level	3	3	2
	Preference	Preferred	Intermediate	Least Preferred
Climate	Summary	No additional traffic volumes expected. Least amount of construction works required.	Some additional traffic volumes expected. Increased amount of construction works required.	Highest traffic volumes expected. Substantial construction works required.
	Qualitative Assessment	Major or highly negative	Major or highly negative	Major or highly negative
	Score/ Impact Level	1	1	1
	Preference	Preferred	Intermediate	Least Preferred
Noise and Vibration	Summary	Corridor Option 1 is marginally preferred over the other two Corridor Options due to the lower number of noise sensitive receptors within 0 – 50m		
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4	4
	Preference	Preferred	Intermediate	Intermediate
Population	Summary	Potential journey amenity issues where a bus is required to leave the hard shoulder bus priority measure due to a vehicle located in the hard shoulder because of an emergency	Less potential journey amenity issues in the westbound direction as a result of the inclusion of a third lane in the westbound direction	Less potential journey amenity issues in both the eastbound and westbound directions as a result of the inclusion of a third lane in both the eastbound and westbound direction
	Qualitative Assessment	Not significant or neutral	Minor or slightly positive	Moderately positive
	Score/ Impact Level	4	5	6
	Preference	Least Preferred	Intermediate	Preferred

Economy Criteria	**Scoring**	**Corridor Option 1**	**Corridor Option 2**	**Corridor Option 3**
Material Assets – Agricultural	Summary	All corridor options perform similar at a macro level and therefore this sub-criterion is not a key differentiator. There is a marginal wider footprint for Corridor Option 3.		
	Qualitative Assessment	Not significant or neutral	Not significant or neutral	Not significant or neutral
	Score/ Impact Level	4	4	4
	Preference	Intermediate	Intermediate	Least Preferred
Material Assets – Non-Agricultural	Summary	All corridor options perform similar at a macro level and therefore this sub-criterion is not a key differentiator. Corridor Option 1 has the narrowest pavement width, Corridor Option 2 has a marginally wider pavement width and Corridor Option 3 has the widest pavement width.		
	Qualitative Assessment	Minor or slightly negative	Minor or slightly negative	Minor or slightly negative
	Score/ Impact Level	4	3	3
	Preference	Preferred	Intermediate	Least Preferred
Environment Result		**Preferred**	**Intermediate**	**Least Preferred**

Economy Criteria	Scoring	Corridor Option 1	Corridor Option 2	Corridor Option 3
Corridor Options - Overall Summary				
Criteria		**Corridor Option 1**	**Corridor Option 2**	**Corridor Option 3**
Economy		**Intermediate**	**Preferred**	**Intermediate**
Engineering		**Preferred**	**Intermediate**	**Least Preferred**
Environment		**Preferred**	**Intermediate**	**Least Preferred**
Policy Context		The hard shoulder bus priority measures in both the eastbound and westbound directions align with the National Investment Framework for Transport in Ireland, National Development Plan, National Planning Framework and the Transport Strategy for the Greater Dublin Area.	The additional third traffic lane in the westbound direction would not align as well as Option 1 with the National Investment Framework for Transport in Ireland, National Development Plan, National Planning Framework or the Transport Strategy for the Greater Dublin Area.	The additional third traffic lane in both the eastbound and westbound directions would not align well with the National Investment Framework for Transport in Ireland, National Development Plan, National Planning Framework or the Transport Strategy for the Greater Dublin Area.
		Preferred	**Intermediate**	**Least Preferred**

5.7.1 Stage 1 Preliminary Options Assessment - Corridor Options Summary

A summary of the Corridors Stage 1 Preliminary Options Assessment is shown in Table 5.6.

Table 5.6: Stage 1 Preliminary Options Assessment - Corridor Options Summary

Corridor Option	Summary
Corridor Option 1	Taken forward to Stage 2 Project Appraisal Matrix
Corridor Option 2	Taken forward to Stage 2 Project Appraisal Matrix
Corridor Option 3	Excluded, not taken forward

5.8 Stage 1 POA Matrix (Economy, Engineering and Environmental) Junctions

5.8.1 Junction 7 Maynooth

The Stage 1 Preliminary Options Assessment Matrix (Economy, Engineering and Environmental) for Junction 7 Maynooth is included in Table 5.7.

Table 5.7: Stage 1 Preliminary Locations Matrix (Economy, Engineering and Environmental) for Junction 7 Maynooth

Economy Criteria	Scoring	Location A	Location B	Location C	Location D	Location E	Location F
Cost	Summary	€20 – €30 million	€15 – €25 million	€15 – €25 million	€10 – €20 million	€10 – €15 million	€10 – €20 million
	Qualitative Assessment	Major or highly negative	Moderately negative	Moderately negative	Minor or slightly negative	Not significant or neutral	Minor or slightly negative
	Score/ Impact Level	1	2	2	3	4	3
	Preference	Least Preferred	Intermediate	Intermediate	Intermediate	Preferred	Intermediate

Economy Criteria	Scoring	Location A	Location B	Location C	Location D	Location E	Location F
Preliminary Economic Benefit	Summary	Locations A to F inclusive would provide a new grade separated junction and enhanced active travel facilities and would therefore provide economic benefits to Maynooth town and environs. Locations A, B and C would include connectivity to proposed population growth areas west of Maynooth town. Locations D, E and F would include connectivity to proposed population growth areas east of Maynooth town. Location A, given it is located furthest west, would introduce additional journey times to and from Dublin. Location E would reuse the existing R405 Ballygoran Overbridge. To the south, it would connect to Ballygoran View. To the north, it would connect to the R405 Ballygoran Road. Location E, given that it would utilise existing infrastructure, would potentially have a shorter construction programme and associated reduced impacts on local businesses. Location E would have minimal impact on land use in the surrounding area compared to the other locations. Location E is preferred.					
	Qualitative Assessment	Minor or slightly negative	Not significant or neutral	Not significant or neutral	Not significant or neutral	Minor or slightly positive	Not significant or neutral
	Score/ Impact Level	3	4	4	4	5	4
	Preference	Least Preferred	Intermediate	Intermediate	Intermediate	Preferred	Intermediate

<table>
<tr><th>Economy Criteria</th><th>Scoring</th><th>Location A</th><th>Location B</th><th>Location C</th><th>Location D</th><th>Location E</th><th>Location F</th></tr>
<tr><td colspan="2">Economy Summary</td><td colspan="6">The six Junction 7 locations would provide improved accessibility for users, reducing journey time, which would provide economic benefits.
Location A, given it is located furthest west, would introduce additional journey times to and from Dublin.
Location E, given that it would utilise existing infrastructure, would potentially have a shorter construction programme and associated reduced impacts on local businesses and residents.
Location E would have minimal impact on land use in the surrounding area compared to the other locations and is also the most financially economical location.
Location E is preferred.</td></tr>
<tr><td colspan="2">Economy Result</td><td>Least Preferred</td><td>Intermediate</td><td>Intermediate</td><td>Intermediate</td><td>Preferred</td><td>Intermediate</td></tr>
<tr><td rowspan="2">Traffic Assessment – including Cross Section</td><td rowspan="2">Summary</td><td colspan="6">Active travel facilities are included in all locations and would typically include a 2m wide footway and 2m wide cycleway (4m in total) on each side of overbridges and approach roads. Thus the total proposed width for active travel, including both sides, is 8m.
There is no discernible difference between the locations from a cross section perspective.</td></tr>
<tr><td colspan="2">Location A is located west of Millfarm, and Location B is located east of Millfarm. Both locations tie into the same local and regional roads, therefore, can be assessed together from a traffic assessment perspective.
These locations are beneficial to local links, when compared to some other locations. The total distance travelled; however this is less when compared to Locations D to F.</td><td>This location can be utilised as a one junction option or combined with Location A to form a two junction option.
The two junction option of A combined with C has the greatest increase in total distance travelled of all locations.</td><td colspan="3">Location D, E and F would be combined with Location A or B to have 2 new junctions with the existing junction being converted to an overbridge.
Both locations tie into the same local and regional roads, therefore, can be assessed together from a traffic assessment perspective.
These locations have the benefit of reduced total travel distance, compared to other locations. There would also be a marginal decrease in Maynooth town centre traffic.</td></tr>
</table>

Economy Criteria	Scoring	Location A	Location B	Location C	Location D	Location E	Location F
	Qualitative Assessment	Minor or slightly positive	Minor or slightly positive	Minor or slightly positive	Minor or slightly positive	Minor or slightly positive	Minor or slightly positive
	Score/Impact Level	5	5	5	5	5	5
	Preference	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate	Intermediate
Geometry & Safety	Summary	Active travel facilities would be incorporated at all locations to improve vulnerable road user safety.					
		Locations A and B do not require significant departures. However Location B would have marginally less geometric constraints and potential for departures and relaxations. Weaving lengths may require a relaxation, depending on the preferred two junction option.		Location C assessed as a one junction option does not require significant departures. As a two junction option, the weaving length between Location A and C would be 1.4km.	Locations D, E and F have more constrained environments than Locations A to C. However, Location E is the preferred location (when comparing D,E, F) as it is less constrained than Locations D and F and potentially requires less departures.		
	Qualitative Assessment	Not significant or neutral	Minor or slightly positive	Minor or slightly positive	Not significant or neutral	Minor or slightly positive	Not significant or neutral
	Score/Impact Level	4	5	5	4	5	4
	Preference	Intermediate	Preferred	Preferred	Least Preferred	Preferred	Least Preferred
Integration & Consistency	Summary	Location A would not fully align with the potential Western Orbital and connectivity with the R148 and R408 would be intricate.		Location C assessed as a one junction, or two junction option would be centrally located and would also have good	Locations D, E and F connect to the R405 Ballygoran Road to the north and the R405 Ballygoran Road/ Ballygoran View to the south.		

Economy Criteria	**Scoring**	**Location A**	**Location B**	**Location C**	**Location D**	**Location E**	**Location F**
		Location B would align with the potential Western Orbital and would have good potential connectivity with the R148 and R408.		alignment with the LAP and potential orbital infrastructure.			
	Qualitative Assessment	Minor or slightly negative	Minor or slightly positive	Minor or slightly positive	Not significant or neutral	Minor or slightly positive	Not significant or neutral
	Score/Impact Level	3	5	5	4	5	4
	Preference	Least Preferred	Preferred	Preferred	Least Preferred	Preferred	Least Preferred
Modes	Summary	All locations provide infrastructure to support an improved balance of transport modes. Active travel facilities are included in all locations and would include a 2m wide footway and 2m wide cycleway (4m in total) on each side of the overbridges and approach roads.					
	Qualitative Assessment	Moderately positive	Moderately positive	Moderately positive	Moderately positive	Moderately positive	Moderately positive
	Score/Impact Level	6	6	6	6	6	6
	Preference	Preferred	Preferred	Preferred	Preferred	Preferred	Preferred
Construction (Constraints)	Summary	Location A, B and C are located to the west of the existing Junction 7 in greenfield sites with the approach roads to the north and south located in areas where construction would not be significantly constrained.			Location D, E and F are located to the east of the existing Junction 7. These locations are constrained by the existing R405, Ballygoran View, Ballygoran Overbridge, M4 Interchange Business Campus and numerous properties. These locations are significantly constrained from a construction and constraints perspective, compared to Locations A, B and C.		
		Location A does not impact on Millfarm or Newtown Road Overbridges.		Does not impact on Millfarm or Newtown Road Overbridges. Impact	Significant impact/potential demolition of a dwelling house on	Minor impact on property on Ballygoran View, Crofton Motors and	Significant impact on a number of properties to the north of the M4 on

Economy Criteria	**Scoring**	**Location A**	**Location B**	**Location C**	**Location D**	**Location E**	**Location F**
		Location B impacts on both Millfarm and Newtown Road Overbridges Both locations are in flooding prone sites.		on one property, southeast of the proposed junction.	Ballygoran View. Also impact on existing R405 Ballygoran Overbridge.	KCC compound on the R405.	the R405. Also an impact on Crofton Motors.
	Qualitative Assessment	Minor or slightly positive	Minor or slightly negative	Not significant or neutral	Major or highly negative	Minor or slightly negative	Major or highly negative
	Score/Impact Level	5	3	4	1	3	1
	Preference	Intermediate	Intermediate	Preferred	Least Preferred	Intermediate	Least Preferred
Operation & Maintenance	Summary	Locations would not impact significantly on maintenance programmes.					
		From an operations perspective, Location A would have a greater weaving distance than Location B, if combined for a two junction option.		Location C assessed as a one junction option would need to cater for predicted traffic volumes taking cognisance of the predicted growth of Maynooth. Location C assessed as a two junction option (Locations A and C) would have a weaving distance of circa 1.4km.	From an operations perspective, Locations D, E and F are comparable, with only minor differentiators between them. Location F would have a greater weaving distance than Location D or E, if combined for a two junction option. However, it would have reduced weaving to the existing Junction 6 Celbridge.		
	Qualitative Assessment	Minor or slightly positive	Not significant or neutral	Minor or slightly positive	Not significant or neutral	Not significant or neutral	Not significant or neutral

Economy Criteria	**Scoring**	**Location A**	**Location B**	**Location C**	**Location D**	**Location E**	**Location F**
	Score/Impact Level	5	4	5	4	4	4
	Preference	Preferred	Intermediate	Preferred	Intermediate	Intermediate	Intermediate
Engineering Result		**Intermediate**	**Intermediate**	**Preferred**	**Least Preferred**	**Intermediate**	**Least Preferred**
Biodiversity	Summary	Location A has impacts on the Lyreen River and the Gradadder stream. Location B has impacts on the Lyreen river at two locations and 10 additional ecological sites of local importance		Impacts on the Taghadoe stream at four separate locations and three additional ecological sites of local importance	Locations D and F impact on four ecological sites and Location E impacts on five ecological sites of local importance. However, Location E is Preferred over D and F, as it reuses an existing structure.		
	Qualitative Assessment	Moderately negative	Moderately negative	Moderately negative	Minor or slightly negative	Minor or slightly negative	Minor or slightly negative
	Score/ Impact	2	2	2	3	3	3
	Preference	Least Preferred	Least Preferred	Least Preferred	Intermediate	Preferred	Intermediate
Soils and Geology	Summary	Both Locations A and B have large volumes of bulk cut and fill and therefore a significant impact on earthworks		No significant impact	Location D potentially impacts a historical quarry. Location E has only minor or slightly negative impacts. Location F has a large volume of bulk cut and fill and therefore a significant impact on earthworks.		
	Qualitative Assessment	Major or highly negative	Major or highly negative	Not significant or neutral	Major or highly negative	Minor or slightly negative	Major or highly negative
	Score/Impact	1	1	4	1	3	1
	Preference	Least Preferred	Least Preferred	Preferred	Least Preferred	Preferred	Least Preferred

<table>
<tr><th>Economy Criteria</th><th>Scoring</th><th>Location A</th><th>Location B</th><th>Location C</th><th>Location D</th><th>Location E</th><th>Location F</th></tr>
<tr><td rowspan="4">Hydrogeology</td><td>Summary</td><td colspan="2">No significant impact</td><td>No significant impact</td><td colspan="3">Locations D, E and F have minor impact due to cuttings</td></tr>
<tr><td>Qualitative Assessment</td><td>Not significant or neutral</td><td>Not significant or neutral</td><td>Not significant or neutral</td><td>Minor or slightly negative</td><td>Minor or slightly negative</td><td>Minor or slightly negative</td></tr>
<tr><td>Score/Impact</td><td>4</td><td>4</td><td>4</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>Preference</td><td>Preferred</td><td>Preferred</td><td>Preferred</td><td>Intermediate</td><td>Intermediate</td><td>Intermediate</td></tr>
<tr><td rowspan="4">Hydrology</td><td>Summary</td><td colspan="2">Location A crosses the Gradadder Stream, a tributary of the Lyreen River, and includes works in proximity to the Rye Water Valley / Carton SAC.
Location B crosses the Lyreen River, a tributary of the Rye Water Valley / Carton SAC.
Both Location A and B could significantly impact on a flood risk site of the Lyreen River."</td><td>Crosses the Meadowbrook (Taghadoe) Stream, a tributary of the Lyreen River. Location C could have a significant impact on a flood risk site of the Meadowbrook (Taghadoe) Stream.</td><td colspan="3">No stream crossing is involved and hence insignificant impact on surface water bodies.
It would not impact on Flood Risk in the Ballygoran area.</td></tr>
<tr><td>Qualitative Assessment</td><td>Major or highly negative</td><td>Major or highly negative</td><td>Moderately negative</td><td>Not significant or neutral</td><td>Not significant or neutral</td><td>Not significant or neutral</td></tr>
<tr><td>Score/Impact</td><td>1</td><td>1</td><td>2</td><td>4</td><td>4</td><td>4</td></tr>
<tr><td>Preference</td><td>Least Preferred</td><td>Least Preferred</td><td>Intermediate</td><td>Preferred</td><td>Preferred</td><td>Preferred</td></tr>
<tr><td>Landscape and Visual</td><td>Summary</td><td colspan="2">Location A – highly negative. Significant impacts on agricultural land and field boundaries. Significant direct impact on a single residential property. Visual impacts on the Royal Canal.</td><td>Highly negative.
Visual impacts on numerous residential receptors and open spaces to the southern edges of</td><td colspan="3">Location D - moderately negative. Relatively limited extents with significant impact on a single property and visual impacts on a limited number of residential properties.
Location E – moderately to highly negative. Significant visual impacts on residential receptors through removal of established</td></tr>
</table>

Economy Criteria	Scoring	Location A	Location B	Location C	Location D	Location E	Location F
		Location B - moderate to highly negative. Significant impacts on agricultural land, trees and hedgerows. Significant visual impacts on the Royal Canal, protected views, and a limited number of residential receptors.		Maynooth and a direct impact on a residential property.	roadside tree screening, and direct impact on a single residential property and a limited extent of agricultural property. Location F - moderate to highly negative. Significant impacts on numerous residential properties, and some non-residential properties		
	Qualitative Assessment	Major or highly negative	Moderately negative	Major or highly negative	Moderately negative	Moderately negative	Moderately negative
	Score/Impact	1	2	1	2	2	2
	Preference	Least Preferred	Intermediate	Least Preferred	Preferred	Intermediate	Intermediate
Archaeological, Architectural and Cultural Heritage	Summary	Locations A and B both have potential to impact on previously unrecorded archaeological remains		Potential to impact on previously unrecorded archaeological remains	Location D requires a small section of previously undisturbed greenfield. Location E requires only a very small section of previously undisturbed greenfield as the existing junction would be upgraded. Location F requires a small section of previously undisturbed greenfield		
	Qualitative Assessment	Moderately negative	Moderately negative	Moderately negative	Minor or slightly negative	Not significant or neutral	Minor or slightly negative
	Score/Impact	2	2	2	3	4	3
	Preference	Least Preferred	Least Preferred	Least Preferred	Intermediate	Preferred	Intermediate
Air Quality	Summary	Both Location A and Location B - Minor or Slightly Negative due to the traffic volumes in proximity to sensitive receptors. Increased traffic volumes from Do-Min scenario.		Decreased traffic volumes from the Do-Minimum. However, Minor or Slightly Negative due to increased	Both Location D and E - Minor or Slightly Negative due to the traffic volumes in proximity to sensitive receptors. Increased traffic volumes from Do-Min scenario.		

Economy Criteria	Scoring	Location A	Location B	Location C	Location D	Location E	Location F
				traffic volumes in proximity to sensitive receptors on the link roads. Location C is in proximity to the highest number of new and existing sensitive receptors.	Location F - Minor or Slightly Negative due to the traffic volumes in proximity to sensitive receptors. Increased traffic volumes from Do-Min scenario. This location has the second highest property counts within the 0 – 50m band and is in proximity to the second highest number of new and existing sensitive receptors.		
	Qualitative Assessment	Minor or slightly negative	Minor or slightly negative	Minor or slightly negative	Minor or slightly negative	Minor or slightly negative	Minor or slightly negative
	Score/Impact	3	3	3	3	3	3
	Preference	Preferred	Preferred	Least Preferred	Intermediate	Intermediate	Least Preferred
Climate	Summary	Location A and B are likely to result in the same levels and operational carbon and levels of required infrastructure.		Likely to see the most substantial reductions in operational carbon, although significant levels of embodied carbon are likely to be produced in this location, the significant reductions in operational carbon would outweigh the levels of embodied carbon in the long-term.	Location D - significant new infrastructure is required. Substantial level of embodied carbon, as a result of construction. Location E – likely to result in reductions in operational carbon from the Do-Minimum scenario and is likely to result in the lowest levels of embodied carbon as moderate new infrastructure is required, relative to all other locations. Location F - significant new infrastructure is required. Substantial level of embodied carbon, as a result of construction.		

Economy Criteria	Scoring	Location A	Location B	Location C	Location D	Location E	Location F
	Qualitative Assessment	Minor to slightly positive	Minor to slightly positive	Moderately positive	Minor to slightly positive	Moderately positive	Minor to slightly positive
	Score/Impact	5	5	6	5	6	5
	Preference	Intermediate	Intermediate	Preferred	Least Preferred	Preferred	Intermediate
Noise and Vibration	Summary	Moderate to minor impacts. Possible to mitigate.		Moderate to minor/negligible impacts. Possible to mitigate.	Location D - existing high road traffic noise levels – likely to be increased. Difficult to mitigate. Location E - existing high road traffic noise levels – may possibly increase. Less significant compared to Locations D and F. Location F - existing high road traffic noise levels – likely to be increased. Difficult to mitigate.		
	Qualitative Assessment	Moderately negative	Moderately negative	Moderately negative	Major or highly negative	Moderately negative	Major or highly negative
	Score/Impact	2	2	2	1	2	1
	Preference	Preferred	Preferred	Intermediate	Least Preferred	Intermediate	Least Preferred
Population	Summary	Positive impacts for local B&Bs or guest houses. Negative impact on businesses on R406 in event that existing junction is closed.		Possible impact on football club. Significant impacts on local residential estates	Both Locations D and E have an impact on schools. Location F has a significant impacts on Barrogstown.		
	Qualitative Assessment	Minor or slightly negative	Not significant or neutral	Minor or slightly negative	Moderately negative	Moderately negative	Major or highly negative
	Score/Impact	3	5	3	2	2	1
	Preference	Intermediate	Preferred	Intermediate	Intermediate	Intermediate	Least Preferred
Material Assets – Agricultural	Summary	Some severance by link roads		Some severance by link roads	Locations D and E have some negative landtake impacts.		

Economy Criteria	Scoring	Location A	Location B	Location C	Location D	Location E	Location F
					Location F includes some severance by link roads, including severance in a highly sensitive stud farm.		
	Qualitative Assessment	Minor or slightly negative	Minor or slightly negative	Minor or slightly negative	Not significant or neutral	Not significant or neutral	Minor or slightly negative
	Score/Impact	3	3	3	4	4	3
	Preference	Least Preferred	Least Preferred	Least Preferred	Preferred	Preferred	Least Preferred
Material Assets – Non-Agricultural	Summary	Some minor or slightly negative impacts on properties and utilities.		Not significant or neutral impacts on properties and utilities.	Impacts vary from not significant or neutral to moderately negative impacts on properties and utilities.		
	Qualitative Assessment	Minor or slightly negative	Not significant or neutral	Not significant or neutral	Minor or slightly negative	Not significant or neutral	Moderately negative
	Score/Impact	3	4	4	3	4	2
	Preference	Intermediate	Preferred	Preferred	Intermediate	Preferred	Least Preferred
Environment Result		**Least Preferred**	**Intermediate**	**Intermediate**	**Intermediate**	**Preferred**	**Least Preferred**
Junction 7 Maynooth - Overall Summary							
Criteria		**Location A**	**Location B**	**Location C**	**Location D**	**Location E**	**Location F**
Economy		**Least Preferred**	**Intermediate**	**Intermediate**	**Intermediate**	**Preferred**	**Intermediate**
Engineering		**Intermediate**	**Intermediate**	**Preferred**	**Least Preferred**	**Intermediate**	**Least Preferred**
Environment		**Least Preferred**	**Intermediate**	**Intermediate**	**Intermediate**	**Preferred**	**Least Preferred**

Policy is included in Table 5.9 which is the overall Junction 7 Maynooth options summary.

5.8.1.1 Junction 7 Maynooth Summary

The preferred option from each of the four categories is outlined in Table 5.8.

Table 5.8: Junction 7 Maynooth Summary (Preferred in each Category)

Category/ Option	Category Description	Sift 1 and 2 Referencing	Sift 3 Location Reference	Result	Comments
Category/ Option 1	Improve Existing Junction	Improve Existing	Improve Existing	Category/ Option 1 Preferred	Taken forward to Category 1 to 4 assessment.
Category/ Option 2	Provide 1 New Junction and Convert Existing to an Overbridge	4.1.1	C	Category/ Option 2 Preferred	Taken forward to Category 1 to 4 assessment.
Category/ Option 3	Improve Existing Junction and Provide a 2nd Junction	2.1.1	Improve Existing + A	Discounted	Location B preferred to Location A
		2.1.2	Improve Existing + B	Category/ Option 3 Preferred	Taken forward to Category 1 to 4 assessment.
Category/ Option 4	Provide 2 New Junctions and Convert Existing to an Overbridge	3.1.2	(A or B) + F	Discounted	Location E preferred to Location F
		3.2.2	(A or B) + E	Category/ Option 4 (B + E) Preferred	Taken forward to Category 1 to 4 assessment.
		3.3.1	(A or B) + D	Discounted	Location E preferred to Location D
		3.4.1	A + C	Discounted	Location B preferred to Location A

The preferred option in each category was then assessed against each other.

A graphic of each of the four options are shown in Figure 5.36 to Figure 5.39.

Figure 5.36: Option 1 – Improve Existing Junction (1 Junction Option)

Figure 5.37: Option 2 - Provide 1 New Junction and Convert Existing to an Overbridge (1 Junction Option)

Figure 5.38: Option 3 - Improve Existing Junction and Provide a 2nd Junction (2 Junction Option)

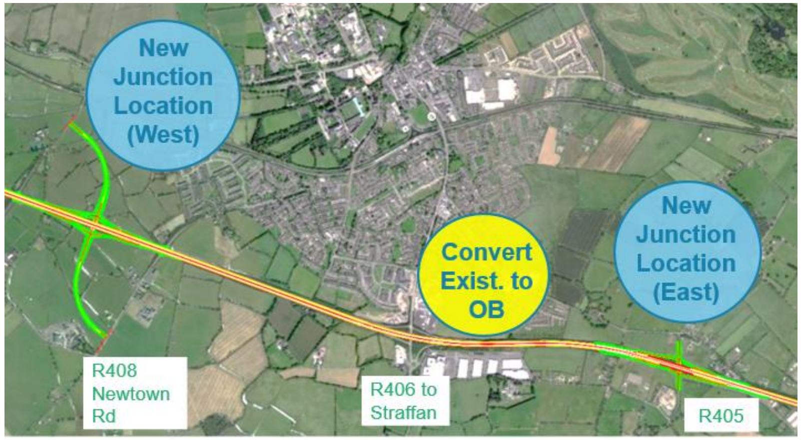


Figure 5.39: Option 4 - Provide 2 New Junctions and Convert Existing to an Overbridge (2 Junction Option)

An overall comparison of Options 1 to 4 is shown in Table 5.9.

Table 5.9: Junction 7 Maynooth – Overall Options Summary

Criteria	Option 1	Option 2	Option 3	Option 4
Economy				
Cost	Preferred	Intermediate	Intermediate	Least Preferred
Preliminary Economic Benefit	Preferred - based on connectivity to growth areas to the west and east of Maynooth town	Intermediate - based on connectivity to growth areas to the west and east of Maynooth town	Least Preferred - includes connectivity to growth areas to the west and east of Maynooth town	Least Preferred - includes connectivity to growth areas to the west and east of Maynooth town
Overall Qualitative Assessment	Minor or slightly negative	Moderately negative	Major or highly negative	Major or highly negative
Overall Score/Impact	3	2	1	1
Economy Result	**Preferred**	**Intermediate**	**Least Preferred**	**Least Preferred**
Engineering				
Traffic Assessment	Intermediate - does not induce more traffic, more hop-on hop-off type movements or associated weaving on strategic corridor - R406 Straffan Road may be congested	Preferred - does not induce more traffic, more hop-on hop-off type movements or associated weaving on strategic corridor - R406 Straffan Road converted to an overbridge would be advantageous	Least Preferred - May induce more traffic, more hop-on hop-off type movements and associated weaving on strategic corridor	Least Preferred - May induce more traffic, more hop-on hop-off type movements and associated weaving on strategic corridor

Criteria	Option 1	Option 2	Option 3	Option 4
Geometry & Safety	Intermediate -Improvements can be made to junction, however, may be difficult to address all geometry and safety issues - Is not as good as Option 2 in its potential to address existing conflict points at the existing junction between traffic and pedestrians/cyclists	Preferred -Possible to remove some of the existing safety issues and conflict points at the existing junction between traffic and pedestrians/cyclists	Least Preferred -May requires weaving departure for distance between Junction 7 and new junction -Weaving and associated movements may impact on safety	Least Preferred -Weaving between the 2 proposed junctions is 3.05km. However, may require weaving departure for distance between Junction 6 and new junction -Weaving and associated movements may impact on safety
Integration and Consistency	Preferred Based on connectivity to growth areas to the west and east of town, all options are equal.			
Modes	Intermediate - Option 2 is preferred over Option 1 from an active travel perspective (due to conflicts at existing junction)	Preferred - Option 2 is preferred over Option 1 from an active travel perspective (due to conflicts at existing junction)	Least Preferred -2 junctions would make car journeys more attractive to commuters	Intermediate -Converting existing to an overbridge is advantageous from an active travel perspective -However, 2 junctions would make car journeys more attractive to commuters
Construction	Preferred - Has the benefit of utilising the existing junction	Preferred – One junction, same as Option 1 and construction possibly more straight forward from a Temporary Traffic Management perspective and working in a greenfield site.	Intermediate -Required construction of a new junction and improvement of an existing junction	Least Preferred -Required construction of a new junction and converting and existing overbridge to a junction
Operation and Maintenance	Preferred Operating and maintaining one junction	Preferred Operating and maintaining one junction	Least Preferred Operating and maintaining two junctions	Least Preferred Operating and maintaining two junctions

Criteria	Option 1	Option 2	Option 3	Option 4
Overall Qualitative Assessment	Not significant or neutral	Not significant or neutral	Moderately negative	Moderately negative
Overall Score/Impact	4	4	2	2
Engineering Result	**Intermediate**	**Preferred**	**Least Preferred**	**Least Preferred**
Environment				
Environment Summary	Has the benefit of utilising the existing junction	- Required construction of a new junction and converting an existing junction to an overbridge	-Required construction of a new junction and improvement of an existing junction.	-Required construction of a new junction and converting and existing overbridge to a junction. This would have greater environmental impacts compared to Option 2 and 3
Overall Qualitative Assessment	Not significant or neutral	Moderately negative	Moderately negative	Major or highly negative
Overall Score/Impact	4	2	2	1
Environmental Result	**Preferred**	**Intermediate**	**Intermediate**	**Least Preferred**

The cost estimates have been carried out in the previous section and in Appendix 5.4, contained in Volume C of this report.

The environmental assessments have been carried out in the previous sections and are included in Appendix 5.6B, contained in Volume C Appendices of this Options Report. This is summarised in this table and as follows:

Criteria	**Option 1**	**Option 2**	**Option 3**	**Option 4**

- Option 1 is given a PAG score of 4 – Not significant or neutra1, as it is optimising and reusing the existing junction
- Options 2, 3 and 4 – the score is based on data from Table 5.7.

Overall Summary				
Economy	Preferred	Intermediate	Least Preferred	Least Preferred
Engineering	Intermediate	Preferred	Least Preferred	Least Preferred
Environment	Preferred	Intermediate	Intermediate	Least Preferred
Policy	Preferred This option aligns with the National Investment Framework for Transport in Ireland, National Development Plan, National Planning Framework and the Transport Strategy for the Greater Dublin Area.	Intermediate In accordance with the GDA Strategy, there is greater potential to investigate safety improvements such as the provision of a new junction, without increasing the number of junctions i.e. the existing junction would be converted to an overbridge.	Least Preferred This option would not align well with the National Investment Framework for Transport in Ireland, National Development Plan, National Planning Framework or the Transport Strategy for the Greater Dublin Area.	Least Preferred This option would not align well with the National Investment Framework for Transport in Ireland, National Development Plan, National Planning Framework or the Transport Strategy for the Greater Dublin Area.
Overall Result	**Take Forward to Stage 2 PAM**	**Take Forward to Stage 2 PAM**	**Discounted**	**Discounted**

5.8.2 Junction 5 Leixlip

The Stage 1 Preliminary Locations Assessment Matrix (Economy, Engineering and Environmental) for Junction 5 Leixlip is included in Table 5.10.

Table 5.10: Stage 1 Preliminary Locations Matrix (Economy, Engineering and Environmental) for Junction 5 Leixlip

Economy Criteria	Scoring	Location A	Location B
Cost	Summary	€10 - €20 million	€15 - €25 million
	Qualitative Assessment	Minor or slightly negative	Moderately negative
	Score/Impact Level	3	2
	Preference	Preferred	Least Preferred
Preliminary Economic Benefit	Summary	Locations A and B would provide enhanced active travel facilities and would therefore provide economic benefits. Location A, given that it would utilise existing infrastructure, would potentially have a shorter construction programme and associated reduced impacts on local businesses and other sensitive receptors. Location A would have minimal impact on land use in the surrounding area compared to Location B. Location A is preferred.	
	Qualitative Assessment	Moderately positive	Minor or slightly positive
	Score/Impact Level	6	5
	Preference	Preferred	Least Preferred
Economy Result		**Preferred**	**Least Preferred**

Economy Criteria	**Scoring**	**Location A**	**Location B**
Traffic Assessment – Including Cross Sections	Summary	Active travel facilities are included in both locations and would include a 2m wide footway and 2m wide cycleway (4m in total) on each side of proposed overbridges and approach roads. Thus the total proposed width for active travel, including both sides, is 8m. There is no discernible difference between the locations from a cross section perspective.	
		Location A is a new grade separated junction whereby the existing R404 Overbridge is reused, utilising existing infrastructure. This location would increase traffic volumes on the existing R404 and in Leixlip town centre.	Location B is a new grade separated junction located between the Liffey River Bridge and the existing Junction 5. This location would marginally decrease traffic volumes in Leixlip town centre.
	Qualitative Assessment	Minor or slightly negative	Minor or slightly positive
	Score/Impact Level	3	5
	Preference	Least Preferred	Preferred
Geometry & Safety	Summary	The proximity of the existing Junction 6 and Junction 4A are the key geometric constraints. The weaving length between the existing Junction 5 and Junction 4A is 235m. The weaving length between Location A and the existing Junction 4a is 2.3km. The weaving length between Location A and the existing Junction 6 is 690m. Active travel facilities are incorporated in this location to improve vulnerable road user safety.	The proximity of the existing Junction 6 and Junction 4A are the key geometric constraints. The weaving length between the existing Junction 5 and Junction 4A is 235m. The weaving length between Location B and the existing 4A is 440m. The weaving length between Location B and the existing Junction 6 is 2.5km. Active travel facilities are incorporated in this location to improve vulnerable road user safety.
	Qualitative Assessment	Minor or slightly positive	Minor or slightly positive
	Score/Impact Level	5	5
	Preference	Preferred	Least Preferred

Economy Criteria	Scoring	Location A	Location B
Integration & Consistency	Summary	Both locations perform similar at a macro level under integration and consistency, with only minor differentiators between the locations.	
		Location A utilises existing infrastructure and would have minimal impact on land use in the surrounding area.	Location B is a new junction and would therefore have a marginally higher impact on land use in the surrounding area, when compared to Location A, however it is not difference
	Qualitative Assessment	Not significant or neutral	Not significant or neutral
	Score/Impact Level	4	4
	Preference	Intermediate	Intermediate
Modes	Summary	Both locations provide infrastructure to support an improved balance of transport modes. Active travel facilities are included in both locations and would include a 2m wide footway and 2m wide cycleway (4m in total) on each side of the overbridges and approach roads. The existing Junction 5 overbridge would be converted to an overbridge, which would be a positive from an active travel perspective.	
	Qualitative Assessment	Minor or slightly positive	Minor or slightly positive
	Score/Impact Level	5	5
	Preference	Intermediate	Intermediate
Construction (Constraints)	Summary	Location A reusing the existing R404 Overbridge, therefore, there would be a significant impact on this structure during construction, with significant traffic management required to implement the works. There would be minimal impact on land use.	Location B is primarily a greenfield site with the approach road to the north and south located in areas whereby construction would be less constrained, compared to Location A. There would be a marginally higher impact on land use in the surrounding area, when compared to Location A.
	Qualitative Assessment	Minor or slightly negative	Minor or slightly negative
	Score/Impact Level	3	3
	Preference	Least Preferred	Preferred

Economy Criteria	Scoring	Location A	Location B
Operation & Maintenance	Summary	Location A and B would not impact significantly on maintenance programmes.	
		From an operations perspective, Location A would have a greater weaving distance to Junction 4A, compared to Location B. Given that there are significant traffic movements at this location between Junction 5 and 4A, an increase in weaving would improve the operational performance of this section of the road network. However, it is noted that this location would reduce the weaving length to Junction 6 from the current scenario.	From an operations perspective, Location B would have a reduced weaving distance to Junction 4A, compared to Location A. Given that there are significant traffic movements at this location between Junction 5 and 4A, this reduced weaving, when compared to Location A, would be a disadvantage. However, it is noted that this location would marginally increase the weaving length from the current scenario.
	Qualitative Assessment	Not significant or neutral	Not significant or neutral
	Score/Impact Level	4	4
	Preference	Preferred	Least Preferred
Engineering Result		**Intermediate**	**Intermediate**
Biodiversity	Summary	Impacts on 5 ecological sites of local importance. Reuses the existing structure and converts it to a junction.	Impacts on 4 ecological sites of local importance. Requires the construction of a new junction.
	Qualitative Assessment	Minor or slightly negative	Minor or slightly negative
	Score/Impact Level	3	3
	Preference	Preferred	Intermediate
Soils and Geology	Summary	Moderate impact on earthworks	Potential minor impact on the criteria of Soil Deposits and Contaminated Sites
	Qualitative Assessment	Moderately negative	Moderately negative
	Score/Impact Level	2	2
	Preference	Preferred	Least Preferred

Economy Criteria	**Scoring**	**Location A**	**Location B**
Hydrogeology	Summary	Fewer impacts than Location A	One agricultural spring, which resulted in a moderate impact
	Qualitative Assessment	Not significant or neutral	Minor or slightly negative
	Score/Impact Level	4	3
	Preference	Preferred	Intermediate
Hydrology	Summary	No stream crossing is involved and hence insignificant impact on surface water bodies. Uses existing junction. No visible flood risk.	No stream crossing is involved and hence insignificant impact on surface water bodies. Involves construction of a new junction and thus potential for greater impact than Location A. No visible flood risk.
	Qualitative Assessment	Not significant or neutral	Not significant or neutral
	Score/ Impact Level	4	4
	Preference	Preferred	Intermediate
Landscape and Visual	Summary	Significant impacts on the Wonderful Barn and Environs and on some nearby residential receptors	Significant localised impacts on high amenity designation. Significant direct impact on residential property and visual impacts on a number of residential receptors
	Qualitative Assessment	Moderately negative	Major or highly negative
	Score/Impact Level	2	1
	Preference	Preferred	Least Preferred
Archaeological, Architectural and Cultural Heritage	Summary	Requires the least amount of greenfield and as such has less chance of negatively impacting buried archaeological remains	Requires more greenfield and as such has more chance of negatively impacting buried archaeological remains
	Qualitative Assessment	Not significant or neutral	Minor or slightly negative
	Score/Impact Level	4	3

Economy Criteria	**Scoring**	**Location A**	**Location B**
	Preference	Preferred	Least Preferred
Air Quality	Summary	It is not in proximity to any new or existing sensitive receptors relative to Location B	It is in proximity to a higher number of sensitive receptors with higher traffic volumes relative to Location A
	Qualitative Assessment	Minor or slightly negative	Minor or slightly negative
	Score/Impact Level	3	3
	Preference	Preferred	Least Preferred
Climate	Summary	Moderate new infrastructure is required. Significant reductions in operational carbon predicted against the Do-Minimum scenario. Significantly less embodied carbon is likely to be produced from construction relative to Location B.	Significant new infrastructure is required. Significant reductions in operational carbon predicted against the Do-Minimum scenario. Construction periods are likely to result in a substantial level of embodied carbon as a result of construction materials used.
	Qualitative Assessment	Minor or slightly positive	Minor or slightly positive
	Score/Impact Level	5	5
	Preference	Preferred	Least Preferred
Noise and Vibration	Summary	Minor impacts at properties close to junction location with potential to mitigate	Moderate impacts at closest properties, minor impact at properties in further distance bands. It may be difficult to mitigate.
	Qualitative Assessment	Minor or slightly negative	Major or highly negative
	Score/Impact Level	3	1
	Preference	Preferred	Least Preferred
Population	Summary	Some positives with this location and also some impacts	Some positives with this location and also some impacts
	Qualitative Assessment	Not significant or neutral	Not significant or neutral
	Score/Impact Level	4	4

Economy Criteria	**Scoring**	**Location A**	**Location B**
	Preference	Preferred	Preferred
Material Assets – Agricultural	Summary	Some negative landtake impacts	Minor adverse due to severance by link roads. Severance in a highly sensitive enterprise.
	Qualitative Assessment	Not significant or neutral	Minor or slightly negative
	Score/Impact Level	4	3
	Preference	Preferred	Least Preferred
Material Assets – Non-Agricultural	Summary	No significant impact	Some potential minor impacts
	Qualitative Assessment	Not significant or neutral	Moderately negative
	Score/Impact Level	4	2
	Preference	Preferred	Least Preferred
Environment Result		**Preferred**	**Least Preferred**
Junction 5 Leixlip – Overall Summary			
Criteria		**Location A**	**Location B**
Economy		**Preferred**	**Least Preferred**
Engineering		**Intermediate**	**Intermediate**
Environment		**Preferred**	**Least Preferred**

Policy is included in Table 5.12 which is the overall Junction 5 Leixlip options summary.

5.8.2.1 Junction 5 Summary

A summary of the Junction 5 locations is shown in Table 5.11.

Table 5.11: Junction 5 Summary

Options	Option Description	Sift 1 and 2 Referencing	Sift 3 Location Reference	Result	Comments
Option 2	Provide a new junction and Convert the existing junction to an overbridge	2.1	A	Preferred	Preferred over Location B. Taken forward for assessment against Option 1
		2.2	B	Discounted	Location A preferred to Location B

An overall comparison of Option 1 (Improve the Existing Junction) against Option 2 (Location A - New Junction at the Existing R404 Overbridge and Convert the existing to an Overbridge) is shown in Table 5.12.

Table 5.12: Junction 5 Leixlip – Overall Options Summary

Criteria	**Option 1** – **Improve Existing Junction**	**Option 2 – Provide 1 New Junction at the Existing R404 Overbridge and Convert Existing to an Overbridge**
Economy		
Cost	Preferred – Option 1 has a lower cost relative to Option 2	Least Preferred - Construction of a new junction is higher cost relative to Option 1
Preliminary Economic Benefit	Preferred - Direct connectivity to Leixlip	Least Preferred - Circuitous connectivity to Leixlip
Overall Qualitative Assessment	Minor or slightly negative	Moderately negative
Overall Score/ Impact	3	2
Economy Result	**Preferred**	**Intermediate**
Engineering		
Traffic Assessment	Preferred - Does not induce traffic within Leixlip town centre	Least Preferred - Induces more traffic within Leixlip town centre, due to traffic from the east of the town, travelling through the town to access the new junction location
Geometry & Safety	Intermediate	Intermediate

Criteria	**Option 1 –** **Improve Existing Junction**	**Option 2 –** **Provide 1 New Junction at the Existing R404 Overbridge and Convert Existing to an Overbridge**
	- Current weaving issues between existing Junction 5 and Junction 4A	- Include improvements to current weaving issues between existing Junction 5 and Junction 4A. However, these are offset against potential weaving issues being introduced between the existing Junction 6 and proposed Junction 5.
Integration and Consistency	Preferred - Direct connectivity to Leixlip	Least Preferred - Circuitous connectivity to Leixlip
Modes	Least Preferred - Option 2 is preferred over Option 1 from an active travel perspective as the existing junction is being converted to an overbridge, with greater space for active travel	Preferred - Option 2 is preferred over Option 1 from an active travel perspective as the existing junction is being converted to an overbridge, with greater space for active travel
Construction	Preferred Reuse and improvement of an existing junction	Least Preferred Converting an existing overbridge to a junction
Operation and Maintenance	Preferred Option contains one junction and one overbridge	Preferred Option contains one junction and one overbridge
Overall Qualitative Assessment	Not significant or neutral	Minor or slightly negative
Overall Score/ Impact	4	3
Engineering Result	**Preferred**	**Least Preferred**

Criteria	Option 1 – Improve Existing Junction	Option 2 – Provide 1 New Junction at the Existing R404 Overbridge and Convert Existing to an Overbridge
Environment		
Environment Summary	Preferred Reuse and improvement of an existing junction	Least Preferred Converting an existing overbridge to a junction
Overall Qualitative Assessment	Not significant or neutral	Moderately negative
Overall Score/ Impact	4	2
Preference	**Preferred**	**Intermediate**

The cost estimate have been carried out in the previous section and in Appendix 5.4, contained in Volume C of this report.

The environmental assessments have been carried out in previous sections and are included in Appendix 5.6B, contained in Volume C Appendices of this Options Report. This is summarised in this table and as follows:

- Option 1 is given a PAG score of 4 – Not significant or neutra1, as it is optimising and reusing the existing junction
- Options 2 – the score is based on data from Table 5.10.

Overall Summary		
Economy	Preferred	Least Preferred
Engineering	Preferred	Least Preferred

Criteria	**Option 1** – **Improve Existing Junction**	**Option 2 – Provide 1 New Junction at the Existing R404 Overbridge and Convert Existing to an Overbridge**
Environment	Preferred	Least Preferred
Policy	Preferred This option aligns with the National Investment Framework for Transport in Ireland, National Development Plan, National Planning Framework and the Transport Strategy for the Greater Dublin Area.	Intermediate In accordance with the GDA Strategy, there is potential to investigate safety improvements such as the provision of a new junction, without increasing the number of junctions i.e. existing junction become overbridge.
Overall Result	**Taken Forward to Stage 2 PAM**	**Discounted**

A summary of the Junction 5 Leixlip options is as follows:

Table 5.13: Junction 5 Leixlip – Overall Options Summary

Options	Option Description	Sift 1 and 2 Referencing	Sift 3 Location Reference	Result	Comments
Option 1	Improve Existing Junction	Improve Existing	Improve Existing	Preferred	Taken forward to Stage 2 PAM
Option 2	Provide 1 New Junction and Convert Existing to an Overbridge	2.1	A	Discounted	Option 1 preferred

5.9 Overall Summary

This Stage 1 Preliminary Options Assessment is the third sift in Stage 1, with the previous two sifts outlined in Chapter 3. The Stage 1 Preliminary Options Assessment Matrix (Economy, Engineering and Environmental) assessed three corridor options. Corridor Option 1 and Corridor Option 2 were taken forward to Stage 2 Project Appraisal Matrix.

The Stage 1 Preliminary Options Assessment Matrix (Economy, Engineering and Environmental) also assessed six junction configurations and four options for Junction 7 Maynooth. Option 1 and Option 2 were taken forward to Stage 2 Project Appraisal Matrix.

The Stage 1 Preliminary Options Assessment Matrix (Economy, Engineering and Environmental) assessed two options for Junction 5 Leixlip. Option 1 was taken forward to Stage 2 Project Appraisal Matrix.

Active travel options at a number of different locations have been developed and are assessed as part of Stage 2 Project Appraisal Matrix. Table 5.14 provides an overall summary in a tabulated manner.

Table 5.14: Overall Summary of Options taken forward to Stage 2 Project Appraisal Matrix

Description	Option taken to Stage 2 PAM	Option Description
Corridor	Option 1	Corridor Option 1 consists of proposed bus priority measures within the hard shoulder in both the eastbound and westbound directions. The typical width of this option is circa 29m
	Option 2	Corridor Option 2 consists of proposed bus priority measures within the hard shoulder in both the eastbound and westbound directions. However, it differs in that it includes an additional third traffic lane in the westbound direction, therefore it has wider extents. The typical width of this option is circa 30.5m.
Junction 7	Option 1	Option 1 consists of improving the existing junction (1 junction option)
	Option 2	Option 2 consists of providing 1 new junction and converting the existing junction to an overbridge (1 junction option)
Junction 6	N/A	The existing junction would be improved and optimised, primarily for vulnerable road users. Refer to Sift 1 and 2 which are included in Chapter 3 of this report.
Junction 5	Option 1	Option 1 consists of improving the existing junction
Active Travel	N/A	Active travel options at a number of different locations have been developed and are assessed as part of the Stage 2 Project Appraisal Matrix

6 Stage 2 Project Appraisal Matrix

6.1 Introduction

The Stage 2 Project Appraisal Matrix (PAM) has been undertaken in accordance with the TII Project Manager's Manual for Major National Roads Projects (PE-PMG-02042) and the TII Project Appraisal Guidelines (PAG) Unit 7.0 Multi-Criteria Analysis (PE-PAG-02031), with additional guidance sourced from other TII PAG units as required.

The Stage 2 PAM is typically the longest and most detailed stage within the overall appraisal process, drawing upon a substantial body of environmental constraints gathering work and analysis, transport modelling and economic assessment. The focus of the Stage 2 PAM is on estimating the likely performance and impact of interventions against the six Common Appraisal Framework (CAF) criteria headings. Under each of these headings, TII PAG outlines further sub-criteria under which options should be assessed, namely:

- Economy;
    - Transport Efficiency and Effectiveness;
    - Wider Economic Impacts; and
    - Funding Impacts.
- Safety;
    - Collision Reduction;
    - Security; and
    - Engineering Geometry.
- Environment;
    - Biodiversity;
    - Soils and Geology;
    - Hydrogeology;
    - Hydrology;
    - Landscape and Visual;
    - Air Quality and Climate;
    - Noise and Vibration;
    - Population;
    - Archaeology, Architectural and Cultural Heritage;
    - Material Assets – Agriculture;
    - Material Assets – Non-agricultural; and
    - Waste.

- Accessibility and Social Inclusion;
  - Deprived Geographical Areas; and
  - Vulnerable Groups.
- Integration;
  - Transport Integration;
  - Land use Integration;
  - Geographical Integration; and
  - Other Government Policy Integration.
- Physical Activity.

In conjunction with assessments against the TII PAG criteria, the compatibility of options against the agreed project objectives, as presented in Chapter 1, remains foremost in the overall appraisal process.

6.2 Development of and Description of Stage 2 PAM Options

6.2.1 Overview

A brief summary of the Corridor, Junction and Active Travel options taken forward to Stage 2 Project Appraisal Matrix (PAM) is presented in the tables below. Graphics of all the options are included in Appendix 6.1.

Table 6.1: Stage 2 PAM Corridor Options

Corridor Option	Option Description
Corridor Option 1	Bus priority measures within the hard shoulder in both the eastbound and westbound directions
Corridor Option 2	Bus priority measures within the hard shoulder in both the eastbound and westbound directions and an additional traffic lane in the westbound direction.

Table 6.2: Stage 2 PAM Junction Options

Junction	Option Description
Junction 7 Maynooth	Option 1 – Maintain and Optimise/Improve the Existing Junction
	Option 2 - New Junction and Convert the existing Junction to an Overbridge
Junction 6 Celbridge	Optimise/Improve the Existing Junction
Junction 5 Leixlip	Optimise/Improve the Existing Junction

Table 6.3: Stage 2 PAM Active Travel Options

Location	Option Description
R408 Newtown Road Overbridge	East Option vs West Option
Junction 7 Maynooth	East Option vs West Option
R405 Ballygoran Overbridge	East Option vs West Option
Junction 6 Celbridge	East Option vs West Option
R404 Celbridge Road Overbridge	East Option vs West Option
Junction 5 Leixlip	East Option vs West Option

6.2.2 Corridors

A summary of the corridor options Stage 1 Preliminary Options Assessment outcome is as follows:

- Corridor Option 1: Taken forward into Stage 2 Multi-Criteria Analysis; and
- Corridor Option 2: Taken forward into Stage 2 Multi-Criteria Analysis.

6.2.2.1 Corridor Option 1

Corridor Option 1 consists of proposed hard shoulder bus priority measures within the hard shoulder in both the eastbound and westbound directions. The typical width of this option is circa 29m. Refer to Figure 6.1 and Figure 6.2. Drawings are also included in Volume B Figures.

Figure 6.1: Corridor Option 1 – Plan

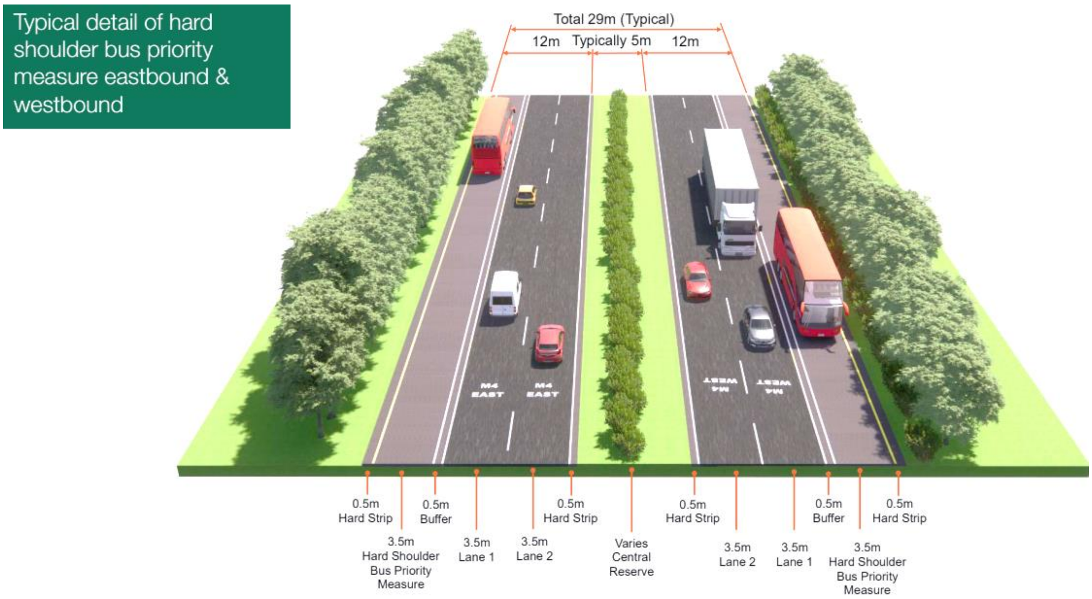


Figure 6.2: Corridor Option 1 – Cross Section

6.2.2.2 Corridor Option 2

Similar to Corridor Option 1, Corridor Option 2 consists of proposed hard shoulder bus priority measures within the hard shoulder in both the eastbound and westbound directions. However, it differs in that it includes an additional third traffic lane in the westbound direction, therefore it has wider extents. The typical width of this option is circa 30.5m. Refer to Figure 6.3 and Figure 6.4. Drawings are also included in Volume B Figures.

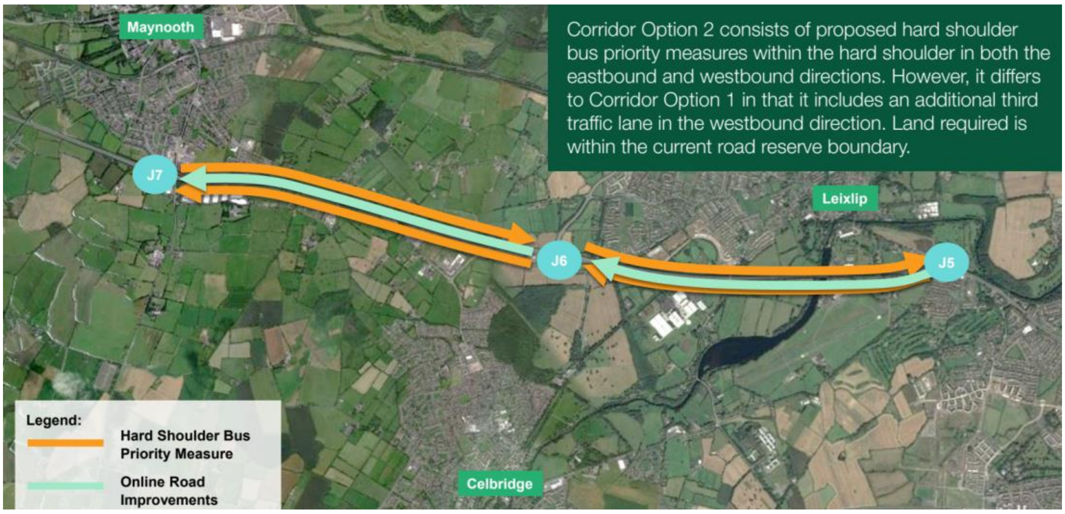


Figure 6.3: Corridor Option 2 – Plan

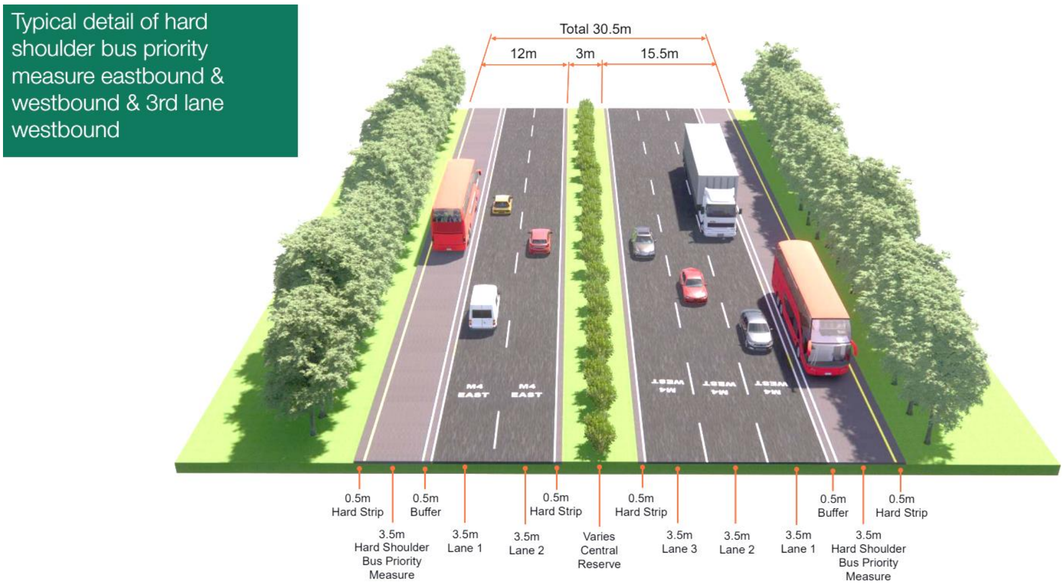


Figure 6.4: Corridor Option 2 – Cross Section

6.2.2.3 Hard Shoulder Bus Priority Measures

Design Standards and Criteria

The hard shoulder bus priority measures are designed in accordance with *Hard Shoulder Bus Priority Measures on Motorways and Type 1 Dual Carriageways* (*DN-GEO-03087*) and other applicable standards and guidance as required.

Alignment and Cross Section

It is proposed that the hard shoulder on the nearside of the M4/N4 in both the eastbound and westbound directions would accommodate the bus priority measures, delivering a practicable sustainable transport solution. The existing M4/N4 horizontal and vertical geometry would be largely retained, with widening occurring as an extension of the existing crossfall. In addition, the existing access and route provision would also be retained.

Widening

Widening required to accommodate the corridor options is generally provided as follows:

- Widening into the central reserve where possible, with the design to match the existing nearside pavement edge. This is due to the generally wide existing median of circa 7m, and constrained corridor on the nearside of the existing M4/N4. It also has the potential to minimise the extent of works at junctions/accesses.
- Central reserve widening may not always be achievable as there may be instances whereby widening beyond the nearside pavement edge is required due to visibility requirements or other localised constraints.

- Widening on both sides of the existing carriageway. This generally occurs at junction merges and diverges or areas where widening is transitioning to/from being on the central reserve side to/from the nearside.

Structures

For Corridor Option 1, it is envisaged that existing overbridges and the River Liffey Bridge would not be significantly impacted. For Corridor Option 2, it is envisaged that the River Liffey Bridge would need to be widened or a separate bridge constructed adjacent to the existing bridge to accommodate the additional westbound traffic lane. Gantries and cantilevers signage may be impacted and be required to be relocated.

Emergency Refuge Areas

Emergency refuge areas would be provided at an a spacing of circa 500m, depending on site constraints for both Corridor Option 1 and Corridor Option 2. There would be a total of 16 emergency refuge areas in both of the corridor options, eight in the eastbound and eight in the westbound direction.

The purpose of these emergency refuge areas would be to provide an additional safe refuge for vehicles which may become disabled or required to leave the mainline in an emergency. The hard shoulder would remain accessible for all vehicles which may become disabled or required to leave the mainline in an emergency.

6.2.3 Junctions

6.2.3.1 Junction 7 Maynooth

Option 1 – Maintain and Optimise/Improve Existing Junction

Option 1 would consist of maintaining and optimising/improving the existing junction, together with the provision of the Maynooth Outer Orbital Route (MOOR). In order to provide an optimised junction arrangement at the intersection of the MOOR with Straffan Road, the eastbound diverge slip road has to be shifted west slightly along the M4 mainline. Two scenarios have been developed for the intersection of the eastbound diverge slip road with the MOOR – a roundabout and a signalised T-Junction. Both junction schematics can be seen in Figure 6.5 and Figure 6.6.

The westbound diverge is proposed to be realigned as part of Option 1. The current configuration is a combination of a diamond junction and a roundabout that provides access to the Maynooth Business Campus. Option 1 would include a signalised diamond junction by realigning the westbound diverge. This would provide a more consistent junction configuration.

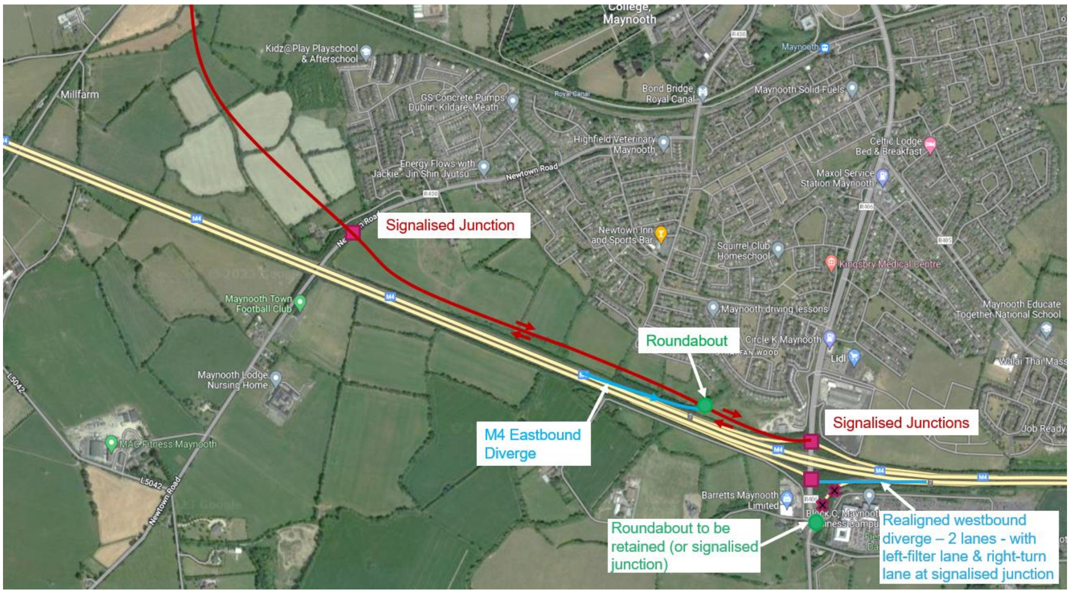


Figure 6.5: Option 1 – Roundabout Schematic (© Google Imagery ©2024 DigitalGlobe)

The T-Junction Option at the intersection with the MOOR is preferred over the roundabout option. It would provide a more efficient movement of traffic by incorporating traffic signals, and the geometric design of the signalised T-junction is more advantageous than the roundabout option.

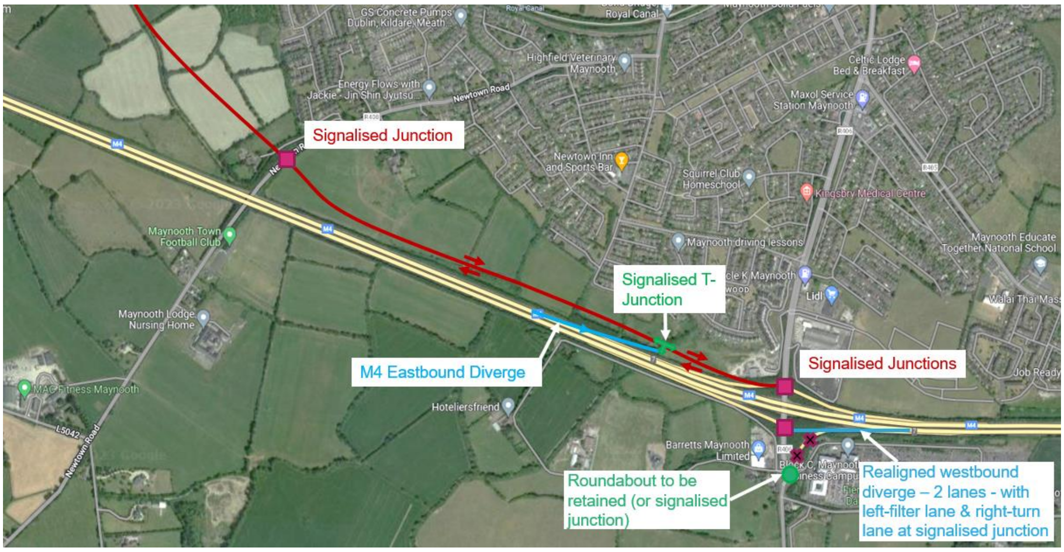


Figure 6.6: Option 1 - T-Junction Schematic (© Google Imagery ©2024 DigitalGlobe)

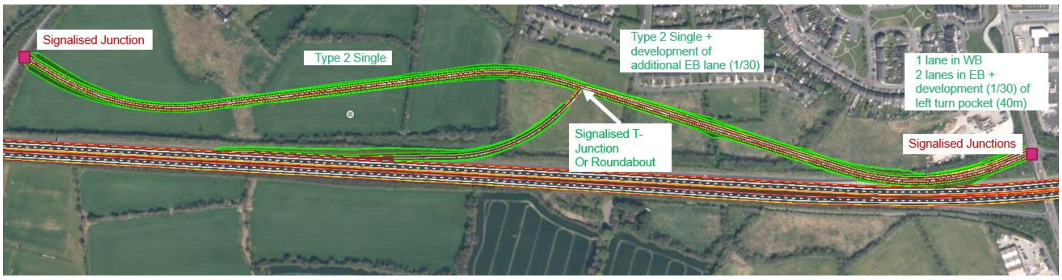


Figure 6.7: Option 1 - T-Junction Geometric Design (© Google Imagery ©2024 DigitalGlobe)

The existing junction would be maintained and optimised as shown in Figure 6.6**.** The westbound diverge would be realigned, with a left-filter lane and right-turn lane at a new signalised junction. The section of the westbound diverge marked as 'X' would be closed. The westbound merge would be signalised at part of this signalisation. The eastbound diverge would be reconfigured to incorporate the Maynooth Outer Orbital Route, with a left-filter lane and right-turn lane at a new signalised junction. The eastbound merge would be signalised at part of this signalisation. The Straffan Road Roundabout would be retained or converted to a signalised junction.

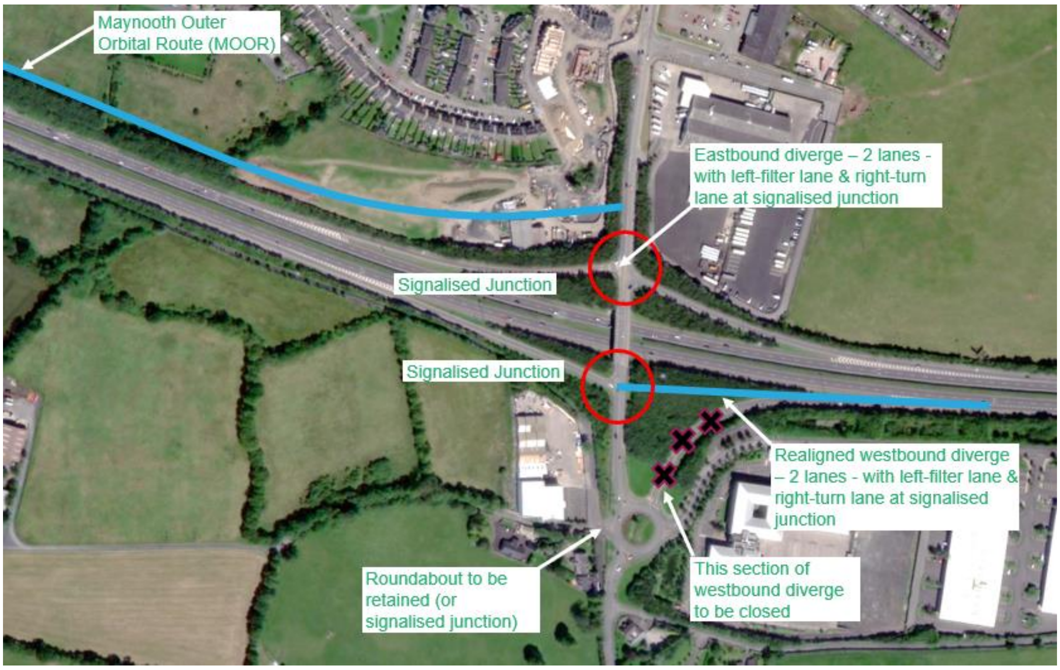


Figure 6.8: Option 1 – Existing Junction Interventions (© Google Imagery ©2024 DigitalGlobe)

Junction 7 Option 1 Plan and Profile drawings are included in Volume B Figures.

Option 2 – Provide a New Junction between Newtown Road and Straffan Road and convert the existing to an Overbridge

Option 2 would include a new grade separated junction between Straffan Road and Newtown Road and convert the existing Junction 7 to an overbridge. The provision of a new grade separated junction and conversion of the existing to an overbridge would facilitate the enhancement of the existing active travel infrastructure on Straffan Road.

Linkages to the north and south were developed and assessed in terms of transport modelling, infrastructure engineering design and associated land impacts. Developed junction designs with linkages to the north and south are shown in Figure 6.9 and Figure 6.10.

Figure 6.9: Option 2 - Linkage to the North - Signalised Diamond on northern side and Loop on southern side (© Google Imagery ©2024 DigitalGlobe)

Figure 6.10: Option 2 - Linkage to the South (© Google Imagery ©2024 DigitalGlobe)

Data from the transport model indicate that the linkage to the south would not provide sufficient benefits to justify its provision. Refer to Appendix 6.4A and Appendix 6.4B for further details on the justification. This southern linkage would also have a significant cost and environmental and land impacts. Additionally, it would not fully align with current government policies such as NIFTI and the Climate Action Plan. For these reasons, the southern linkage was discounted.

In both options, Maynooth and its hinterland would be served by one junction. Both option would include the Maynooth Outer Orbital Route (MOOR) with active travel provision.

Junction 7 Option 2 Plan and Profile drawings are included in Volume B Figures.

6.2.3.2 Junction 6 Celbridge

Trip Attractors and Key Linkages

The main trip attractors in the vicinity of Junction 6 can be seen in Figure 6.11; journeys conducted here include those by vulnerable road users travelling from the Kilmacredock area to Celbridge Community College and Salesian College and ongoing large, residential developments. Construction has commenced at Leixlip Gate, which is located directly northeast of Junction 6. The proposed development will comprise of 239 residential dwellings and associated commercial properties. The development will also incorporate 393 car parking spaces and 208 cycle parking bays. In addition to existing trip attractors and ongoing construction, future construction is anticipated within the Junction 6 area.

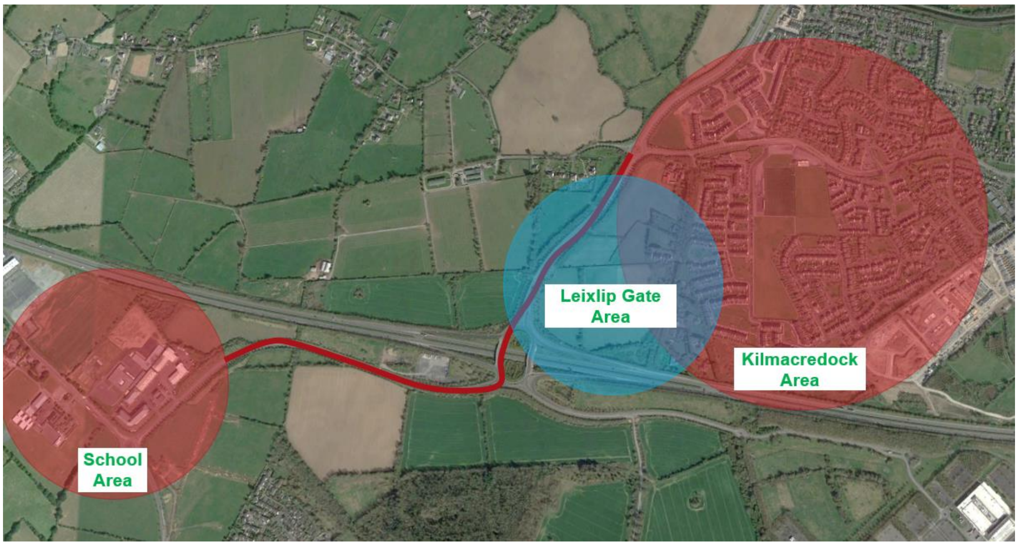


Figure 6.11: R449 Segregated Vulnerable Road User Facilities (© Google Imagery ©2024 DigitalGlobe)

Existing Vulnerable Road User Facilities

The majority of Junction 6 and the surrounding road network provides fully segregated cyclist and pedestrian facilities. On the R449, both to the north and south of Junction 6, a segregated 1.5m cycleway and a segregated 1.5m footway are located on both sides of the carriageway.

A similar configuration is on the Barnhall Road. There are pedestrian and cyclist facilities on the Junction 6 overbridge structure, these include a 1.5m cycleway and a 1.5m footway as shown in Figure 6.12.

Figure 6.12: Segregated Vulnerable Road User Facilities on western side of existing structure (© Google Imagery ©2024 DigitalGlobe)

There are uncontrolled pedestrian crossings throughout Junction 6 comprising of dropped kerbs and tactile/ladder paving as shown in Figure 6.12. Utilising the western side of the Junction 6 structure is favourable due to less crossing movements required to navigate through the junction.

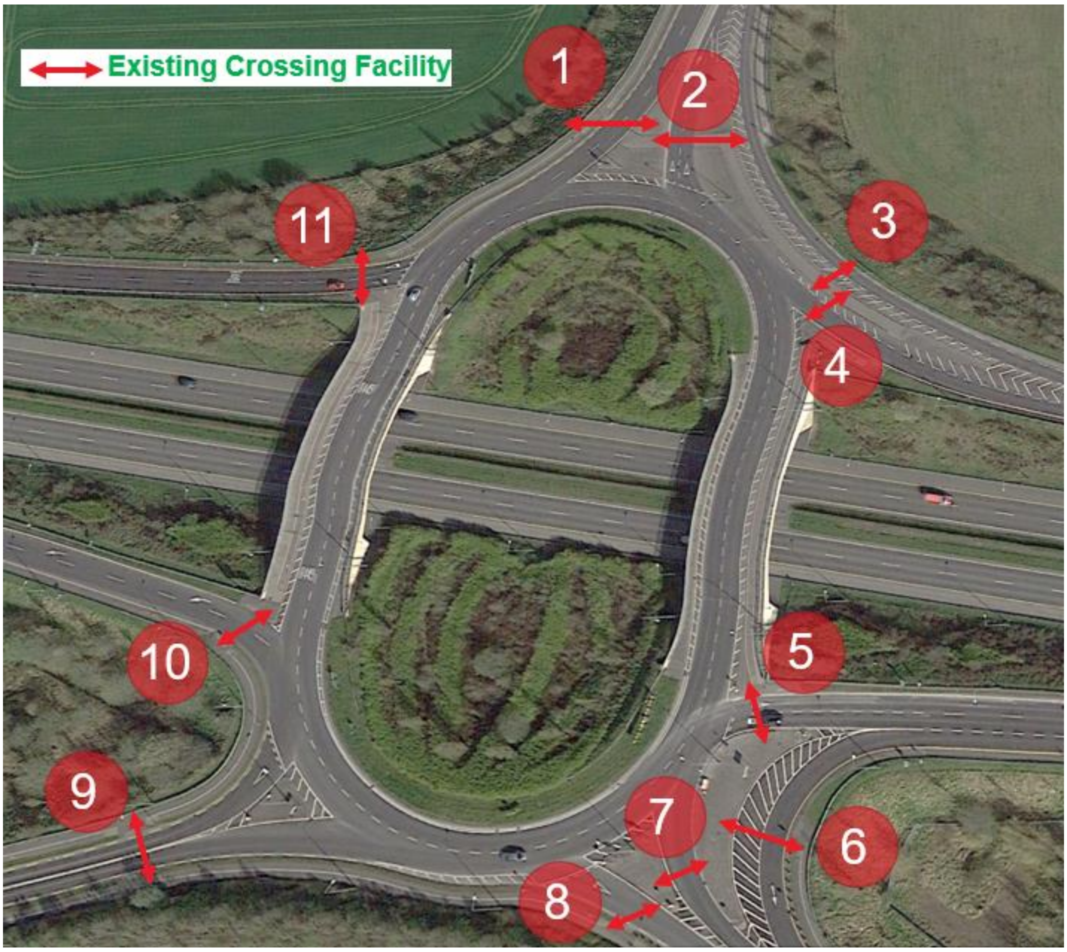


Figure 6.13: Junction 6 Existing Crossing Facility Locations (© Google Imagery ©2024 DigitalGlobe)

Existing Issues Identified

There is a risk to vulnerable road users travelling from the Kilmacredock area to Celbridge Community College and Salesian College. Currently, users commuting to these schools appear to utilise the eastern side of the Junction 6 structure. The eastern side of the Junction 6 structure has six crossing points. Each crossing point may be a potential conflict point where vulnerable road users are required to interact with vehicular traffic to make a safe movement.

Vehicular traffic travelling through Junction 6 may be travelling at a high speed as they are approaching the junction from a motorway environment with a 120km/hr speed limit. The potential for excessive speed is evident and was also noted by numerous residents during the public consultation who use the junction.

The geometric design of the junction may promote excessive speed due to a lack of self-enforcing speed reduction.

The main cohort utilising the junction and its surrounding road network is anticipated to be school children. Feedback from the public consultation highlighted risks such as excessive speed, difficulties in safely utilising a designated crossing point and bad driver decisions.

It can be ascertained that vulnerable road users making the journey to/from the school area/Kilmacredock are at risk.

Proposed Optimisations

Overview

For simplicity of assessment, the Junction 6 area has been divided as follows.

- Do-Minimum; and
- Minor safety and vulnerable road user optimisations at the existing junction.

Do-Minimum

This would require minimal construction and result in low cost; however, it is deemed inadequate due to existing safety issues and concerns.

Minor Safety and Vulnerable Road User Optimisations at the Existing Junction

It is proposed to signalise all approaches to the junction, therefore having controlled crossings at all locations for vulnerable road users, as shown in Figure 6.15. A toucan/signalised crossing would also be provided on the R449 north of the junction, as shown in Figure 6.14. This would provide additional comfort to users exiting/entering Kilmacredock and navigating through Junction 6.

Leixlip Gate, currently under construction, is proposed to provide access on to the R449 for vulnerable road users. The proposed crossing facility would align with the future vulnerable road user access to/from Leixlip Gate. In addition, cross sectional design improvements would be incorporated, such as lane width reductions and traffic calming measures.

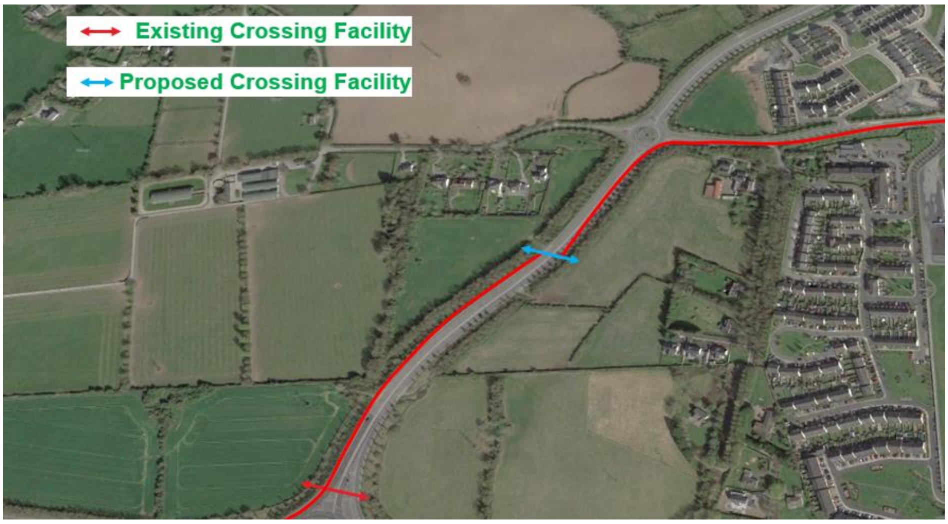


Figure 6.14: Junction 6 Proposed Crossing Facilities on R449 (© Google Imagery ©2024 DigitalGlobe)

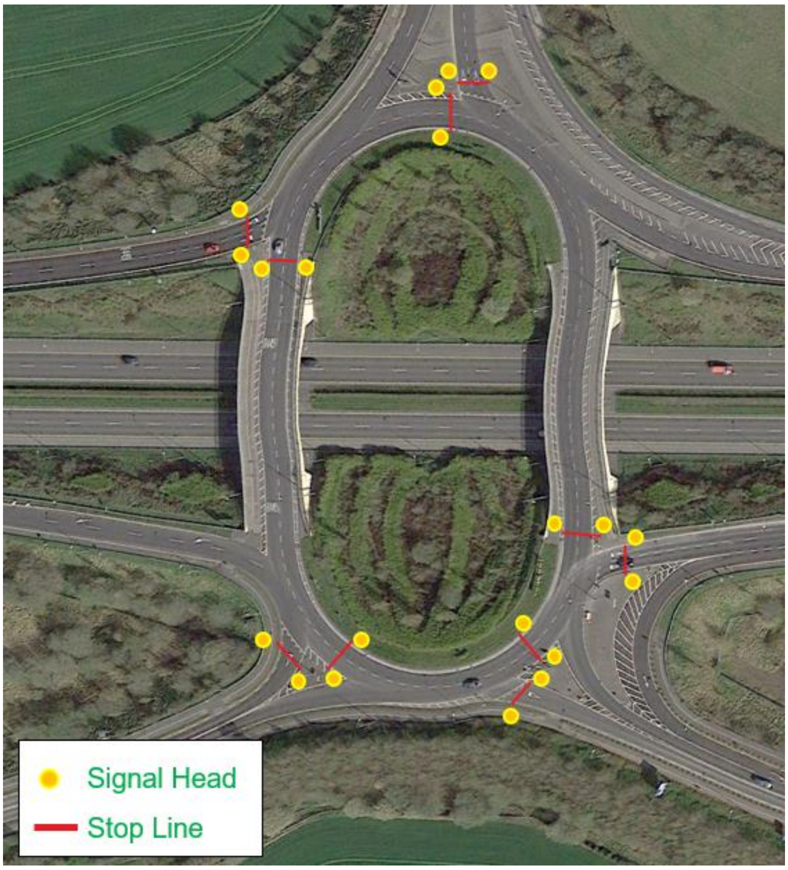


Figure 6.15: Junction 6 Proposed Signalisation (© Google Imagery ©2024 DigitalGlobe)

6.2.3.3 Junction 5 Leixlip

Trip Attractors and Key Linkages

The main trip attractors can be seen in Figure 6.16 and include Leixlip, Lucan, Celbridge and the proposed Adamstown Strategic Development Zone (SDZ).

Figure 6.16: Trip Attractors in vicinity of Junction 5 (© Google Imagery ©2024 DigitalGlobe)

Existing Issues Identified

The key issues identified in the vicinity of Junction 5 include the following:

- Bespoke junction layout whereby the southern side of the junction is a typical signalised diamond junction, while the northern side of the junction is an unclassified junction layout with a priority junction for the eastbound diverge and a roundabout at the eastbound merge tie in to the R148 and the R403.
- Eastbound merge includes 100m of a 2-way section to provide full access for two private dwelling houses located between the M4/N4 mainline and the merge. Refer to Figure 6.17. Moreover, there are two additional direct accesses between the Junction 5 eastbound merge and the Junction 4A eastbound diverge and a distance of approximately 300m between consecutive merge and diverge which increases weaving issues and potential conflict points.

- Several uncontrolled crossing points at the junction, as well as active travel facilities that are not fully segregated; these safety and accessibility concerns can decrease the attractiveness of the route for vulnerable road users.

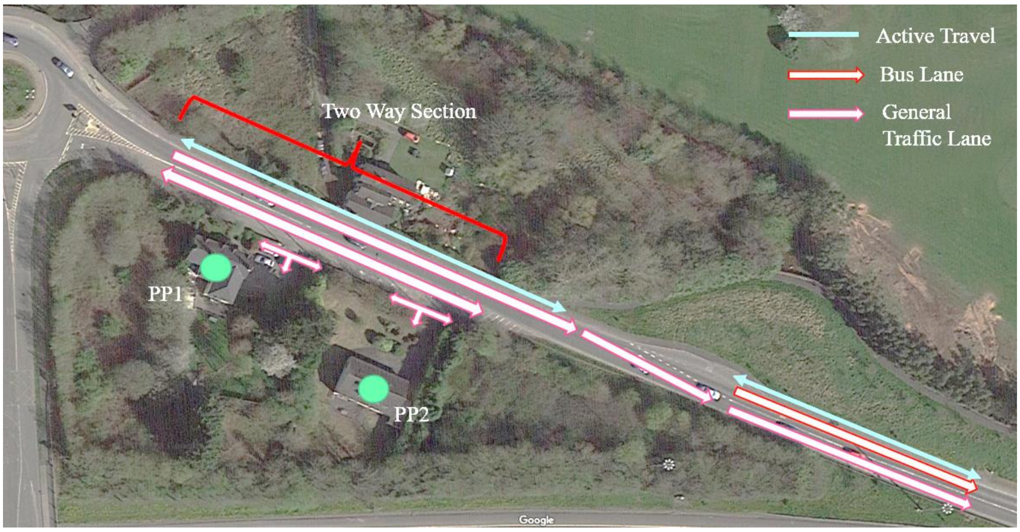


Figure 6.17: Eastbound Merge Existing Layout

Proposed Optimisations

Overview

As outlined in *TII PAG Unit 4.0* (*Consideration of Alternatives and Options*), the initial step focuses on drafting a long list of potential options that may address the need for intervention.

Options on this initial list are qualitatively assessed against the project objectives, environmental and engineering constraints to establish, at a fundamental level, if these options would address the transport problems identified.

For simplicity of assessment, the Junction 5 area has been divided into three sections. The measures for each section are generally interchangeable:

- Eastbound diverge;
- Eastbound merge;
- Junction 5 to Junction 4A Eastbound Carriageway.

Optimisation of the Eastbound Diverge

Scenario 1 – Amend from 1 Lane Diverge to 2 Lane Diverge and Signalise Junction

Scenario 1 for the eastbound diverge would consist of amending the diverge from 1 lane to 2 lanes and signalising the junction with the R403 as shown in Figure 6.18.

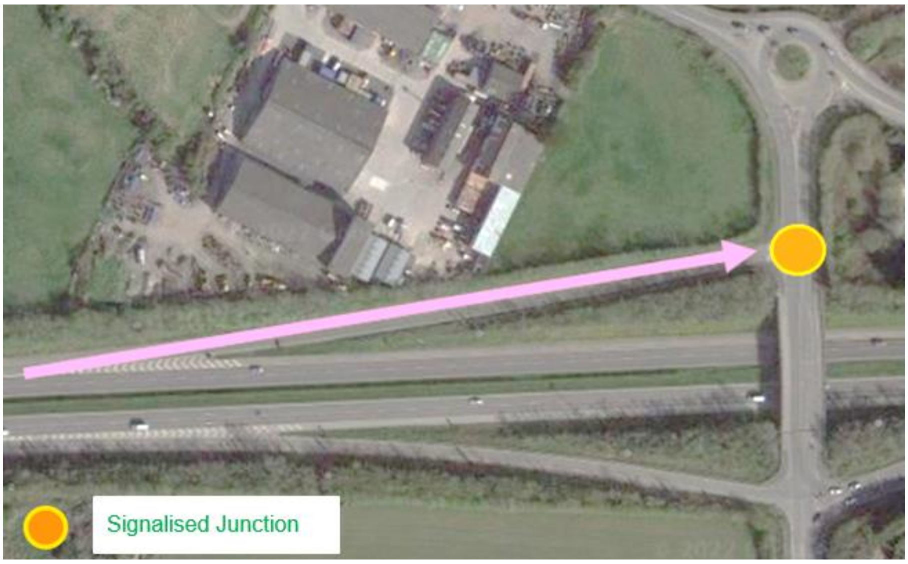


Figure 6.18: Eastbound Diverge Scenario 1 - Amend from 1 Lane Diverge to 2 Lane Diverge and Signalise Junction

Scenario 2 – Dumbbell

Scenario 2 would consist of realigning the eastbound diverge to provide a half dumbbell junction as shown in Figure 6.19. The realignment would require relocating and amending the roundabout to balance the approach arms, as well as realigning the tie ins of the arms.

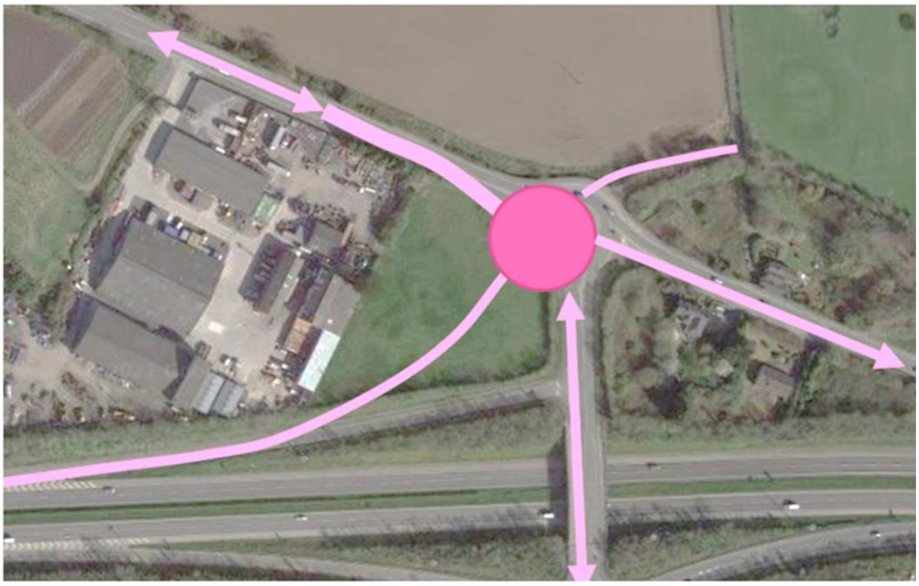


Figure 6.19: Eastbound Diverge - Scenario 2 - Dumbbell Layout

Optimisation of the Eastbound Merge

Scenario 1 - Do-Minimum

Scenario 1 would consist of retaining the 100m 2-way section for access to the two dwellings as shown in Figure 6.20.

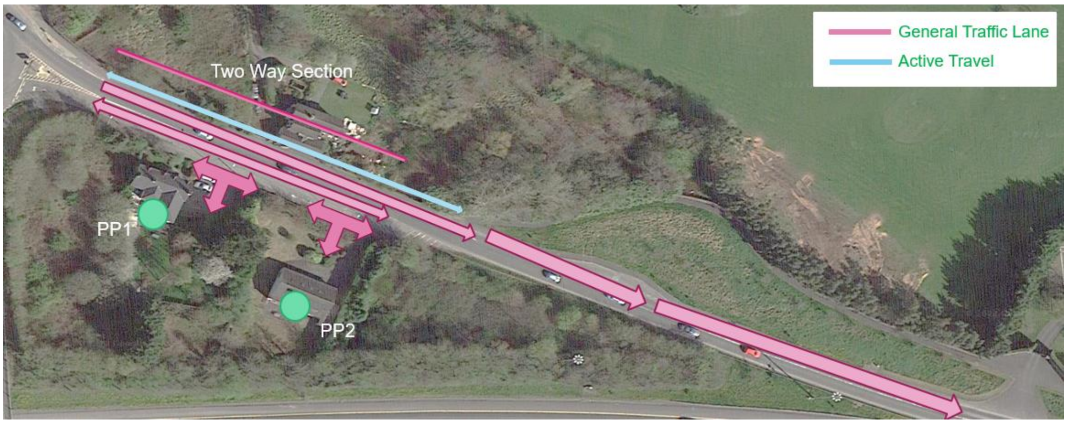


Figure 6.20: Eastbound Merge Scenario 1 – Do Minimum

Scenario 2 – One Way Merge

Scenario 2 would convert the 2-way eastbound merge to a standard one-way merge as shown in Figure 6.21. This scenario would require the two dwellings to travel eastbound on the N4 to come back westbound, thought the J4a diverge and L1018 Left-in Left-out merge, to reach Leixlip, as shown in Figure 6.22. This detour is approximately 2.5km in length from the dwelling back to the Junction 5 northern roundabout.

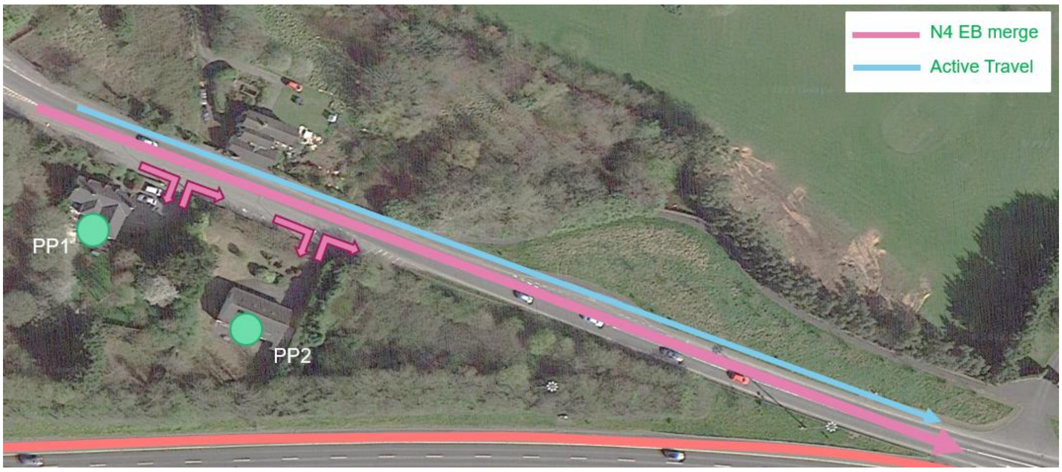


Figure 6.21: Eastbound Merge – Scenario 2 - One-way Slip Road

Figure 6.22: Eastbound Merge – Scenario 2 Dwelling Detour

Scenario 3 – Diamond

Scenario 3 would realign the current eastbound merge slip road to tie in to the R403 in line with the eastbound diverge. This scenario would require acquisition/demolition of the two dwellings located between the existing eastbound merge and the M4/N4 mainline.

The existing eastbound merge slip road may then be converted into an active travel facility or used as a merge for a potential parallel service road between Junction 5 and Junction 4a. Refer to Figure 6.23 and Figure 6.24.

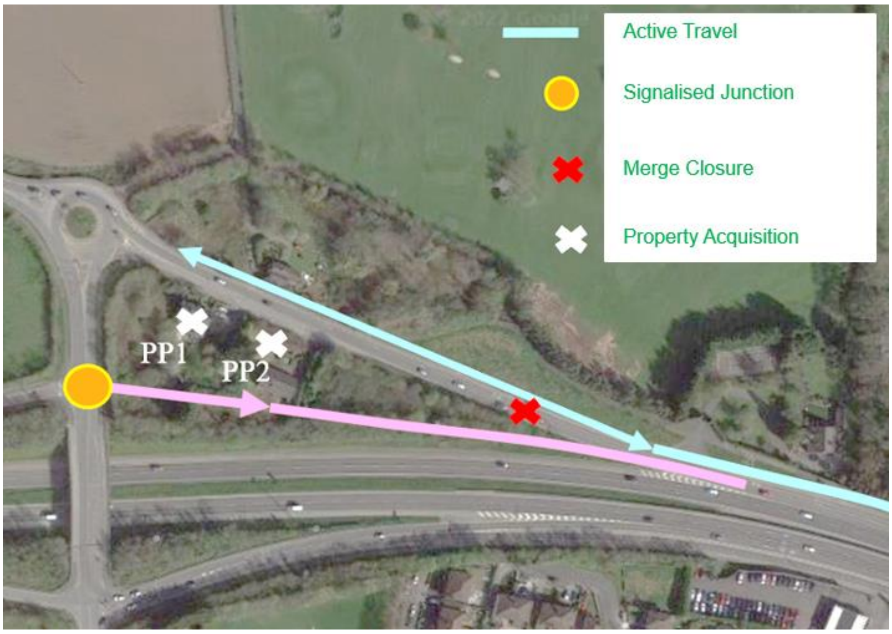


Figure 6.23: Eastbound Merge Scenario 3 – Diamond Junction

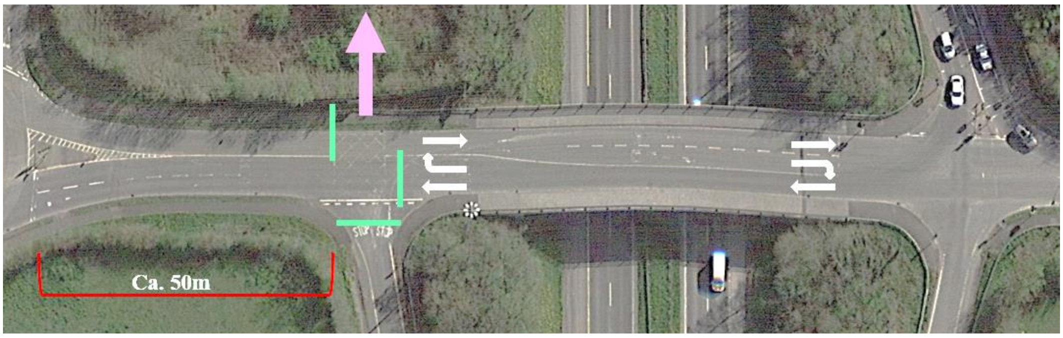


Figure 6.24: Eastbound Merge Scenario 3 – Diamond Junction Bridge Layout

Optimisations to Junction 5 – Junction 4a Eastbound Carriageway Section

The existing M4/N4 mainline layout between Junction 5 and Junction 4a in the eastbound direction includes two general traffic lanes, one continuous auxiliary lane, a bus lane on the nearside with adjacent shared use active travel facility.

The distance between the junctions is approximately 300m, with two direct accesses onto the mainline. The short distance between the junctions and the direct accesses results in weaving issues and increases the number of potential conflict points.

To solve these issues, it is proposed to include a parallel service road to cater for the traffic diverging at Junction 4a and for the two direct accesses. The traffic on the M4/N4 that wants to exist at Junction 4a would be required to exit at Junciton 5 and use the parallel road.

Refer to Figure 6.25, Figure 6.26 and Figure 6.27.

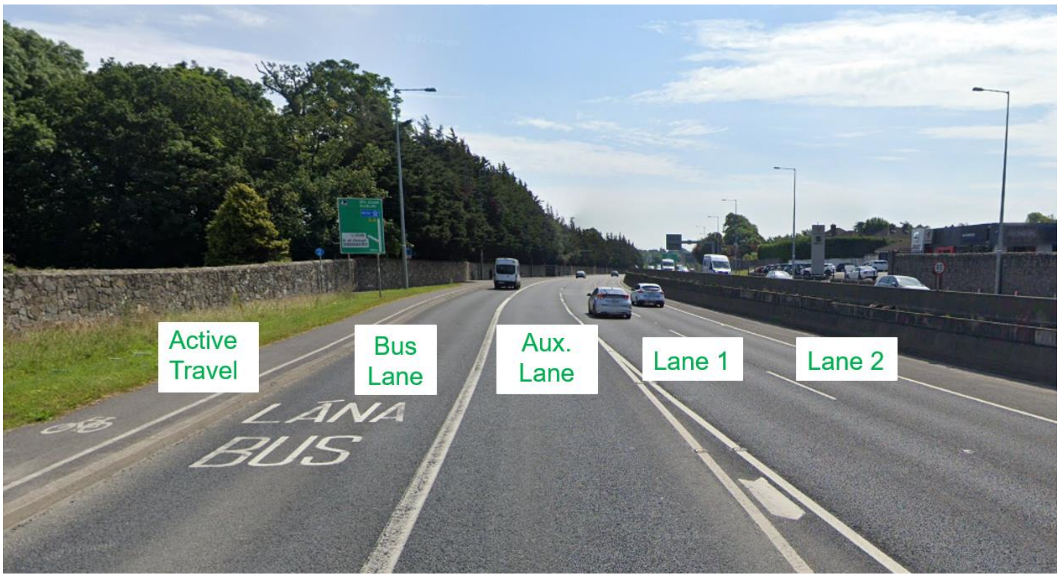


Figure 6.25: N4 Junction 5 to Junction 4A - Existing Configuration

Figure 6.26: M4/N4 Junction 5 to Junction 4a Existing Layout

Figure 6.27: M4/N4 Junction 5 to Junction 4a Parallel Service Road

6.2.4 Active Travel

6.2.4.1 Overview

Active travel options that have been taken through to Stage 2 Project Appraisal Matrix (PAM) are as follows:

- R408 Newtown Road Overbridge *****;
- Junction 7 Maynooth;
- R405 Ballygoran Overbridge;
- Junction 6 Celbridge;
- R404 Celbridge Road Overbridge; and
- Junction 5 Leixlip.

*** Note:**

Active travel options at the R408 Newtown Road Overbridge were not proposed or assessed during the Stage 1 Preliminary Options Assessment. This has been introduced as a new active travel location during the Stage 2 Project Appraisal Matrix to align with the updated NTA Greater Dublin Area Draft Cycle Network Plan. Within this plan, the Maynooth, Leixlip and Celbridge Proposed Cycle Network includes the R408 Newtown Road Overbridge as a secondary route. It was not included as a route during the Stage 1 Preliminary Options Assessment.

Two active travel options were developed at each of the above locations.

- Option 1 – New bridge parallel to existing on the western side; and
- Option 2 – New bridge parallel to existing on the eastern side.

These are described in the following sections. Plan and Profile drawings for each of the options are included in Volume B Figures.

Provision for cycle parking and infrastructure will be a consideration on the preferred option(s).

6.2.4.2 Design Basis

Design Standards and Criteria

The active travel options have been designed in accordance with current geometry requirements for cycle facilities in *Rural Road Link Design (DN-GEO-03031)*, cross section requirements in *Cross Sections and Headroom (DN-GEO-03036)* and *Rural Cycleway Design (Offline & Greenway) (DN-GEO-03047).*

Cross Section

The cross section adopted consists of a 4m wide active travel facility with, typically, a 1.5m grassed verge on the nearside to accommodate facilities such as lightning, landscaping, etc.

The volume of active travel users has not yet been defined. Table 4.5 of *DN-GEO-03036* mandates a desirable minimum width of 3m for a two-way shared use facility for low volumes. Table 4.8 of *DN-GEO-03047* is more generic and does not differentiate between a one-way and two-way shared use cycleway, mandating a minimum of 3m cross section for low volumes.

Alignment

The alignments of the various overbridge options, adjacent to the existing overbridge, follow the requirements set out in Rural Road Link Design (*DN-GEO-03031)* with regards to minimum horizontal radii and maximum vertical gradients. Assuming a cyclist design speed of 30km/h, the minimum horizontal radius is 25m. However, on approach to junctions, a reduced design speed of 10km/h is acceptable over short distances, for which the desirable minimum horizontal radius is 4m.

The vertical alignment requirements set out in *Rural Road Link Design (DN-GEO-03031)* state that the desirable maximum gradient for cycle facilities is 3%.

Notwithstanding the adoption of 25m horizontal radius, there have been instances where, due to space constraints, the 4m radius has been used. These locations generally coincide with the tie ins to existing facilities, approach and departure from overbridge alignments and approaches to junctions.

The vertical alignment desirable maximum of 3% was exceeded only at tie-ins to existing facilities or where it was required due to the existing road vertical alignment.

6.2.4.3 R408 Newtown Road Overbridge

This option consists of active travel enhancements at the R408 Newtown Road Overbridge and is shown on Figure 6.28.

Figure 6.28: Active Travel Enhancement at R408 Newtown Road Overbridge

Option 1 - West

This option would include a new parallel active travel overbridge on the western side of the existing overbridge. This proposed facility would be 4m wide. Vulnerable road users would be required to travel on the western side of the carriageway on the existing footway before reaching the new overbridge. South of the overbridge, the proposed facility ties into the existing footway on the western side of the carriageway before reaching the existing crossing point at the bus stop location. The existing footway widths are between 1.1 and 2.3m, therefore, widening is required to integrate them with the new active travel facility of 4m. The vertical alignment of the new overbridge generally follows the existing terrain levels. This option is shown in Figure 6.29.

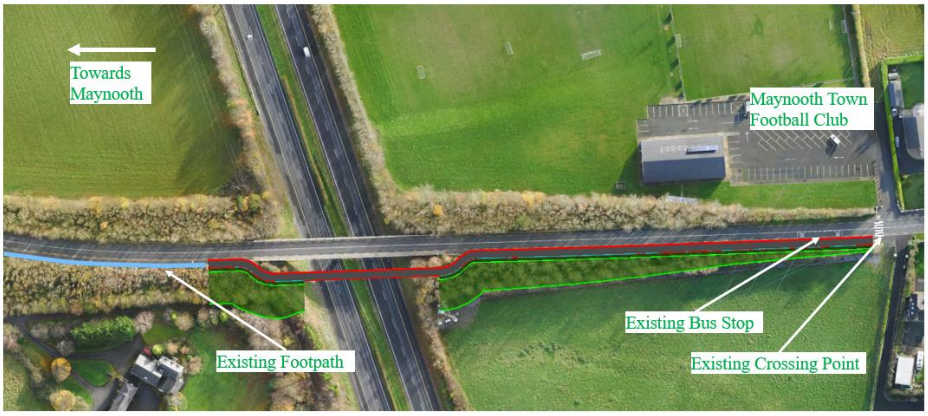


Figure 6.29: Option 1 - Active Travel Overbridge west of the existing R408 Newtown Road Overbridge

Option 2 - East

This option would include a new parallel active travel overbridge on the eastern side of the existing overbridge. This proposed facility would be 4m wide. Vulnerable road users would be required to cross the R408 to the north to reach the new overbridge, as the existing footway north of the R408 is located on the western side. South of the overbridge, the new facility continues parallel to the existing edge of pavement to tie into the Maynooth Town Football Club access. At this location there is an existing crossing point marked with ramped tactile pavement, but without zebra crossing road markings. The vertical alignment of the new overbridge generally follows the existing terrain levels. This option is shown in Figure 6.30.

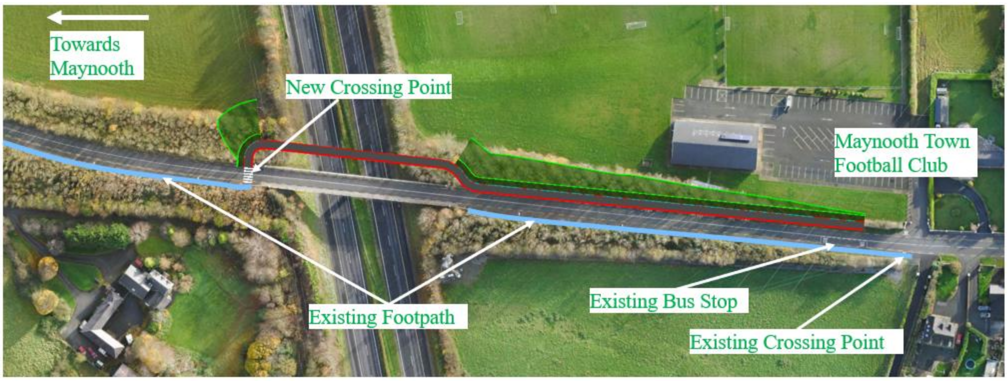


Figure 6.30: Option 2 - Active Travel Overbridge east of the existing R408 Newtown Road Overbridge

6.2.4.4 Junction 7 Maynooth

This option would consist of active travel enhancements at Junction 7 Maynooth and is shown on Figure 6.31.

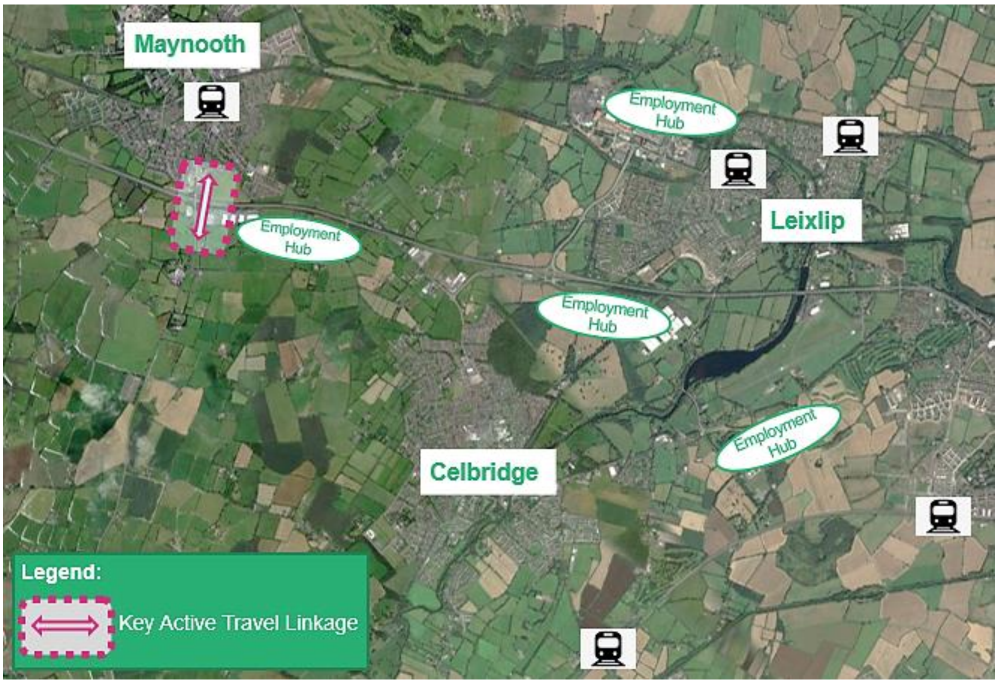


Figure 6.31: Active Travel Enhancements at Junction 7 Maynooth

Option 2 - West

This option would include a new parallel active travel overbridge on the western side of the existing Junction 7 overbridge. This proposed facility would be 4m wide. It would tie into the existing facility north and south of the overbridge. Vulnerable road users would be required to cross both the eastbound diverge and the westbound merge, when using the new active travel facility. This option is shown in Figure 6.32.

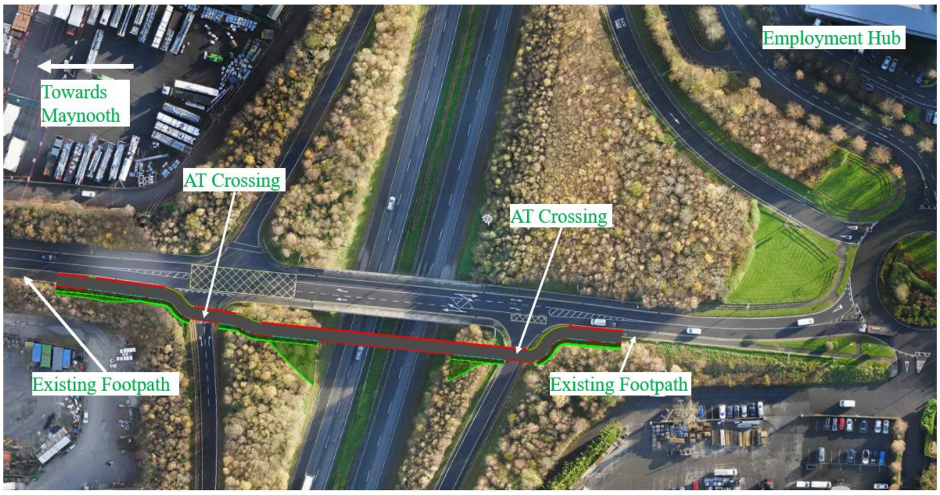


Figure 6.32: Option 1 - Active Travel Overbridge west of the existing Junction 7 Overbridge

Option 2 - East

This option would include a new parallel active travel overbridge on the eastern side of the existing Junction 7 overbridge. This proposed facility would be 4m wide. It would tie into the existing facility north and south of the overbridge. It is proposed that the existing facility to the south would be widened to a 4m cross section, providing continuity to the employment hub. Vulnerable road users would be required to cross the eastbound merge slip road to access the new active travel overbridge. The vertical alignment follows the existing terrain levels, thus minimising earthworks. This option is shown in Figure 6.33.

Figure 6.33: Option 2 - Active Travel Overbridge east of the existing Junction 7 Overbridge

6.2.4.5 R405 Ballygoran Overbridge

This option consists of active travel enhancements at the R405 Ballygoran Overbridge and is shown on Figure 6.34.

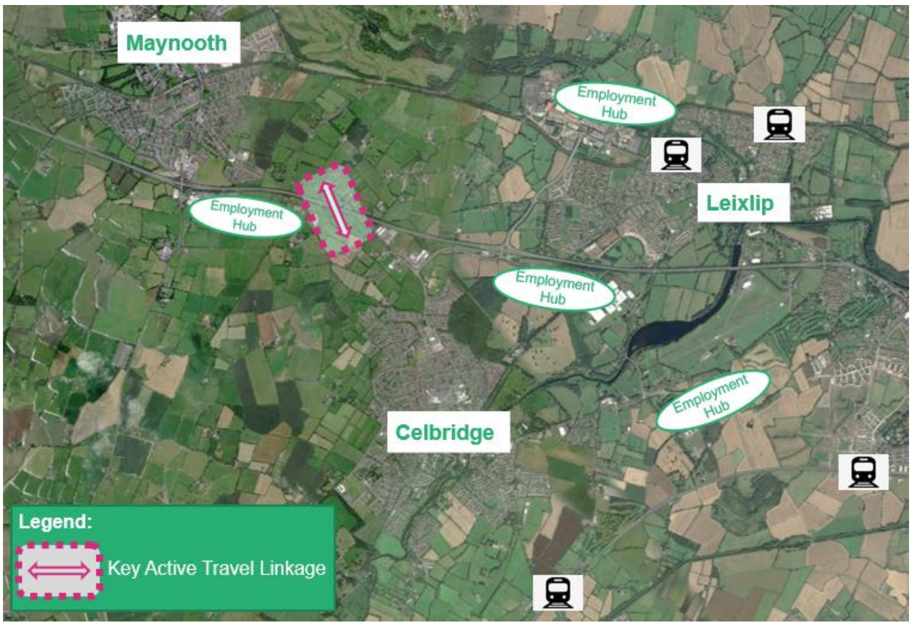


Figure 6.34: Active Travel Enhancement at the R405 Ballygoran Overbridge

Option 1 - West

This option would include a new parallel overbridge on the western side of the existing bridge to accommodate vulnerable road users. This proposed facility would be 4m wide and would tie into the existing carriageway at the two extremities. The existing R405 does not include any active travel facility north or south of the overbridge, therefore resulting in a gap in the network, whereby vulnerable road users are required to join the traffic lane to continue their journey to Maynooth, to the north, or Celbridge to the south. Further discussion between the National Transport Authority, Transport Infrastructure Ireland and the relevant Local Authorities would be required if the intent is to provide continuity for vulnerable road users. The vertical alignment generally follows the existing terrain levels on both extremities of the bridge but differs from the existing R405 Ballygoran Overbridge vertical alignment (which is essentially flat). This option is shown in Figure 6.35.

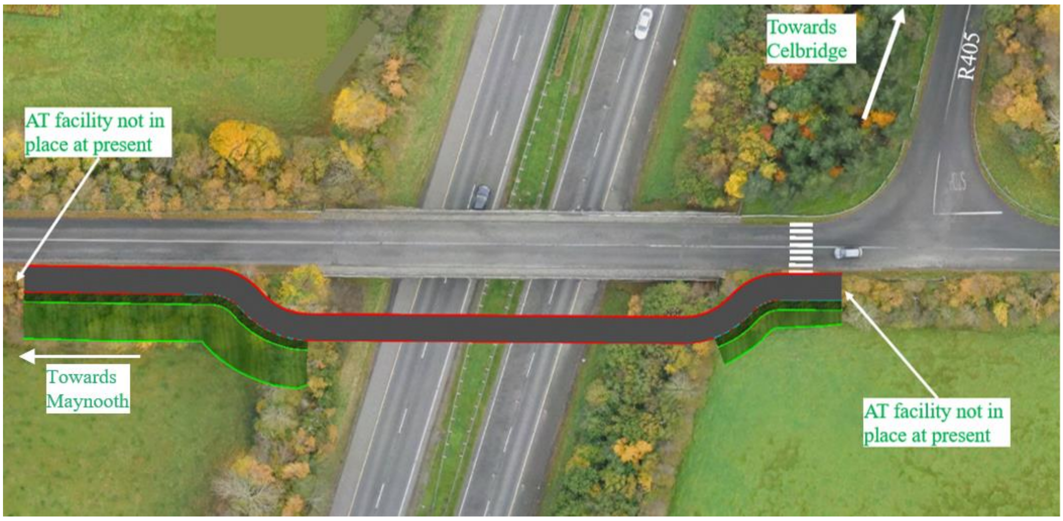


Figure 6.35: Option 1 - Active Travel Overbridge west of the existing R405 Ballygoran

Option 2 - East

This option would include a new parallel overbridge on the eastern side of the existing bridge to accommodate vulnerable road users. This proposed facility would be 4m wide. The existing R405 does not have any active travel facilities north or south of the overbridge. The proposed facility would tie into the existing carriageway at the two extremities. This would leave a gap in the network; whereby vulnerable road users would be required to join the traffic lane to continue their journey to Maynooth or Celbridge. Further discussion among the National Transport Authority, Transport Infrastructure Ireland and the relevant Local Authorities would be required if the intent is to provide continuity for vulnerable road users. The vertical alignment generally follows the existing terrain levels on both extremities of the bridge but differs from the existing R405 Ballygoran Overbridge vertical alignment (which is essentially flat). This option is shown in Figure 6.36.

Figure 6.36: Option 2 - Active Travel Overbridge east of the existing R405 Ballygoran Overbridge

6.2.4.6 Junction 6 Celbridge

This option consists of active travel enhancements at Junction 6 Celbridge and is shown on Figure 6.37.

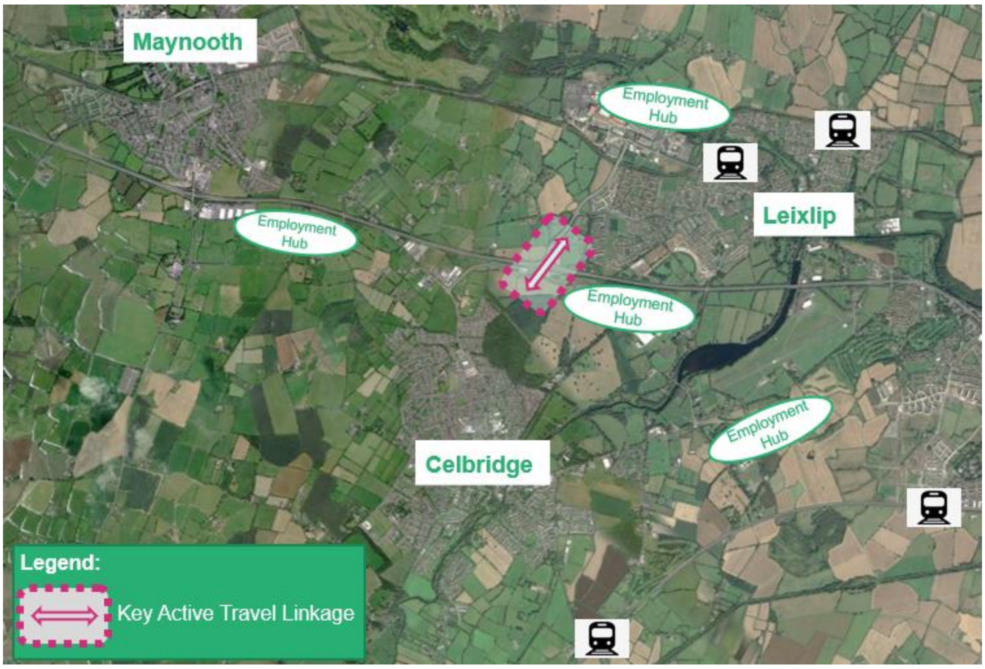


Figure 6.37: Active Travel Enhancement at Junction 6 Celbridge

Option 1 - West

This option would include a new overbridge on the western side of the existing bridge to accommodate vulnerable road users. This proposed facility would be 4m wide.

The proposed facility would not interact with the existing junction, crossing over the existing slip roads to improve directness and safety for vulnerable road users.

At the northern tie in, the facility would join the existing segregated one-way active travel facility on the western side of the R449 where vulnerable road users travelling north can use the existing facility.

Vulnerable road users travelling south on the existing facility of the R449 most likely would be located on the eastern side of the road and would then cross to join the new active travel facility.

At the southern end, the new facility would join the R449 towards Celbridge. A new crossing would be required at this location to enable travel in both directions on the existing one-way facilities.

This option is shown in Figure 6.38.

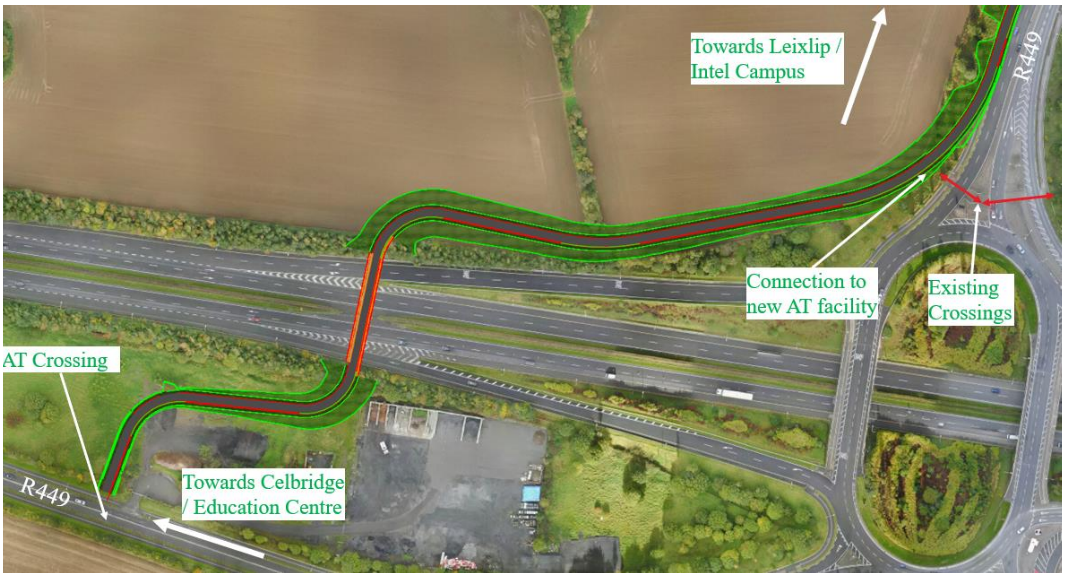


Figure 6.38: Option 1 - Active Travel Overbridge west of Junction 6 Celbridge

Option 2 - East

This option would include a new overbridge on the eastern side of the existing bridge to accommodate vulnerable road users. This proposed facility would be 4m wide. The proposed facility would not interact with the existing junction. It would cross over the existing slip roads to improve directness and safety for vulnerable road users. At the northern tie in, the facility would join the existing segregated one-way active travel facility on the eastern side of the R449.

Vulnerable road users on the new facility towards Leixlip would use the existing uncontrolled crossings to reach the existing one-way facility on the western side of the R449 or negotiate the existing facility to the east, with the vulnerable road users travelling south.

At the southern end, the new facility would tie into the outside of bend on the Barnhall Road, approximately 140m from the existing right turn ghost island junction. A new crossing point would be proposed at this location to enable vulnerable road users to use the existing facility in the westbound direction towards Celbridge and the education centre.

The vertical alignment generally follows the existing ground levels, before lifting 7.5m, alignment to alignment (including headroom of 5.7m and allowance for structure depth), above the M4/N4 and the east facing slip roads. The maximum gradient of the facility would be 3%.

This option is shown in Figure 6.39.

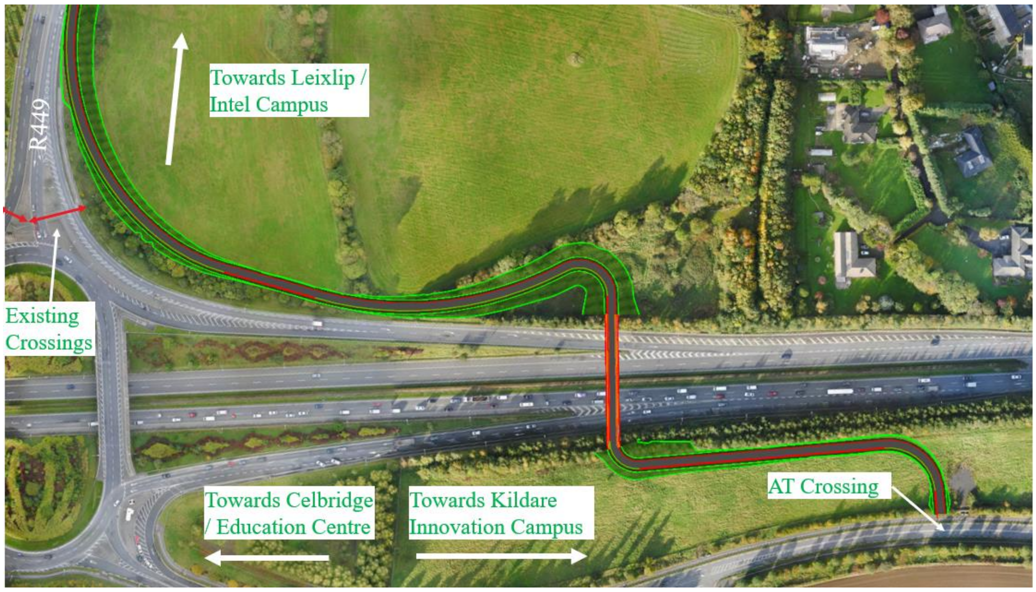


Figure 6.39: Option 2 - Active Travel Overbridge east of Junction 6 Celbridge

6.2.4.7 R404 Celbridge Road Overbridge

This option consists of active travel enhancements at the R404 Celbridge Road Overbridge and is shown on Figure 6.40.

Figure 6.40: Active Travel Enhancement at the R404 Celbridge Road Overbridge

Option 1 - West

This option would include a new overbridge on the western side of the existing overbridge to accommodate vulnerable road users. This proposed facility would be 4m wide. It would tie into the existing 2.5m wide footway, both to the south and north. The existing facility may require widening to facilitate the tie into the proposed active travel overbridge.

Vulnerable road users would cross the R404 at the existing signalised crossing at the Wonderful Barn, located approximately 60m from the proposed northern tie in. For the southern section of the R404, pedestrians and cyclists would then be able to safely cross the regional road at the existing signalised crossing, located 500m from the proposed southern tie in.

This option is shown in Figure 6.41.

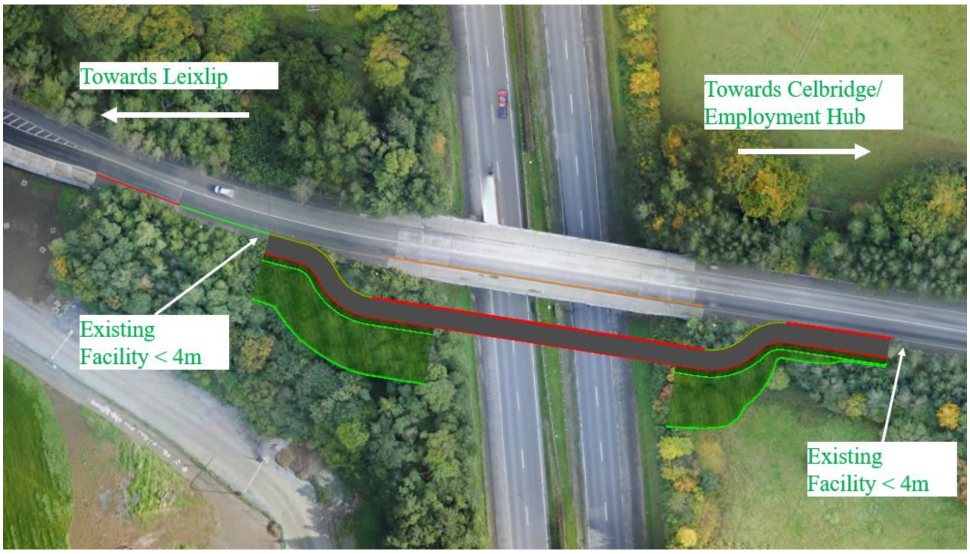


Figure 6.41: Option 1 - Active Travel Overbridge west of the R404 Celbridge Road Overbridge

Option 2 - East

This option would include a new overbridge on the eastern side of the existing overbridge to accommodate vulnerable road users. This proposed facility would be 4m wide and would tie into the existing footway at both northern and southern extremities of the existing overbridge. The existing facility is 2.5m wide, and therefore may require widening at the tie in points to accommodate linkage with the proposed overbridge.

Vulnerable road users would cross the R404 at the existing signalised crossing at the Wonderful Barn, located approximately 60m from the proposed northern tie in. For the southern section of the R404, pedestrians and cyclists would then be able to safely cross the regional road at the existing signalised crossing located 500m from the proposed southern tie in. This option is shown in Figure 6.42.

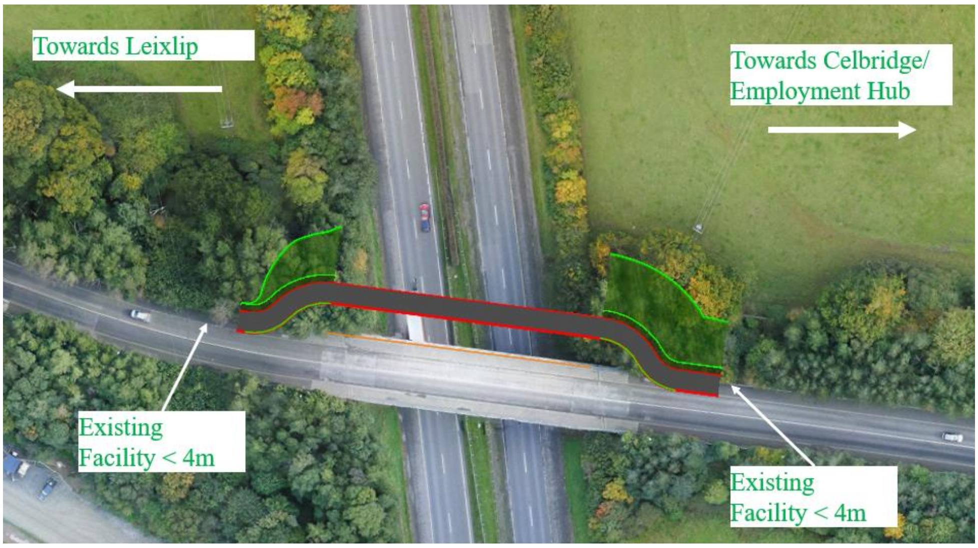


Figure 6.42: Option 2 - Active Travel Overbridge east of the R404 Celbridge Road Overbridge

6.2.4.8 Junction 5 Leixlip

This option consists of active travel enhancements at Junction 5 Leixlip and is shown on Figure 6.43.

Figure 6.43: Active Travel Enhancement at Junction 5 Leixlip

Option 1 - West

This option would include a new overbridge on the western side of the existing overbridge to accommodate vulnerable road users. This proposed facility would be 4m wide. At both the northern and southern ends, it would traverse the existing west facing slip roads before tying into the existing footway, which is approximately 3m in width.

This would require widening to accommodate the linkage to the proposed facility. Vulnerable road users would be required to traverse the eastbound diverge and the westbound merge. Currently, both these locations consist of uncontrolled crossings. These would be signalised as part of this option. At the southern junction, vulnerable road users can move around the junction by using the existing controlled crossing points. Similarly to Option 1, at the northern junction, vulnerable road users would be accommodated through uncontrolled crossing points located on two of the three arms of the roundabout. This option is shown in Figure 6.44.

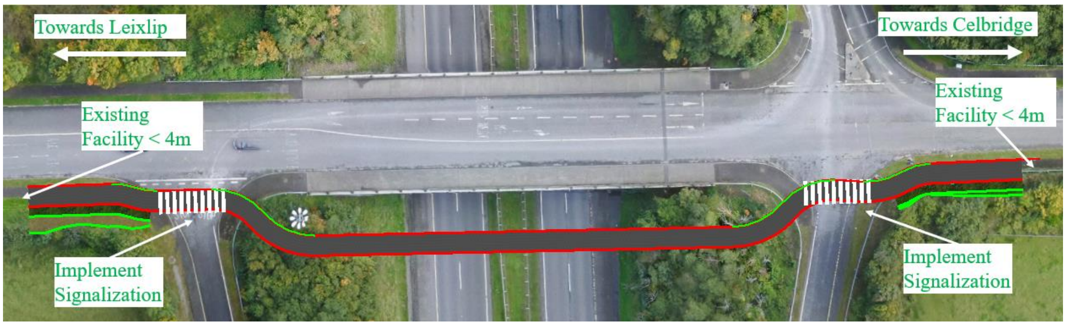


Figure 6.44: Option 1 - Active Travel Overbridge west of the Junction 5 Overbridge

Option 2 - East

This option would include a new overbridge on the eastern side of the existing overbridge to accommodate vulnerable road users. This proposed facility would be 4m wide. To the north, it would tie into the existing footway of approximately 3m in width, which would require widening to accommodate the linkage to the proposed cross section. At the southern end, the tie in would be located at the existing signalised crossing of the westbound diverge. At this location, vulnerable road users would be able to use the controlled crossing for their movement around the junction. To the north, it would be preferable that vulnerable road users would utilise the existing roundabout, where existing traffic speeds are reduced, before making their movement around the junction. The crossing points at the roundabout are all uncontrolled crossings and consist of dropped kerbs only. There is a footway located on both sides of the R148, there are no dropped kerb that indicates a crossing point. This option is shown in Figure 6.45.

Figure 6.45: Option 2 - Active Travel Overbridge east of the Junction 5 Overbridge

6.2.5 Demand Management

There are no demand management options taken forward from Stage 1 Preliminary Options Assessment. A number of demand management options will be tested or a consideration on the preferred option. Refer to Chapter 7 Stage 3 Preferred Option and Project Appraisal Balance Sheet (PABS) for further details.

6.2.6 Park and Ride Considerations

The NTA Park and Ride Development Office are developing a strategy for the M4/N4 corridor, which will be considered on the preferred option. Based on the NTA strategy and the Stage 1 assessments, the following four options will be considered on the preferred option, in consultation with the National Transport Authority:

- Rail (and bus) -based Park and Ride at Collinstown;
- Bus-based Park and Ride at Junction 6 Celbridge;
- Local Mobility Hub(s); and
- Local Park and Ride(s).

Refer to Chapter 7 Stage 3 Preferred Option and Project Appraisal Balance Sheet (PABS) for further details.

6.2.7 Test Rail

The DART+West will be considered on the preferred option in consultation with the National Transport Authority. Refer to Chapter 7 Stage 3 Preferred Option and Project Appraisal Balance Sheet (PABS) for further details.

6.3 Multi-Criteria Analysis

6.3.1 Context

The Stage 2 PAM concurrently assesses the options which emerged from the Stage 1 Preliminary Options Analysis (as detailed in Chapter 5) and the further transport modelling work undertaken in tandem. The preferred corridor and preferred junctions and overbridges which emerge from the Stage 2 PAM combine to form the overall recommended option to be taken forward to complete the Stage 3 Project Appraisal Balance Sheet (PABS).

The graphic below is the NIFTI modal hierarchy which was followed.

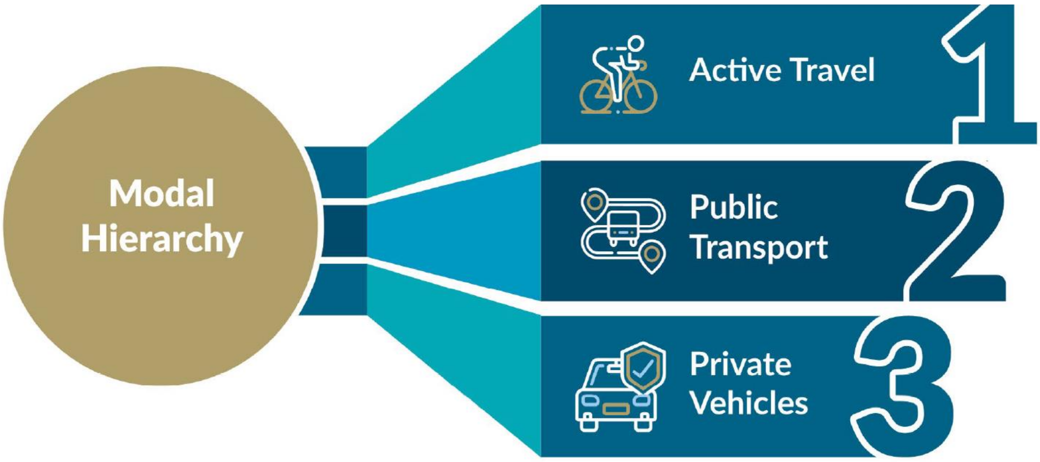


Figure 6.46: NIFTI Modal Hierarchy

6.3.2 Ranking and Scoring for Stage 2 PAM Appraisal

Using the Multi Criteria Analysis (MCA) from the Transport Infrastructure Ireland (TII) Project Appraisal Guidelines for National Roads Unit 7.0 - Multi-Criteria Analysis, 2016 (hereafter referred to as the TII PAG)[1], a performance matrix for each option was compiled which includes both quantitative and qualitative assessments. Each option was scored against the seven-point scale below.

- 7 – Major or highly positive;
- 6 – Moderately positive;
- 5 – Minor or slightly positive;
- 4 – Not significant or neutral;
- 3 – Minor or slightly negative;
- 2 – Moderately negative; or
- 1 – Major or highly negative.

[1] Transport Infrastructure Ireland (TII) Project Appraisal Guidelines for National Roads Unit 7.0 - Multi-Criteria Analysis, 2016. Available from: https://www.tiipublications.ie/library/PE-PAG-02031-01.pdf

Using the scores and professional judgement, a determination was made as to whether each option assessed is *Preferred* or *Least Preferred*. However, in some cases the effects of multiple options were comparable, and an objective determination could not be made between options on balance. As such, there are instances where more than one option may be identified as preferred or least preferred for a particular discipline. The assessment may also judge that all options are neutral on balance, given the magnitude and severity of effects.

6.3.3 Methodology for Comparing Options

6.3.3.1 Corridors

An absolute assessment and score as per TII PAG was undertaken on Corridor Option 1 and Corridor Option 2 initially. Corridor Option 1 and Corridor Option 2 were then compared against each other.

6.3.3.2 Junction/Overbridges and Active Travel

Based on the Greater Dublin Area Transport Strategy and BusConnects, there is no proposed dedicated public transport facility at any of the junctions or overbridges. Therefore, it is deemed appropriate to combine public transport and private vehicles under the theme of Traffic in the table below.

Based on the data and issues outlined at each of the locations in previous chapters, the table below outlines a summary of the Stage 2 PAM assessments to be carried out.

Table 6.4: Active Travel Assessment Requirements

Location	Active Travel Assessment
R408 Newtown Road Overbridge	Yes (Options)
Junction 7 Maynooth	Yes (Options)
R405 Ballygoran Overbridge	Yes (Options)
Junction 6 Celbridge	Yes (Options)
R404 Celbridge Road Overbridge	Yes (Options)
Junction 5 Leixlip	Yes (Options)

Table 6.5: Traffic Assessment Requirements

Location	Traffic Assessment
R408 Newtown Road Overbridge	No
Junction 7 Maynooth	Yes (Options)
R405 Ballygoran Overbridge	No

Location	Traffic Assessment
Junction 6 Celbridge	No options assessment – Junction Optimisation only *
R404 Celbridge Road Overbridge	No
Junction 5 Leixlip	No options assessment – Junction Optimisation only *

* Optimise – based on data and assessment already completed, it has already been determined that these locations have been short-listed to just one option. Thus, this assessment focus is on scenarios to optimise these junctions.

Active Travel

For the Stage 2 PAM junctions and bridges, it has been established in previous chapters that active travel is required at each location. The optimum active travel facility would provide for active travel user movement, which would align with the relevant traffic direction. This can be achieved using a number of scenarios:

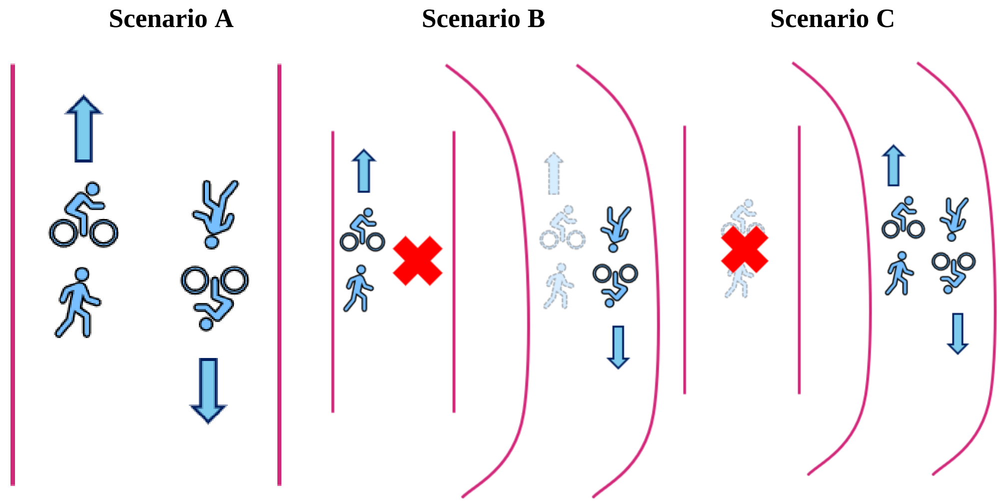


Figure 6.47: Active Travel Scenarios

In terms of NIFTI hierarchy, the scenarios would be ranked from A to C, i.e., if it can cater for facilities as per Scenario A, then there would be no requirement to move to Scenario B. A further scenario would be to provide active travel facilities on both sides, however taking cognisance of the NIFTI hierarchy, it may not be appropriate to provide two structures. This may constitute excessive intervention.

A geometric cross section analysis was carried out. This determined which scenario was preferred at each location.

Table 6.6: Active Travel Scenario Assessment

Location	Scenario A	Scenario B	Scenario C
R408 Newtown Road Overbridge	X	X	Yes
Junction 7 Maynooth	X	Yes	
R405 Ballygoran Overbridge	X	X	Yes
Junction 6 Celbridge			Yes *
R404 Celbridge Road Overbridge	X	Yes **	
Junction 5 Leixlip	X	Yes ***	

Notes:

* Junction 6 Celbridge – it was deemed not appropriate to provide for facilities through the junction.

** R404 Celbridge Road Overbridge – a location for a proposed separate structure west of the existing structure is currently being investigated. This is in line with the Local Area Plan.
*** Scenario A was possible at this location, however, given existing and future demand on this junction, it was deemed inappropriate to proceed with Scenario A.

All of the above locations require a separate active travel structure (Scenario B or Scenario C from the above table). Therefore, at each location an active travel structure option east and west of the existing bridge will be assessed against each other in a Stage 2 active travel options assessment.

Junctions and Overbridges Appraisal – Traffic

Junction 7 – Options

Based on assessments to date, the operational efficiency and safety of the junction was reviewed. Transport modelling and engineering optimisation was completed for Option 1 and Option 2. A number of linkage scenarios were tested for Option 1 and Option 2 to determine the optimum configuration.

Junction 6 – Optimisations

Based on the assessments to date, a number of optimisations were considered. A number of scenarios have been assessed to determine the optimised layout.

Junction 5 – Optimisations

Based on the assessments to date, the following optimisations were considered:

- Eastbound diverge – operational efficiency;
- Eastbound merge – review of non-standard configuration; and
- Junction 5 / Junction 4A interaction - operational efficiency and safety.

6.3.3.3 Summary of Stage 2 PAM Appraisal

A summary of the Stage 2 PAM is outlined in Table 6.7.

Table 6.7: Active Travel and Traffic Assessment Requirements

Location	Assessment Required	
	Active Travel Assessment	Traffic Assessment
R408 Newtown Road Overbridge	East Option vs West Option	No
Junction 7 Maynooth	East Option vs West Option	Option 1 vs Option 2
R405 Ballygoran Overbridge	East Option vs West Option	No
Junction 6 Celbridge	East Option vs West Option	No options assessment – Junction Optimisation only
R404 Celbridge Road Overbridge	East Option vs West Option	No
Junction 5 Leixlip	East Option vs West Option	No options assessment – Junction Optimisation only

6.4 Criteria Description

6.4.1 Safety Assessment

In accordance with TII PAG Unit 7.0, the Stage 2 Safety appraisal typically considers the following sub-criteria:

- Collision Reduction; and
- Security.

In addition, the safety assessment also incorporates Engineering Geometry.

The above sub-criteria are outlined below. The particulars of how the corridor, junction and active travel options respond to this sub-criteria are described in Sections 6.5, Section 6.6 and Section 6.7 respectively.

6.4.1.1 Collision Reduction

As outlined in TII PAG, the Stage 2 safety appraisal typically makes reference to the forecast reduction in vehicle collision and the associated safety benefits that would accrue from each option. Collision forecasts presented in the Cost Benefit Analysis (CBA) would typically comprise of a COBALT analysis, which uses details of road cross section, collision rates, casualty costs and projected traffic volumes to derive a monetised safety benefit as a result of the interventions delivered by the options.

6.4.1.2 Security

The security sub-criteria is concerned with improving the personal security of travellers and their property. Security also take into account the security of vulnerable road users, such as pedestrians and cyclists.

6.4.1.3 Engineering Geometry

Engineering geometry, while not a TII PAG Unit 7.0 requirement, is included as an additional sub-criteria. The options are assessed against current TII Standards and proposed interventions are assessed for items such as departures and relaxations from standard.

6.4.2 Economy Assessment

In accordance with TII PAG Unit 7.0, the Stage 2 Economy appraisal considers the following sub-criteria:

- Transport Efficiency and Effectiveness;
- Wider Economic Impacts; and
- Funding Impacts.

The measurement of economic impacts within the MCA aims to determine the relative welfare gain arising from the implementation of each option.

The above sub-criteria are outlined below. The particulars of how the corridor, junction and active travel options respond to the sub-criteria are described in Sections 6.5, Section 6.6 and Section 6.7 respectively.

6.4.2.1 Transport Efficiency and Effectiveness

Option Comparison Estimates

The economy assessment as part of the Stage 2 Project Appraisal Matrix includes the preparation of Option Comparison Estimates (OCEs) ranges in accordance with the requirements of the TII Cost Management Manual.

The total figures are an aggregate cost for each option under the following headings:

- Planning and Design;
- Land and Property;
- Archaeology;
- Advance Works and Other Contracts;
- Main Contract Construction;
- Main Contract Supervision (Employer's Costs); and
- Walking/Cycling/Asset Renewal.

Provisions for operation, maintenance and capital interventions required during the operational life of the project are excluded from the cost estimates.

Cost Benefit Analysis

In accordance TII PAG Unit 7.0, the assessment of options under the heading of Transport Efficiency and Effectiveness is generally captured through Cost Benefit Analysis (CBA). As noted in TII Publication PE-PMG-02042, the CBA typically encompasses all options advanced from the Stage 1 (Preliminary Options Assessment), to assess how each could increase overall welfare, after allowing for economic cost. In the case of the Maynooth to Leixlip Project, a CBA was carried out on the Corridor options and the Junction 7 options only. The reasons for this are outlined in the Transport Modelling Report. Refer to Appendix 6.4C.

6.4.2.2 Wider Economic Impact

In accordance with TII PAG Unit 7.0, the assessment of options under the criterion of Wider Economic Impacts considers the following sub-criteria:

- Competition in the market;
- Agglomeration;
- Inward Investment;
- Labour Supply; and

- Urban Regeneration.

Competition in the Market

Corridor, junction and active travel options would significantly enhance market accessibility, fostering economic competition, efficiency, employment and consumer choice. This is most likely to be successfully achieved through a combination of transport measures, including public transport, active travel and junction improvements and optimisation, supplemented by strategic demand management.

Agglomeration

Corridor, junction and active travel options would greatly improve connectivity at a local and regional level, enhancing links between markets within the study area, the Greater Dublin Area (GDA) and wider export markets via improved access to other key transport infrastructure (e.g. Dublin Port and Dublin Airport). The provision of an enhanced bus service in the region, would also present significant benefits in strengthening market linkages at a local and regional level.

Inward Investment

The improvements in transport infrastructure proposed within all options may act as a catalyst for attracting inward investment into the study area, fostering sustainable, long-term development. By enhancing connectivity both within the study area and beyond, the attractiveness of the region to investors across many sectors, including tourism, is likely to increase – where existing chronic congestion issues would otherwise stymie sustainable development.

Labour Supply

The delivery of the Maynooth to Leixlip Project would ensure strengthened linkages between key labour and employment markets both within the study area and the greater Dublin region. Enhanced bus priority and active travel facilities would encourage and support investment, tourism and employment, and enhance the economic prospects within the study area.

Urban Regeneration

Although the Maynooth to Leixlip Project traverses through areas which may be considered semi-urban in nature and may offer some indirect benefits, the regeneration of urban areas is not an overriding objective of the project.

6.4.2.3 Funding Impacts

The future funding mechanism for the project is not known at this stage. As the M4 corridor forms part of the Comprehensive TEN-T network and provides a strategically important link from the West of Ireland to the GDA, there may be potential to secure non-exchequer EU funding.

6.4.3 Environmental Assessment

In accordance with the TII PAG Unit 7.0, the environmental disciplines under which the corridor, junction and active travel options were assessed are as follows:

- Biodiversity;
- Soils and geology (including waste);
- Hydrogeology;
- Hydrology;
- Landscape and visual;
- Air Quality and climate;
- Noise and vibration;
- Human beings;
- Archaeology, architectural and cultural heritage;
- Material assets – agriculture;
- Material assets – non-agricultural; and
- Waste.

The Stage 2 environmental assessments for the corridor, junction and active travel options are outlined in Sections 6.5, Section 6.6 and Section 6.7 respectively.

6.4.4 Integration

The integration appraisal seeks to analyse the degree to which options would align with Government policy and investment priorities, at local, regional, national and EU level.

The integration appraisal focuses on the following key areas:

- Transport Integration;
- Land Use Integration;
- Geographical Integration; and
- Other Government Policy Integration.

The above sub-criteria are outlined below. The particulars of how the corridor, junction and active travel options respond to this sub-criteria are described in Sections 6.5, Section 6.6 and Section 6.7 respectively.

6.4.4.1 Transport Integration

This element evaluates improved user comfort levels, safety, and vehicular movements.

6.4.4.2 Land Use Integration

This element evaluates the compatibility of the project to support local development plans, frameworks, strategic connectivity for long distance trips for greater benefits at a regional and national scale and the mitigates the risk of urban sprawl.

6.4.4.3 Geographical Integration

This element seeks to achieve the goals set out in the National Planning Framework (NPF), particularly in relation to the key policy objectives of *"Sustainable Mobility"*, *"Compact Growth"* and *"Enhanced Regional Accessibility"*.

6.4.4.4 Other Government Policy Integration

This element focuses on promoting balanced regional development in the context of the National Development Plan (NDP), National Planning Framework (NPF) and the Greater Dublin Area Transport Strategy 2022 to 2042. Moreover, the assessment also considers alignment with other Government planning frameworks, including the Regional Spatial and Economic Strategy (RSES), the Climate Action Plan (CAP) and the National Investment Framework for Transport in Ireland (NIFTI).

6.4.5 Accessibility and Social Inclusion

For the accessibility and social inclusion assessment, corridor, junction and active travel options were evaluated in recognition of the likely benefits to those suffering from social deprivation, geographic isolation and mobility and sensory deprivation.

Two key areas are considered:

- Deprived Geographical Areas; and
- Vulnerable Groups.

Based on 2016 Pobal HP Deprivation Index census data information, the majority of the study area is within the *marginally above – affluent* level according to this index. Some areas of relative disadvantage are present – these being typically confined to more urban areas and towns.

The particulars of how the corridor, junction and active travel options respond to the sub-criteria are described in Sections 6.5, Section 6.6 and Section 6.7 respectively.

6.4.6 Physical Activity

The purpose of the Physical Activity assessment is to assess the nature of physical activity impacts of the project on active travel modes, physical recreational activities and on vulnerable groups of road users such as pedestrians and cyclists. TII PAG Unit 13.0 outlines the sub-criteria to be considered in the appraisal of options as part of the Physical Activity assessment, which include the following:

- Health Benefits;

- Absenteeism Benefits;
- Journey Ambiance Benefits;
- Changes in the number of incidents or journey time for pedestrians and cyclists; and
- Other possible impacts of pedestrian and cyclist facilities.

The particulars of how the corridor, junction and active travel options respond to the sub-criteria are described in Sections 6.5, Section 6.6 and Section 6.7 respectively.

6.5 Stage 2 Project Appraisal Matrix – Corridors

6.5.1 Safety

6.5.1.1 Collision Reduction

A qualitative appraisal has been undertaken to comparatively assess the corridor options with respect to collision reduction. Both corridor options would provide hard shoulder bus priority measures, which would aim to promote a modal shift towards public transport and therefore would have the potential to reduce the number of private vehicles on the M4/N4 decreasing collision frequency. The additional traffic lane for Corridor Option 2 may increase the need for weaving manoeuvres, thus increasing the potential for side swipe type collisions.

Table 6.8: Stage 2 PAM Corridors Assessment (Safety – Collision Reduction)

Safety	**Corridor Option 1**	**Corridor Option 2**
Qualitative Assessment	Minor or Slightly Positive	Not Significant or Neutral
Score / Impact Level	5	4
Preference	**Preferred**	**Least Preferred**

6.5.1.2 Security

Security of road users would be improved for both corridor options and each are scored positively in this regard. Both corridor options would provide hard shoulder bus priority measures, which would aim to promote a modal shift towards public transport and thus reduce the number of private vehicles on the M4/N4 decreasing collision frequency. The hard shoulder bus priority measures would be designed to current TII Standards and would also include amendments to the current configuration of the N4 eastbound carriageway between Junction 5 and Junction 4A.

Table 6.9: Stage 2 PAM Corridors Assessment (Safety – Security)

Safety	**Corridor Option 1**	**Corridor Option 2**
Qualitative Assessment	Moderately Positive	Moderately Positive
Score / Impact Level	6	6
Preference	**Preferred**	**Preferred**

6.5.1.3 Engineering Geometry

Both corridor options would provide hard shoulder bus priority measures, which would be designed to current TII Standards and would also include amendments to the current configuration of the N4 eastbound carriageway between Junction 5 and Junction 4A.

These amendments would improve the current geometric design which currently include departures from standard. These proposed interventions for both options would improve the horizontal alignment in the vicinity of Junction 5, however, the departure would not be removed. This would not be possible within the current site constraints. Corridor Option 2 would include an additional third traffic lane, which would be designed to current TII Standards.

Table 6.10: Stage 2 PAM Corridors Assessment (Safety – Engineering Geometry)

Safety	**Corridor Option 1**	**Corridor Option 2**
Qualitative Assessment	Moderately Positive	Moderately Positive
Score / Impact Level	6	6
Preference	**Preferred**	**Preferred**

6.5.2 Economy

6.5.2.1 Transport Efficiency and Effectiveness (Cost and Preliminary Economic Benefit)

The measurement of economic impacts within the MCA aims to determine the relative welfare gain arising from the implementation of both options. The Corridor Option Comparison Estimates (OCE's) are included in Appendix 6.2A.

Table 6.11: Stage 2 PAM Corridors Assessment (Economy - Option Comparison Estimates (OCE's)

Economy Criteria	**Scoring**	**Corridor Option 1**	**Corridor Option 2**
Option Cost	Summary	€25 - €35 million	€40 - €50 million
	Preference	Preferred	Least Preferred
Cost Benefit Analysis (CBA)	Summary	The Economic Assessment has been undertaken using TUBA in accordance with the relevant TII Project Appraisal Guidelines. The assessment calculated Benefit to Cost Ratio (BCR) values over a 30-year appraisal period based on the estimated costs for both options. Corridor Option 1 had a BCR of 1.56 and Corridor Option 2 had a BCR of 2.24.	
	Overall Qualitative Assessment	Moderately Negative	Moderately Negative
	Overall Score / Impact Level	2	2
	Preference	Least Preferred	Preferred

6.5.2.2 Wider Economic Impacts

In the assessment of wider economic impacts, both corridor options have been ranked neutral.

Competition in the Market

Corridor Option 1 and Corridor Option 2 may enhance market accessibility, fostering economic competition, efficiency, employment, and consumer choice. This is most likely to be successfully achieved through a combination of transport measures, including the addition of a dedicated public transport lane on the M4/N4 corridor and road improvements, supplemented by strategic demand management. Both options are therefore considered to be slightly positive.

Agglomeration

Corridor Option 1 and Corridor Option 2 may improve connectivity at a local and regional level, enhancing links between markets within the study area, the Greater Dublin Area (GDA) and wider export markets via improved access to other key transport infrastructure. The provision of an enhanced bus service in the region, will also present significant benefits in strengthening market linkages at a local and regional level. Both options are considered to be slightly positive in this regard.

Inward Investment

The improvements in transport infrastructure proposed within both options may act as a catalyst for attracting inward investment into the study area, fostering sustainable, long-term development.

By enhancing connectivity both within the study area and beyond, the attractiveness of the region to investors across many sectors, including tourism, is likely to increase – where existing chronic congestion issues would otherwise stymie sustainable development. Both options are therefore ranked as slightly positive with a slight preference for Corridor Option 2.

Labour Supply

The delivery of the Maynooth to Leixlip Project would ensure strengthened linkages between key labour and employment markets both within the study area and the greater Dublin region. Improvements in journey time and journey time reliability would encourage and support investment, tourism, and employment, and enhance the economic prospects within the study area. Both options are therefore ranked as slightly positive.

Urban Regeneration

The regeneration of urban areas is not an overriding objective of the project. Thus, both options are considered neutral in this regard.

Table 6.12: Stage 2 PAM Corridor Assessment (Economy - Wider Economic Impact)

Economy - Wider Economic Impacts	Corridor Option 1	Corridor Option 2
Competition in the Market	5	5
Agglomeration	5	5
Inward Investment	5	5
Labour Supply	5	5
Urban Regeneration	4	4
Overall Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
Overall Score / Impact Level	5	5
Preference	**Preferred**	**Preferred**

6.5.2.3 Funding Impacts

The future funding mechanism for the Maynooth to Leixlip Project is not known at this stage. As the M4/N4 corridor forms part of the Comprehensive TEN-T network and provides a strategically important link to from the west and northwest to Dublin and Dublin Port, there may be potential to secure non-exchequer EU funding.

As Corridor Option 2 is circa €15m more than Corridor Option 1, this may have an impact on the affordability and the potential availability of funding streams to deliver. Furthermore, bus priority measures are contained in the Greater Dublin Area Transport Strategy, which covers the entirety of Corridor Option 1. As such, Corridor Option 1 is Preferred.

Table 6.13: Stage 2 PAM Corridors Assessment (Economy – Funding Impacts)

Economy – Funding Impacts	Corridor Option 1	Corridor Option 2
Qualitative Assessment	Minor or Slightly Negative	Moderately Negative
Score / Impact Level	3	2
Preference	**Preferred**	**Least Preferred**

6.5.3 Environment

The Stage 2 Project Appraisal Matrix (PAM) environmental assessments for the corridor options are included in Appendix 6.3A.

Table 6.14: Stage 2 PAM Corridors Assessment (Environment)

Criteria	Scoring	Corridor Option 1	Corridor Option 2
Biodiversity	Summary	11 minor or slightly negative impacts on ecological sites	12 minor or slightly negative impacts on ecological sites
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/Impact Level	3	3
	Preference	Preferred	Least Preferred
Soils and Geology	Summary	Corridor Option 1 has the least impact as it follows the footprint of the existing M4/N4. Corridor Option 2 has a greater impact due to the addition of the westbound traffic lane.	
	Qualitative Assessment	Minor or Slightly Negative	Moderately Negative
	Score/ Impact Level	3	2
	Preference	Preferred	Least Preferred
Hydrogeology	Summary	There are no karst features, groundwater dependant habitats, groundwater discharge licenses or records of historical groundwater flooding identified within the corridor options. There are also no groundwater sources or groundwater abstractions. Corridor Option 2 would involve works at the River Liffey Bridge, therefore the impact on the aquifers is considered to be minor or slightly negative.	
	Qualitative Assessment	Not Significant or Neutral	Minor or Slightly Negative
	Score/ Impact Level	4	3
	Preference	Preferred	Least Preferred
Hydrology	Summary	The corridor options are differentiated by the number of lanes and subsequent width of the carriageway. Corridor Option 1 is preferred because it has the least amount of paved area.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Preferred	Least Preferred

Criteria	Scoring	Corridor Option 1	Corridor Option 2
Landscape and Visual	Summary	Some loss of vegetation/hedgerows due to the emergency refuge areas and cut and fill, with resulting impacts on surrounding landscape and visual receptors. Moderate negative. Overall marginally greater impacts with Corridor Option 2 because of the additional westbound traffic lane.	
	Qualitative Assessment	Moderately Negative	Moderately Negative
	Score/ Impact Level	2	2
	Preference	Preferred	Least Preferred
Archaeology, Architectural and Cultural Heritage	Summary	The corridor options would not result in any negative direct or indirect impacts upon the archaeological, architectural or cultural heritage resource.	
	Qualitative Assessment	Not significant or neutral	Not significant or neutral
	Score / Impact Level	4	4
	Preference	Preferred	Preferred
Air Quality	Summary	The provision of the hard shoulder bus priority measures offers a more sustainable option to private cars, potentially reducing emissions into the future. Corridor Option 1 is Preferred, as no change is predicted in the AADT and there is no predicted increase in NOx exposure. Corridor Option 2 is Least Preferred, as there is a predicted increase in both AADT values and NOx exposure. However, these increases are marginal.	
	Qualitative Assessment	Not Significant or Neutral	Minor or Slightly Negative
	Score/ Impact Level	4	3
	Preference	Preferred	Least Preferred
Climate	Summary	Corridor Option 1 is Preferred as there is no predicted increase in operational carbon and would result in less construction embodied carbon generated when compared with Corridor Option 2. Corridor Option 2 is predicted to result in an increase in operational carbon and a moderately negative impact on the climate caused by the embodied carbon of the construction of the corridor. Therefore, Corridor Option 2 is Least Preferred.	
	Qualitative Assessment	Moderately Negative	Moderately Negative
	Score/ Impact Level	2	2
	Preference	Preferred	Least Preferred

Criteria	Scoring	Corridor Option 1	Corridor Option 2
Noise and Vibration	Summary	Corridor Option 1 has a lower number of properties within 0 – 50m of the road edge and would result in a marginally greater reduction in traffic noise levels at the closest noise sensitive locations (NSLs), the difference is negligible and, therefore, both result in a not significant or neutral impact overall.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Preferred	Preferred
Population	Summary	Corridor Option 1 may have potential journey amenity issues where a bus is required to leave the hard shoulder bus priority measure due to a vehicle located in the hard shoulder because of an emergency. With Corridor Option 2, there is less potential journey amenity issues in the westbound direction because of the inclusion of a third lane in the westbound direction.	
	Qualitative Assessment	Not Significant or Neutral	Minor or Slightly Positive
	Score/ Impact Level	4	5
	Preference	Least Preferred	Preferred
Material Assets – Agricultural	Summary	The differences between Corridor Option 1 and Corridor Option 2 arise solely from the additional 1.5m wide carriageway which would result in a marginally higher landtake for Corridor Option 2. This difference is not significant enough to differentiate an option preference.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Preferred	Preferred
Material Assets – Non-Agricultural	Summary	Both corridor options have a similarly minor impacts from a properties and utilities perspective primarily because they are both within the existing M4/N4 corridor. However, given that Corridor Option 1 has a narrower footprint than Corridor Option 2, it is considered to be Preferred.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/ Impact Level	3	3
	Preference	Preferred	Least Preferred
Waste	Material Balance	Import of 16,000m^3	Import of 35,000m^3

Criteria	Scoring	Corridor Option 1	Corridor Option 2
	Summary	The production, processing and transportation of material to make up a deficit or remove a surplus can have significant environmental impacts in terms of traffic movements and associated greenhouse gas emissions. As such, from a constructability and sustainability perspective, options that finely balances the excavated cut and placed fill material volumes are preferred. Therefore, Corridor Option 1 is preferred.	
	Qualitative Assessment	Minor or Slightly Negative	Moderately Negative
	Score/ Impact Level	3	2
	Preference	Preferred	Least Preferred
Environment Result		**Preferred**	**Least Preferred**

6.5.4 Integration

6.5.4.1 Transport Integration

Both corridor options would facilitate improved user comfort levels, safety, and vehicular movements. Both corridor options may facilitate improvements to the operational efficiency of the M4/N4. Both corridor options are ranked as moderately positive.

6.5.4.2 Land Use Integration

Both Corridor Option 1 and Corridor Option 2 are ranked moderately positive as their measures would support local development plans and strategic connectivity, particularly bus services.

6.5.4.3 Geographical Integration

Corridor Option 1 would have better alignment with the key policy objectives of sustainable mobility, compact growth and enhanced regional accessibility. Corridor Option 1 is ranked minor or slightly positive. Corridor Option 2 is ranked not significant or neutral.

6.5.4.4 Other Government Policy Integration

Both options would aim to provide a safer and more accessible transport network that would promote more sustainable transport modes. The proposed measures have been assessed against the NIFTI intervention hierarchy which aims to maintain, optimise, and improve existing assets before adding new infrastructure.

Corridor Option 1 would have better alignment with the Climate Action Plan, than Corridor Option 2. Corridor Option 2 would require the most significant intervention. Therefore, Corridor Option 2 ranked slightly negative when compared to Corridor Option 1.

Table 6.15: Stage 2 PAM Corridor Assessment (Transport Integration Summary)

Integration	Corridor Option 1	Corridor Option 2
Transport Integration	6	6
Land Use	6	6
Geographical Integration	5	4
Other Government Policy	5	3
Overall Qualitative Assessment	Moderately Positive	Minor or Slightly Positive
Overall Score / Impact Level	6	5
Preference	**Preferred**	**Least Preferred**

6.5.5 Accessibility and Social Inclusion

Both corridor options are seen as not significant or neutral. Overall, under both sub-headings, both corridor options would offer positives in respect of improved accessibility for deprived areas, whilst noting that the occurrence of deprivation in the study area is relatively low.

Table 6.16: Stage 2 PAM Corridor Assessment (Accessibility and Social Inclusion)

Accessibility and Social Inclusion	Corridor Option 1	Corridor Option 2
Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
Score / Impact Level	4	4
Preference	**Preferred**	**Preferred**

6.5.6 Physical Activity

Both corridor options are primarily located on a motorway, except for the N4 section at Junction 5 and Junction 4a. Therefore, the impact on active travel modes, physical recreational activities and on vulnerable groups of road users is seen as not significant or neutral.

Table 6.17: Stage 2 PAM Corridor Assessment (Physical Activity)

Physical Activity	Corridor Option 1	Corridor Option 2
Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
Score / Impact Level	4	4
Preference	**Preferred**	**Preferred**

6.5.7 Corridor Options Multi-Criteria Analysis (MCA) Summary

In accordance with TII PAG Unit 7.0, the overall multi-criteria analysis compiles the outcome of each of the assessments detailed below into one overall matrix. The Stage 2 multi-criteria project appraisal matrix for the corridor options is presented below.

Table 6.18: Corridor Options - Multi-Criteria Analysis (MCA) – Sub-Criteria Summary

Criteria		Corridor Option 1	Corridor Option 2
Safety	Collision Reduction	Preferred	Least Preferred
	Security	Preferred	Preferred
	Engineering Geometry	Preferred	Preferred
Economy	Efficiency and Effectiveness	Least Preferred	Preferred
	Wider Economic Impacts	Preferred	Preferred
	Funding Impacts	Preferred	Least Preferred
Environmental	Biodiversity	Preferred	Least Preferred
	Soils and Geology	Preferred	Least Preferred
	Hydrogeology	Preferred	Least Preferred
	Hydrology	Preferred	Least Preferred
	Landscape and Visual	Preferred	Least Preferred
	Archaeological, Architectural and Cultural Heritage	Preferred	Preferred
	Air Quality	Preferred	Least Preferred
	Climate	Preferred	Least Preferred
	Noise and Vibration	Preferred	Preferred
	Population	Least Preferred	Preferred
	Material Assets – Agricultural	Preferred	Preferred
	Material Assets – Non-Agricultural	Preferred	Least Preferred
	Waste	Preferred	Least Preferred
Integration	Transport Integration	Preferred	Least Preferred
	Land Use Integration	Preferred	Least Preferred
	Geographical Integration	Preferred	Least Preferred
	Other Government Policy Integration	Preferred	Least Preferred

Criteria		Corridor Option 1	Corridor Option 2
Accessibility and Social Inclusion	Deprived Geographical Areas	Preferred	Preferred
	Vulnerable Groups	Preferred	Preferred
Physical Activity		Preferred	Preferred

Table 6.19: Corridor Options - Multi-Criteria Analysis (MCA) – CAF Criteria Summary

Criteria	Corridor Option 1	Corridor Option 2
Safety	Preferred	Least Preferred
Economy	Preferred	Preferred
Environmental	Preferred	Least Preferred
Integration	Preferred	Least Preferred
Accessibility and Social Inclusion	Preferred	Preferred
Physical Activity	Preferred	Preferred
Overall Result	**Corridor Option 1 is Preferred**	

6.6 Stage 2 Project Appraisal Matrix – Junction 7

6.6.1 Safety

6.6.1.1 Collision Reduction

As outlined in TII PAG, the Stage 2 safety appraisal typically makes reference to the forecast reduction in vehicle collision and the associated safety benefits that would accrue from each option. Collision forecasts presented in the CBA comprise of a COBALT analysis, which uses details of road cross section, collision rates, casualty costs and projected traffic volumes to derive a monetised safety benefit as a result of the interventions delivered by the options.

Option 2 benefits from more positive casualty changes by severity and discounted safety benefits based on the COBALT analysis. Option 1 and Option 2 remove vulnerable road users from the main carriageway and vehicular traffic, reducing the potential for collisions between road users.

Table 6.20: Stage 2 PAM Junction 7 Assessment (Safety – Collision Reduction)

Safety	**Junction 7 Option 1**	**Junction 7 Option 2**
Qualitative Assessment	Minor or Slightly Positive	Moderately Positive
Score / Impact Level	5	6
Preference	**Least Preferred**	**Preferred**

6.6.1.2 Security

Security of road users would be improved for both junction options, and each scored positively in this regard. Both junction options would provide enhanced vulnerable road user facilities, which would aim to promote a modal shift towards sustainable transport and thus reduce the number of private vehicles within the surrounding area, decreasing collision frequency. Option 2 would be designed to current TII Standards which is seen as advantageous.

Table 6.21: Stage 2 PAM Junction 7 Assessment (Safety – Security)

Safety	**Junction 7 Option 1**	**Junction 7 Option 2**
Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
Score / Impact Level	5	5
Preference	**Preferred**	**Preferred**

6.6.1.3 Engineering Geometry

Both junction options would provide an improvement on the current configuration. Option 2 would be designed as a fully compliant junction with relevant standards and guidelines. Geometric improvements may only be made with Option 1.

Table 6.22: Stage 2 PAM Junction 7 Assessment (Safety – Engineering Geometry)

Safety	**Junction 7 Option 1**	**Junction 7 Option 2**
Qualitative Assessment	Minor or Slightly Positive	Moderately Positive
Score / Impact Level	5	6
Preference	**Least Preferred**	**Preferred**

6.6.2 Economy

6.6.2.1 Transport Efficiency and Effectiveness (Cost and CBA)

The measurement of economic impacts within the MCA aims to determine the relative welfare gain arising from the implementation of both options. The Junction 7 Option Comparison Estimates (OCE's) are included in Appendix 6.2B.

The Cost Benefit Analysis (CBA) for the Junction 7 options is summarised in the table below, Section 6.8 of the Main Report and also the Transport Modelling Report. Refer to the Transport Modelling Report which is included in Appendix 6.4C.

Table 6.23: Stage 2 PAM Junction 7 Assessment (Economy - Option Comparison Estimates (OCE's)

Economy Criteria	**Scoring**	Junction 7 **Option 1**	Junction 7 **Option 2**
Option Cost	Summary	€25 - €30 million	€40 - €45 million
Cost Benefit Analysis (CBA)	Summary	The Economic Assessment has been undertaken using TUBA in accordance with the relevant TII Project Appraisal Guidelines. The assessment calculated Benefit to Cost Ratio (BCR) values over a 30-year appraisal period based on the estimated costs for both options. Option 1 had a BCR of 1.59 and Option 2 had a BCR of 1.16.	
	Overall Qualitative Assessment	Moderately Negative	Major or Highly Negative
	Overall Score / Impact Level	2	1
	Preference	Preferred	Least Preferred

6.6.2.2 Wider Economic Impacts

In the assessment of wider economic impacts, both junction options have been ranked neutral.

Competition in the Market

Option 1 and Option 2 may enhance market accessibility, fostering economic competition, efficiency, employment, and consumer choice. This is most likely to be successfully achieved through a combination of transport measures, including active travel, and road improvements. Both options are therefore considered to be slightly positive with slight preference towards Option 2 due to overall improvements.

Agglomeration

Option 1 and Option 2 may improve connectivity at a local and regional level, enhancing links between markets within the study area, the Greater Dublin Area (GDA) and wider export markets via improved access to other key transport infrastructure. Both options are considered to be slightly positive in this regard with slight preference towards Option 2 due to overall improvements.

Inward Investment

The improvements in transport infrastructure proposed within both options may act as a catalyst for attracting inward investment into the study area, fostering sustainable, long-term development.

By enhancing connectivity both within the study area and beyond, the attractiveness of the region to investors across many sectors, including tourism, is likely to increase – where existing chronic congestion issues would otherwise stymie sustainable development. Both options are therefore ranked as slightly positive with slight preference towards Option 2 due to overall improvements.

Labour Supply

The delivery of the Maynooth to Leixlip Project would ensure strengthened linkages between key labour and employment markets both within the study area and the greater Dublin region. Improvements in journey time and journey time reliability would encourage and support investment, tourism, and employment, and enhance the economic prospects within the study area. Both options are therefore ranked as slightly positive with slight preference towards Option 2 due to overall improvements.

Urban Regeneration

The regeneration of urban areas is not an overriding objective of the project. Thus, all options are considered neutral in this regard.

Table 6.24: Stage 2 PAM Junction 7 Assessment (Economy - Wider Economic Impact)

Economy - Wider Economic Impacts	Junction 7 Option 1	Junction 7 Option 2
Competition in the Market	4	4
Agglomeration	4	4
Inward Investment	4	4
Labour Supply	4	4
Urban Regeneration	4	4
Overall Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
Overall Score / Impact Level	4	4
Preference	**Least Preferred**	**Preferred**

6.6.2.3 Funding Impacts

The future funding mechanism for the Maynooth to Leixlip Project is not known at this stage. As the M4/N4 corridor forms part of the Comprehensive TEN-T network and provides a strategically important link to from the west and northwest to Dublin and Dublin Port, there may be potential to secure non-exchequer EU funding.

As Option 2 is circa €15m more than Option 1, this may have an impact on the affordability and the potential availability of funding streams to deliver. As such, Option 1 is Preferred.

Table 6.25: Stage 2 PAM Junction 7 Assessment (Economy – Funding Impacts)

Economy – Funding Impacts	Junction 7 Option 1	Junction 7 Option 2
Qualitative Assessment	Minor or Slightly Negative	Moderately Negative
Score / Impact Level	3	2
Preference	**Preferred**	**Least Preferred**

6.6.3 Environment

The Stage 2 Project Appraisal Matrix (PAM) environmental assessments for the Junction 7 Options are included in Appendix 6.3B.

Table 6.26: Stage 2 PAM Junction 7 Assessment (Environment)

Criteria	Scoring	Junction 7 Option 1	Junction 7 Option 2
Biodiversity	Summary	There are 3 'moderately' negative impacts and 3 'minor or slightly negative' associated with this option	There are 3 'moderately' negative impacts and 5 'minor or slightly negative' associated with this option
	Qualitative Assessment	Minor or Slightly Negative	Moderately Negative
	Score/Impact Level	3	2
	Preference	Preferred	Least Preferred
Soils and Geology	Summary	Option 1 is considered to have a moderately negative impact on the Soils and Geology. Option 2 is considered to have a major or highly negative impact on the Soils and Geology due to the potential greater loss of topsoil as a result of the works. Option 1 is Preferred and Option 2 is Least Preferred because Option 1 has a lesser impact on the Soils and Geology.	
	Qualitative Assessment	Moderately Negative	Major or Highly Negative
	Score/ Impact Level	2	1
	Preference	Preferred	Least Preferred
Hydrogeology	Summary	Option 1 is Preferred because all the impacts are classified as imperceptible with a PAG ranking of not significant or neutral. Option 2 is Least Preferred because there is a potential impact on the underlying aquifer associated with the earthworks and, resulting in a PAG ranking of minor or slightly negative.	
	Qualitative Assessment	Not Significant or Neutral	Minor or Slightly Negative
	Score/ Impact Level	4	3
	Preference	Preferred	Least Preferred
Hydrology	Summary	Option 1 is Preferred and Option 2 is Least Preferred. This is because Option 1 involves less additional impervious area resulting in reduced water quality and flood risk impact.	
	Qualitative Assessment	Not Significant or Neutral	Minor or Slightly Negative
	Score/ Impact Level	4	3
	Preference	Preferred	Least Preferred

Criteria	Scoring	Junction 7 Option 1	Junction 7 Option 2
Landscape and Visual	Summary	Although both options would be likely to result in significant localised effects on landscape fabric, landscape character and residential receptors, Option 1 is Preferred due to the reduced vertical alignment, reduced overall footprint as well as the exclusion of any proposals within the rural area to the southern side of the M4 corridor.	
	Qualitative Assessment	Major or Highly Negative	Major or Highly Negative
	Score/ Impact Level	1	1
	Preference	Preferred	Least Preferred
Archaeology, Architectural and Cultural Heritage	Summary	Both options are similar in form, being comprised for the most part, by the construction of the MOOR, which runs through open greenfield. As such, the potential impacts are very similar, but Option 2 requires a new junction and as such would result in a greater amount of previously undisturbed greenfield. Whilst both options are assessed as minor or slightly negative, Option 1 is Preferred as it would require less greenfield.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score / Impact Level	3	3
	Preference	Preferred	Least Preferred
Air Quality	Summary	Both Junction 7 Options are expected to result in a not significant or neutral impact on air quality. However, Option 1 is preferred as a lower level of construction works is required, potentially reducing the level of dust generated during the construction phase.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Preferred	Least Preferred
Climate	Summary	Option 1 is Preferred due to the lower level of construction materials required for its implementation compared to Option 2. No significant increase in carbon emissions is expected during the operational phase for either option.	
	Qualitative Assessment	Not Significant or Neutral	Minor or Slightly Negative
	Score/ Impact Level	4	3
	Preference	Preferred	Least Preferred
Noise and Vibration	Summary	In terms of preference both Junction Options are ranked Minor or Slightly Negative due to the proximity of the proposed junction and MOOR to noised sensitive receptors	

Criteria	Scoring	Junction 7 Option 1	Junction 7 Option 2
		(NSRs) within 100m and the minor change in traffic noise levels overall associated with both. Due to the higher traffic volumes along the MOOR and new overbridge north of the M4 associated with Option 2, there is a higher noise impact to NSRs compared to Option 1 and there is a potential requirement for noise mitigation to NSRs at Brookfield Park and Newtown Court. On this basis, Option 1 is Preferred and Option 2 is Least Preferred.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/ Impact Level	3	3
	Preference	Preferred	Least Preferred
Population	Summary	There would be positive impacts in terms of improved accessibility for the west side of Maynooth and for reduced traffic in the centre of the town, but also some moderate increases in traffic and residential severance elsewhere. Option 2 has a distinct positive impact in reducing traffic on Straffan Road providing for reduced congestion and some relief from severance. Option 2 is Preferred and Option 1 is Least Preferred.	
	Qualitative Assessment	Not Significant or Neutral	Minor or Slightly Positive
	Score/ Impact Level	4	5
	Preference	Least Preferred	Preferred
Material Assets – Agricultural	Summary	Option 1 is Preferred due to its lower footprint on agricultural land resulting in lower landtake and severance impacts.	
	Qualitative Assessment	Not Significant or Neutral	Moderately Negative
	Score/ Impact Level	4	2
	Preference	Preferred	Least Preferred
Material Assets – Non-Agricultural	Summary	Both Junction 7 Options have a similar moderately negative impact from a properties and utilities perspective primarily because they are both within predominantly greenfield sites. Junction 7 Option 1 would negatively impact one residential property and both HV and MV/LV overhead lines to the north of the M4. Junction 7 Option 2 would negatively impact one residential property and two commercial properties. Additionally, Junction 7 Option 2 would negatively impact both HV and MV/LV overhead lines to the north and south of the M4. Junction 7 Option 2 is Least Preferred due to the additional negative impacts on commercial properties and utilities.	

Criteria	Scoring	Junction 7 Option 1	Junction 7 Option 2
		Junction 7 Option 1 would not negatively impact commercial properties and has impacts fewer MV/LV overhead lines, and therefore is Preferred.	
	Qualitative Assessment	Moderately Negative	Moderately Negative
	Score/ Impact Level	2	2
	Preference	Preferred	Least Preferred
Waste	Material Balance	Cut of 27,000m^3 Fill of 24,000m^3 Balance of 3,000m^3	Cut of 61,000m^3 Fill of 74,000m^3 Balance of 13,000m^3
	Summary	The production, processing and transportation of material to make up a deficit or remove a surplus can have significant environmental impacts in terms of traffic movements and associated greenhouse gas emissions. As such, from a constructability and sustainability perspective, options that finely balances the excavated cut and placed fill material volumes are preferred. Therefore, Option 1 is preferred.	
	Qualitative Assessment	Minor or Slightly Negative	Moderately Negative
	Score/ Impact Level	3	2
	Preference	Preferred	Least Preferred
Environment Result		**Preferred**	**Least Preferred**

6.6.4 Integration

Transport Integration

Both options would facilitate improved user comfort levels, safety, and vehicular movements. Both options would improve the operational efficiency of Junction 7. Accordingly, both Option 1 and Option 2 are ranked as moderately positive.

Land Use Integration

This element evaluates the compatibility of the project to support local development plans, frameworks, strategic connectivity for long distance trips for greater benefits at a regional and national scale and mitigates the risk of urban sprawl.

Both Option 1 and Option 2 would include the Maynooth Outer Orbital Route (MOOR), as defined in the Draft Maynooth Local Area Plan 2024 – 2030. Both Option 1 and Option 2 are ranked moderately positive as their measures would support the local development plan and strategic connectivity.

Geographical Integration

Option 1 is considered to offer positives in comparison to Option 2, in recognition that it is more aligned with sustainable mobility and compact growth. However, the conversion of the existing Junction 7 to an overbridge, associated with Option 2, would provide improved geographical integration between Maynooth and the businesses located northwest of the M4 corridor. Option 1 and Option 2 are seen as minor or slightly positive.

Other Government Policy Integration

Both options would aim to provide a safer and more accessible transport network that could promote more sustainable transport modes. The proposed measures have been assessed against the NIFTI intervention hierarchy which aims to maintain, optimise, and improve existing assets before adding new infrastructure, therefore Option 1 is Preferred.

Table 6.27: Stage 2 PAM Junction 7 Assessment (Transport Integration Summary)

Integration	Junction 7 Option 1	Junction 7 Option 2
Transport Integration	5	5
Land Use	5	5
Geographical Integration	5	5
Other Government Policy	5	1
Overall Qualitative Assessment	Moderately Positive	Minor or Slightly Positive
Overall Score / Impact Level	6	5
Preference	**Preferred**	**Least Preferred**

6.6.5 Accessibility and Social Inclusion

The options are located at Junction 7, and are therefore not geographically distinct, relative to the wider study area. However, Option 1 and Option 2 would provide new and enhanced infrastructure facilities for vulnerable groups and provide a safer and more accessible route that would have a positive impact in facilitating the movement of people without (or with limited) access to a private car.

Table 6.28: Stage 2 PAM Junction 7 Assessment (Accessibility and Social Inclusion)

Accessibility and Social Inclusion	Junction 7 Option 1	Junction 7 Option 2
Qualitative Assessment	Moderately Positive	Moderately Positive
Score / Impact Level	6	6
Preference	**Preferred**	**Preferred**

6.6.6 Physical Activity

The provision of a new grade separated junction and conversion of the existing junction to an overbridge in Option 2 would facilitate the enhancement of the existing active travel infrastructure on Straffan Road to the Maynooth Business Campus. This would align with the Greater Dublin Area Transport Strategy. In addition, Option 2 would reduce the number of crossings points for active travel users along Straffan Road, which would result in a moderately positive impact for Option 2. On the other hand, Option 1 will provide a separated active travel bridge but there will still be a number of crossing points along Straffan Road in a heavier traffic environment which is seen as minor or slightly positive.

Table 6.29: Stage 2 PAM Junction 7 Assessment (Physical Activity)

Physical Activity	Junction 7 Option 1	Junction 7 Option 2
Qualitative Assessment	Minor or Slightly Positive	Moderately Positive
Score / Impact Level	5	6
Preference	**Least Preferred**	**Preferred**

6.6.7 Junction 7 Options - Multi-Criteria Analysis (MCA) - Summary

In accordance with TII PAG Unit 7.0, the overall multi-criteria analysis compiles the outcome of each of the assessments detailed below into one overall matrix. The Stage 2 project appraisal matrix for the Junction 7 options is presented below.

Table 6.30: Junction 7 Options - Multi-Criteria Analysis (MCA) – Junction 7 Sub-Criteria Summary

Criteria		Junction 7 Option 1	Junction 7 Option 2
Safety	Collision Reduction	Least Preferred	Preferred
	Security	Preferred	Preferred
	Engineering Geometry	Least Preferred	Preferred
Economy	Efficiency and Effectiveness	Preferred	Least Preferred
	Wider Economic Impacts	Least Preferred	Preferred
	Funding Impacts	Preferred	Least Preferred
Environmental	Biodiversity	Preferred	Least Preferred
	Soils and Geology	Preferred	Least Preferred
	Hydrogeology	Preferred	Least Preferred
	Hydrology	Preferred	Least Preferred
	Landscape and Visual	Preferred	Least Preferred

Criteria		Junction 7 Option 1	Junction 7 Option 2
	Archaeological, Architectural and Cultural Heritage	Preferred	Least Preferred
	Air Quality	Preferred	Least Preferred
	Climate	Preferred	Least Preferred
	Noise and Vibration	Preferred	Least Preferred
	Population	Least Preferred	Preferred
	Material Assets – Agricultural	Preferred	Least Preferred
	Material Assets – Non-Agricultural	Preferred	Least Preferred
	Waste	Preferred	Least Preferred
Integration	Transport Integration	Preferred	Preferred
	Land Use Integration	Preferred	Preferred
	Geographical Integration	Preferred	Preferred
	Other Government Policy Integration	Preferred	Least Preferred
Accessibility and Social Inclusion	Deprived Geographical Areas	Preferred	Preferred
	Vulnerable Groups	Preferred	Preferred
Physical Activity		Least Preferred	Preferred

Table 6.31: Junction 7 Options - Multi-Criteria Analysis (MCA) – CAF Criteria Summary

Criteria	Junction 7 Option 1	Junction 7 Option 2
Safety	Least Preferred	Preferred
Economy	Preferred	Least Preferred
Environmental	Preferred	Least Preferred
Integration	Preferred	Least Preferred
Accessibility and Social Inclusion	Preferred	Preferred
Physical Activity	Least Preferred	Preferred
Overall Result	**Junction 7 Option 1 is Preferred**	

6.7 Stage 2 Project Appraisal Matrix – Active Travel

6.7.1 R408 Newtown Road

6.7.1.1 Safety

Collision Reduction

Option 1 would require a pedestrian crossing and traffic calming to be implemented to provide access from the western side of the R408 Newtown Road to Maynooth Town Football Club on the eastern side.

Option 2 would provide an opportunity to tie in to one of the key attractors in the area, Maynooth Town Football Club. It would be possible to provide access from the active travel structure directly into the football club thus reducing the interaction between vehicular traffic and active travel users therefore reducing the probability of collisions.

Table 6.32: R408 Newtown Road Active Travel Assessment (Safety – Collision Reduction)

Safety	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Minor or Slightly Positive	Moderately Positive
Score / Impact Level	5	6
Preference	**Least Preferred**	**Preferred**

Security

With both options, the security of active travel users would be improved due to the segregation created between active travel users and vehicular traffic. In addition, the dedicated access to Maynooth Town Football Club possible as part of Option 2 would increase security for active travel users, when compared to Option 1.

Table 6.33: R408 Newtown Road Active Travel Assessment (Safety – Security)

Safety	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Minor or Slightly Positive	Moderately Positive
Score / Impact Level	5	6
Preference	**Least Preferred**	**Preferred**

Engineering Geometry

Both options would seek to be fully compliant with relevant standards and guidelines. Engineering geometry would not be a differentiator, therefore both options are Preferred.

Table 6.34: R408 Newtown Road Active Travel Assessment (Safety – Engineering Geometry)

Safety	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Moderately Positive	Moderately Positive
Score / Impact Level	6	6
Preference	**Preferred**	**Preferred**

6.7.1.2 Economy

Transport Efficiency and Effectiveness (Cost and Preliminary Economic Benefit)

The Option 1 cost estimate is circa €3.5 million and the Option 2 cost estimate is circa €3.8 million. Therefore, Option 1 is Preferred from a cost perspective.

Table 6.35: R408 Newtown Road Active Travel Assessment (Economy - Option Comparison Estimates (OCE's)

Economy Criteria	Scoring	Option 1 (West)	Option 2 (East)
Option Cost	Summary	€3.5 million	€3.8 million
	Preference	Preferred	Least Preferred
Preliminary Economic Benefit	Summary	Both options provide enhanced active travel facilities at the R408 Newtown Road Overbridge. However, Option 2 would provide enhanced integration and accessibility opportunities compared to Option 1, therefore Option 2 is Preferred.	
	Preference	Least Preferred	Preferred
Overall Qualitative Assessment		Minor or Slightly Negative	Minor or Slightly Negative
Overall Score / Impact Level		3	3
Preference		**Least Preferred**	**Preferred**

Wider Economic Impacts

Wider Economic Impacts is not a differentiator, therefore both options are considered Preferred.

Table 6.36: R408 Newtown Road Active Travel Assessment (Economy - Wider Economic Impact)

Economy - Wider Economic Impacts	Option 1 (West)	Option 2 (East)
Overall Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
Overall Score / Impact Level	4	4
Preference	**Preferred**	**Preferred**

Funding Impacts

The future funding mechanism for the active travel interventions is not known at this stage. There is only a marginal difference between the two options from a cost perspective. As such, both options are Preferred.

Table 6.37: R408 Newtown Road Active Travel Assessment (Economy – Funding Impacts)

Economy – Funding Impacts	**Option 1 (West)**	**Option 2 (East)**
Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
Score / Impact Level	3	3
Preference	**Preferred**	**Preferred**

6.7.1.3 Environment

Table 6.38: R408 Newtown Road Active Travel Assessment (Environment)

Criteria	**Scoring**	**Option 1 (West)**	**Option 2 (East)**
Biodiversity	Summary	Impacts on 4 areas of wooded vegetation, some motorway planting and established embankment wooded area. The proposed vegetation for this option appears to be less impactful in terms of potential extent.	Impacts on 4 areas of wooded vegetation, some motorway planting and established embankment wooded area. The proposed vegetation loss would likely result in greater overall loss of established screening vegetation.
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/Impact Level	3	3
	Preference	Preferred	Least Preferred
Soils and Geology	Summary	From a Soil Deposits perspective, Option 1 would be Moderately Negative while Option 2 would only be Minor or Slightly Negative. Therefore, Option 2 is Preferred. The other Soils and Geology sub-criteria are not a differentiator.	
	Qualitative Assessment	Moderately Negative	Minor or Slightly Negative
	Score/ Impact Level	2	3
	Preference	Least Preferred	Preferred
Hydrogeology	Summary	There are no karst features within the study area. There are no groundwater sources, including industrial or public supply boreholes, or source of protection areas within the study area. There are no sites of potential groundwater contamination	

Criteria	Scoring	Option 1 (West)	Option 2 (East)
		associated with licensed facilities identified within the study area. According to the GSI Groundwater Flood Data Maps there are no areas of potential groundwater flooding within the study area. There are no hydro-ecology sites identified within the study area.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/ Impact Level	3	3
	Preference	Preferred	Preferred
Hydrology	Summary	Possible hydrological connection to the Rye Water Valley SAC. Imperceptible pollution risk expected during construction or operation because of the M4 (flood level) and proposed overbridge. Imperceptible increase in flood risk to the works.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Preferred	Preferred
Landscape and Visual	Summary	There would be impacts on a small number of nearby residential receptors. Significant effects expected to be only temporary construction effects on 2-3 properties due to the works and removal of roadside vegetation.	This option is not likely to notably impact on any residential receptors. The key impacts would be on Maynooth Town Football Club which is likely to experience significant construction effects.
	Qualitative Assessment	Moderately Negative	Moderately Negative
	Score/ Impact Level	2	2
	Preference	Preferred	Least Preferred
Archaeology, Architectural and Cultural Heritage	Summary	This option would not result in any negative direct or indirect impacts upon the archaeological, architectural or cultural heritage resource.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score / Impact Level	4	4
	Preference	Preferred	Preferred
Air Quality	Summary	Slight reduction in traffic volumes due to modal shift from private car to active modes	
	Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive

Criteria	Scoring	Option 1 (West)	Option 2 (East)
	Score/ Impact Level	5	5
	Preference	Least Preferred	Preferred
Climate	Summary	Slight reduction in traffic volumes due to modal shift from private car to active modes	
	Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
	Score/ Impact Level	5	5
	Preference	Preferred	Preferred
Noise and Vibration	Summary	Option 1 would have 6 sensitive receptors. Option 2 would have 1 sensitive receptor. Option 1 would have temporary to short term negative, moderate noise impacts at higher number of NSRs compared to Option 2.	
	Qualitative Assessment	Minor or Slightly Negative	Not Significant or Neutral
	Score/ Impact Level	3	4
	Preference	Least Preferred	Preferred
Population	Summary	Provides for active travel, including for more vulnerable population subsets. Provides for improved journey amenity due to separation from traffic, especially on bridge.	
		Use is less likely for people cycling to the football club.	Use is more given the absence of a footpath on the eastern side of the existing bridge and for people cycling to the football club.
	Qualitative Assessment	Not Significant or Neutral	Minor or Slightly Positive
	Score/ Impact Level	4	5
	Preference	Least Preferred	Preferred
Material Assets – Agricultural	Summary	Option 1 is Least Preferred compared to Option 2, because of the proximity of a farmyard on the western side of the R408 and the higher potential for agricultural landtake.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Least Preferred	Preferred
Material Assets – Non-Agricultural	Summary	No residential or commercial properties would be impacted. Option 2 would impact on Maynooth Town FC lands. ESB lines to the south. ESB lines located west of Option 1 and parallel to the M4. Underground watermain located to west of R408. Eir underground services located to east of	

Criteria	Scoring	Option 1 (West)	Option 2 (East)
		R408. Option 2 is Preferred due to Option 1 having more impacts on services/utilities.	
	Qualitative Assessment	Moderately Negative	Minor or Slightly Negative
	Score/ Impact Level	2	3
	Preference	Least Preferred	Preferred
Waste	Material Balance	Import of 3,300m^3	Import of 2,400m^3
	Summary	From a constructability and sustainability perspective, options that finely balances the excavated cut and placed fill material volumes are preferred. Therefore, Option 2 is Preferred.	
	Qualitative Assessment	Moderately Negative	Moderately Negative
	Score/ Impact Level	2	2
	Preference	Least Preferred	Preferred
Environment Result		**Least Preferred**	**Preferred**

6.7.1.4 Integration

Under the heading of Transport Integration, both options would facilitate improved active travel comfort levels and safety. However, Option 2 would provide enhanced integration with the key attractor in the area, Maynooth Town Football Club, therefore Option 2 is Preferred.

Land Use Integration, Geographical Integration and Other Government Policy Integration are not differentiators.

Table 6.39: R408 Newtown Road Active Travel Assessment (Transport Integration Summary)

Integration	Option 1 (West)	Option 2 (East)
Overall Qualitative Assessment	Minor or Slightly Positive	Moderately Positive
Overall Score / Impact Level	5	6
Preference	**Least Preferred**	**Preferred**

6.7.1.5 Accessibility and Social Inclusion

Both options would provide improved access to services such as health, education and employment for vulnerable road users, particularly Maynooth Lodge Nursing Home. Option 2 would include enhanced accessibility to Maynooth Town Football Club.

Table 6.40: R408 Newtown Road Active Travel Assessment (Accessibility and Social Inclusion)

Accessibility and Social Inclusion	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Not Significant or Neutral	Minor or Slightly Positive
Score / Impact Level	4	5
Preference	**Least Preferred**	**Preferred**

6.7.1.6 Physical Activity

Both options would provide enhancements to existing pedestrian and cyclist facilities. Both options satisfy this criteria, therefore Physical Activity is not a differentiator. Both options are considered Preferred.

Table 6.41: R408 Newtown Road Active Travel Assessment (Physical Activity)

Physical Activity	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Moderately Positive	Moderately Positive
Score / Impact Level	6	6
Preference	**Preferred**	**Preferred**

6.7.1.7 R408 Newtown Road - Active Travel Assessment - Multi-Criteria Analysis (MCA) - Summary

In accordance with TII PAG Unit 7.0, the overall multi-criteria analysis compiles the outcome of each of the assessments detailed below into one overall matrix. The Stage 2 multi-criteria project appraisal matrix is presented hereunder.

Table 6.42: R408 Newtown Road Active Travel Assessment - Multi-Criteria Analysis (MCA) – Sub-Criteria Summary

Criteria		Option 1 (West)	Option 2 (East)
Safety	Collision Reduction	Least Preferred	Preferred
	Security	Least Preferred	Preferred
	Engineering Geometry	Preferred	Preferred
Economy	Efficiency and Effectiveness	Least Preferred	Preferred
	Wider Economic Impacts	Preferred	Preferred
	Funding Impacts	Preferred	Preferred

Criteria		Option 1 (West)	Option 2 (East)
Environmental	Biodiversity	Preferred	Least Preferred
	Soils and Geology	Least Preferred	Preferred
	Hydrogeology	Preferred	Preferred
	Hydrology	Preferred	Preferred
	Landscape and Visual	Preferred	Least Preferred
	Archaeological, Architectural and Cultural Heritage	Preferred	Preferred
	Air Quality	Least Preferred	Preferred
	Climate	Preferred	Preferred
	Noise and Vibration	Least Preferred	Preferred
	Population	Least Preferred	Preferred
	Material Assets – Agricultural	Least Preferred	Preferred
	Material Assets – Non-Agricultural	Least Preferred	Preferred
	Waste	Least Preferred	Preferred
Integration	Transport Integration	Least Preferred	Preferred
	Land Use Integration	Least Preferred	Preferred
	Geographical Integration	Least Preferred	Preferred
	Other Government Policy Integration	Least Preferred	Preferred
Accessibility and Social Inclusion	Deprived Geographical Areas	Least Preferred	Preferred
	Vulnerable Groups	Least Preferred	Preferred
Physical Activity		Preferred	Preferred

Table 6.43: R408 Newtown Road Active Travel Assessment - Multi-Criteria Analysis (MCA) – CAF Criteria Summary

Criteria	Option 1 (West)	Option 2 (East)
Safety	Least Preferred	Preferred
Economy	Least Preferred	Preferred
Environmental	Least Preferred	Preferred
Integration	Least Preferred	Preferred
Accessibility and Social Inclusion	Least Preferred	Preferred
Physical Activity	Preferred	Preferred
Overall Result	**R408 Newtown Road - Option 2 (East) is Preferred. However, Option 1 (West) is still a viable option. Further detailed data collection and evaluation should be carried out at the next phase.**	

6.7.2 Junction 7 Maynooth

6.7.2.1 Safety

Collision Reduction

Option 1 would require active travel users to navigate the R406 Straffan Road from west to east to access the Maynooth Business Campus.

Option 2 would provide an opportunity to tie into the key attractor in the area, the Maynooth Business Campus. It would be possible to provide access from the active travel facility into the campus thus reducing the interaction between vehicular traffic and active travel users therefore reducing the probability of collisions.

Table 6.44: Junction 7 Maynooth - Active Travel Assessment (Safety – Collision Reduction)

Safety	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Minor or Slightly Positive	Moderately Positive
Score / Impact Level	5	6
Preference	**Least Preferred**	**Preferred**

Security

With both options, the security of active travel users would be improved due to the segregation created between active travel users and vehicular traffic. Both options are Preferred.

Table 6.45: Junction 7 Maynooth - Active Travel Assessment (Safety – Security)

Safety	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
Score / Impact Level	5	5
Preference	**Preferred**	**Preferred**

Engineering Geometry

Both options would seek to be fully compliant with relevant standards and guidelines. Engineering geometry would not be a differentiator, therefore both options are Preferred.

Table 6.46: Junction 7 Maynooth - Active Travel Assessment (Safety – Engineering Geometry)

Safety	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Moderately Positive	Moderately Positive
Score / Impact Level	6	6
Preference	**Preferred**	**Preferred**

6.7.2.2 Economy

Transport Efficiency and Effectiveness (Cost and Preliminary Economic Benefit)

The Option 1 cost estimate is circa €2.9 million and the Option 2 cost estimate is circa €3.4 million. Therefore, Option 1 is Preferred from a cost perspective.

Table 6.47: Junction 7 Maynooth - Active Travel Assessment (Economy - Option Comparison Estimates (OCE's)

Economy Criteria	Scoring	Option 1 (West)	Option 2 (East)
Option Cost	Summary	€2.9 million	€3.4 million
	Preference	Preferred	Least Preferred
Preliminary Economic Benefit	Summary	Both options would provide enhanced active travel facilities. However, Option 2 would provide enhanced integration and accessibility for the Maynooth Business Campus compared to Option 1, therefore Option 2 is Preferred.	
	Preference	Least Preferred	Preferred
Overall Qualitative Assessment		Minor or Slightly Negative	Minor or Slightly Negative
Overall Score / Impact Level		3	3
Preference		**Least Preferred**	**Preferred**

Wider Economic Impacts

Wider Economic Impacts is not a differentiator, therefore both options are Preferred.

Table 6.48: Junction 7 Maynooth - Active Travel Assessment (Economy - Wider Economic Impact)

Economy - Wider Economic Impacts	Option 1 (West)	Option 2 (East)
Overall Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
Overall Score / Impact Level	4	4
Preference	**Preferred**	**Preferred**

Funding Impacts

The future funding mechanism for the active travel interventions is not known at this stage. There is only a marginal difference between the two options from a cost perspective. As such, both options are Preferred.

Table 6.49: Junction 7 Maynooth - Active Travel Assessment (Economy – Funding)

Economy – Funding Impacts	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
Score / Impact Level	3	3
Preference	**Preferred**	**Preferred**

6.7.2.3 Environment

Table 6.50: Junction 7 Maynooth - Active Travel Assessment (Environment)

Criteria	Scoring	Option 1 (West)	Option 2 (East)
Biodiversity	Summary	Option 1 would impact on 4 areas of wooded vegetation, mostly established Junction embankment wooded area, some of which extends north and south along Straffan Road. Option 2 would impact on 3 areas of wooded vegetation.	
		Qualitatively, whilst Option 1 has 1 extra KER over Option 2, it is nonetheless comprised of smaller parcels of habitat loss and hence floristic diversity.	While Option 2 would interact with 1 less KER than Option 1, qualitatively, the loss of edge vegetation along the eastern parcel of EC19 is considered more impactful, given the apparent greater impact on the integrity of this established copse.
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/Impact Level	3	3

Criteria	Scoring	Option 1 (West)	Option 2 (East)
	Preference	Preferred	Least Preferred
Soils and Geology	Summary	All Soils and Geology sub-criteria are the same and there is no differentiator. Therefore, both Option 1 and Option 2 are Preferred.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/ Impact Level	3	3
	Preference	Preferred	Preferred
Hydrogeology	Summary	There are no karst features within the study area. There are no groundwater sources, including industrial or public supply boreholes, or source of protection areas within the study area. There are no sites of potential groundwater contamination associated with licensed facilities identified within the study area. There are no areas of potential groundwater flooding within the study area. There are no hydro-ecology sites identified within the study area.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/ Impact Level	3	3
	Preference	Preferred	Preferred
Hydrology	Summary	Possible hydrological connection to the Rye Water Valley SAC. Imperceptible pollution risk expected during construction or operation because of the M4 level and proposed overbridge. Imperceptible increase in flood risk to the works.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Preferred	Preferred
Landscape and Visual	Summary	Impacts associated with Option 1 are limited to removal of roadside vegetation. Impacts associated with Option 2 are limited to loss of grassland and removal of roadside vegetation, with a greater area of tree loss than for Option 1.	
	Qualitative Assessment	Moderately Negative	Moderately Negative
	Score/ Impact Level	2	2
	Preference	Preferred	Least Preferred
Archaeology, Architectural	Summary	These options would not result in any negative direct or indirect impacts upon the archaeological, architectural or cultural heritage resource.	

Criteria	Scoring	Option 1 (West)	Option 2 (East)
and Cultural Heritage	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score / Impact Level	4	4
	Preference	Preferred	Preferred
Air Quality	Summary	Slight reduction in traffic volumes due to modal shift from private car to active modes	
	Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
	Score/ Impact Level	5	5
	Preference	Preferred	Preferred
Climate	Summary	Slight reduction in traffic volumes due to modal shift from private car to active modes	
	Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
	Score/ Impact Level	5	5
	Preference	Preferred	Preferred
Noise and Vibration	Summary	Both options have 0 sensitive receptors. Both options are comparable.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Preferred	Preferred
Population	Summary	Provides an active travel alternative to a busy road. Provides for improved journey amenity due to separation from vehicular traffic.	
		Use is less likely for people cycling to the business campus	Use is more likely for people travelling to the business campus
	Qualitative Assessment	Moderately Positive	Major or Highly Positive
	Score/ Impact Level	6	7
	Preference	Least Preferred	Preferred
Material Assets – Agricultural	Summary	Land is of good quality. No highly sensitive enterprises. No agricultural landtake.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4

Criteria	Scoring	Option 1 (West)	Option 2 (East)
	Preference	Preferred	Preferred
Material Assets – Non-Agricultural	Summary	No residential properties would be impacted. There would be minimal impact with Option 2 extending onto the Maynooth Business Campus although access to the campus would be improved. No amenities would be impacted. HV infrastructure within Option 2 although minimal. MV/ LV infrastructure within both options, however minimal. Watermains located to west of R406. Sewer located to east of R406. Eir and UPC services are located to the west of the R406. Option 1 is Preferred due to Option 2 having more impacts on services/utilities.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/ Impact Level	3	3
	Preference	Preferred	Least Preferred
Waste	Material Balance	Import of 700m^3	Import of 400m^3
	Summary	From a constructability and sustainability perspective, options that finely balances the excavated cut and placed fill material volumes are preferred. Both options are Preferred.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/ Impact Level	3	3
	Preference	Preferred	Preferred
Environment Result		**Preferred**	**Least Preferred**

6.7.2.4 Integration

Under the heading of Transport Integration, both options would facilitate improved active travel comfort levels and safety. However, Option 2 would provide enhanced integration with the key attractor in the area, Maynooth Business Campus, therefore Option 2 is Preferred.

Land Use Integration, Geographical Integration and Other Government Policy Integration are not differentiators.

Table 6.51: Junction 7 Maynooth – Active Travel Assessment (Transport Integration Summary)

Integration	Option 1 (West)	Option 2 (East)
Overall Qualitative Assessment	Minor or Slightly Positive	Moderately Positive
Overall Score / Impact Level	5	6
Preference	**Least Preferred**	**Preferred**

6.7.2.5 Accessibility and Social Inclusion

Both options would provide improved access to services such as health, education and employment for vulnerable road users. Option 2 would include enhanced accessibility to Maynooth Business Campus and therefore is Preferred.

Table 6.52: Junction 7 Maynooth – Active Travel Assessment (Accessibility and Social Inclusion)

Accessibility and Social Inclusion	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Not Significant or Neutral	Minor or Slightly Positive
Score / Impact Level	4	5
Preference	**Least Preferred**	**Preferred**

6.7.2.6 Physical Activity

Both options would provide enhancements to existing pedestrian and cyclist facilities. Both options satisfy this criteria, therefore Physical Activity is not a differentiator. Both options are Preferred.

Table 6.53: Junction 7 Maynooth – Active Travel Assessment (Physical Activity)

Physical Activity	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Moderately Positive	Moderately Positive
Score / Impact Level	6	6
Preference	**Preferred**	**Preferred**

6.7.2.7 Junction 7 Maynooth – Active Travel - Multi-Criteria Analysis (MCA) – Summary

In accordance with TII PAG Unit 7.0, the overall multi-criteria analysis compiles the outcome of each of the assessments detailed below into one overall matrix. The Stage 2 multi-criteria project appraisal matrix is presented hereunder.

Table 6.54: Junction 7 Maynooth – Active Travel Assessment – Multi-Criteria Analysis (MCA) – Sub-Criteria Summary

Criteria		Option 1 (West)	Option 2 (East)
Safety	Collision Reduction	Least Preferred	Preferred
	Security	Preferred	Preferred
	Engineering Geometry	Preferred	Preferred
Economy	Efficiency and Effectiveness	Least Preferred	Preferred
	Wider Economic Impacts	Preferred	Preferred
	Funding Impacts	Preferred	Preferred
Environmental	Biodiversity	Preferred	Least Preferred
	Soils and Geology	Preferred	Preferred
	Hydrogeology	Preferred	Preferred
	Hydrology	Preferred	Preferred
	Landscape and Visual	Preferred	Least Preferred
	Archaeological, Architectural and Cultural Heritage	Preferred	Preferred
	Air Quality	Preferred	Preferred
	Climate	Preferred	Preferred
	Noise and Vibration	Preferred	Preferred
	Population	Least Preferred	Preferred
	Material Assets – Agricultural	Preferred	Preferred
	Material Assets – Non-Agricultural	Preferred	Least Preferred
	Waste	Preferred	Preferred
Integration	Transport Integration	Least Preferred	Preferred
	Land Use Integration	Least Preferred	Preferred
	Geographical Integration	Least Preferred	Preferred
	Other Government Policy Integration	Least Preferred	Preferred
Accessibility and Social Inclusion	Deprived Geographical Areas	Least Preferred	Preferred
	Vulnerable Groups	Least Preferred	Preferred

Criteria	Option 1 (West)	Option 2 (East)
Physical Activity	Preferred	Preferred

Table 6.55: Junction 7 Maynooth – Active Travel Assessment - Multi-Criteria Analysis (MCA) – CAF Criteria Summary

Criteria	Option 1 (West)	Option 2 (East)
Safety	Least Preferred	Preferred
Economy	Least Preferred	Preferred
Environmental	Preferred	Preferred
Integration	Least Preferred	Preferred
Accessibility and Social Inclusion	Least Preferred	Preferred
Physical Activity	Preferred	Preferred
Overall Result	**Junction 7 Maynooth - Option 2 (East) is Preferred**	

6.7.3 R405 Ballygoran Road

6.7.3.1 Safety

Collision Reduction

Option 1 would require vulnerable road users to make a crossing movement on Ballygoran View which has no existing vulnerable road user facilities.

Option 2 would require vulnerable road users to make a crossing movement on the R405 which has no existing vulnerable road user facilities.

Table 6.56: R405 Ballygoran Road – Active Travel Assessment (Safety – Collision Reduction)

Safety	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
Score / Impact Level	5	5
Preference	**Preferred**	**Preferred**

Security

The personal security of vulnerable road users and their property would be improved due to the segregation created between vulnerable road users and vehicular traffic. Both options are Preferred.

Table 6.57: R405 Ballygoran Road – Active Travel Assessment (Safety – Security)

Safety	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
Score / Impact Level	5	5
Preference	**Preferred**	**Preferred**

Engineering Geometry

Both options would seek to be fully compliant with relevant standards and guidelines. Engineering geometry would not be a differentiator, therefore both options are Preferred.

Table 6.58: R405 Ballygoran Road – R408 Newtown Road Active Travel Assessment (Safety – Engineering Geometry)

Safety	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Moderately Positive	Moderately Positive
Score / Impact Level	6	6
Preference	**Preferred**	**Preferred**

6.7.3.2 Economy

Transport Efficiency and Effectiveness (Cost and Preliminary Economic Benefit)

The Option 1 cost estimate is circa €3.0 million and the Option 2 cost estimate is circa €3.9 million. Therefore, Option 1 is Preferred from a cost perspective.

Table 6.59: R405 Ballygoran Road – Active Travel Assessment (Economy – Option Comparison Estimates (OCE’s)

Economy Criteria	Scoring	Option 1 (West)	Option 2 (East)
Option Cost	Summary	€3.0 million	€3.9 million
	Preference	Preferred	Least Preferred
Preliminary Economic Benefit	Summary	Both options would provide enhanced active travel facilities	
	Preference	Preferred	Preferred
Overall Qualitative Assessment		Minor or Slightly Negative	Minor or Slightly Negative

Economy Criteria	Scoring	Option 1 (West)	Option 2 (East)
Overall Score / Impact Level		3	3
Preference		**Preferred**	**Least Preferred**

Wider Economic Impacts

Wider Economic Impacts is not a differentiator, therefore both options are considered Preferred.

Table 6.60: R405 Ballygoran Road – Active Travel Assessment (Economy – Wider Economic Impact)

Economy – Wider Economic Impacts	Option 1 (West)	Option 2 (East)
Overall Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
Overall Score / Impact Level	4	4
Preference	**Preferred**	**Preferred**

Funding Impacts

The future funding mechanism for the active travel interventions is not known at this stage. There is only a marginal difference between the two options from a cost perspective. As such, both options are Preferred.

Table 6.61: R405 Ballygoran Road – Active Travel Assessment (Economy – Funding)

Economy – Funding Impacts	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
Score / Impact Level	3	3
Preference	**Preferred**	**Preferred**

6.7.3.3 Environment

Table 6.62: R405 Ballygoran Road – Active Travel Assessment (Environment)

Criteria	Scoring	Option 1 (West)	Option 2 (East)
Biodiversity	Summary	Impacts on 2 areas of wooded vegetation, mostly established Junction embankment wooded area as well as some motorway verge grassland.	
		Option 1 is less impactful in terms of overall extent of disturbance and wooded vegetation loss.	EC23 is a large, more established parcel of wooded vegetation. In addition, Option 2 also has a greater loss of woodland vegetation.
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative

Criteria	Scoring	Option 1 (West)	Option 2 (East)
	Score/Impact Level	3	3
	Preference	Preferred	Least Preferred
Soils and Geology	Summary	From a Soil Deposits perspective, Option 1 would be Not Significant or Neutral while Option 2 would be Minor or Slightly Negative. Therefore, Option 1 is Preferred. The other Soils and Geology sub-criteria are not a differentiator.	
	Qualitative Assessment	Moderately Negative	Moderately Negative
	Score/ Impact Level	2	2
	Preference	Preferred	Least Preferred
Hydrogeology	Summary	There are no karst features within the study area. There are no groundwater sources, including industrial or public supply boreholes, or source of protection areas within the study area. There are no sites of potential groundwater contamination associated with licensed facilities identified within the study area. There are no areas of potential groundwater flooding within the study area. There are no hydro-ecology sites identified within the study area.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/ Impact Level	3	3
	Preference	Preferred	Preferred
Hydrology	Summary	There would be no connection to the Rye Water Valley SAC. Imperceptible pollution risk expected during construction or operation because of the M4 level and proposed overbridge. Imperceptible increase in flood risk to the works.	Low risk of impacting the Rye Water Valley SAC. Imperceptible pollution risk expected during construction or operation because of the M4 (flood level) and proposed overbridge. Imperceptible increase in flood risk to the works.
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Preferred	Preferred
Landscape and Visual	Summary	There would be an impact on roadside planting to the west of the R405 but no other notable impacts on landscape fabric and there would be no impact on character.	

Criteria	Scoring	Option 1 (West)	Option 2 (East)
		There are no nearby sensitive visual receptors to the west of the road and no significant visual effects are expected	There is likely to be an indirect impact on a single nearby residential property to the northeast and the effect could be significant particularly during construction.
	Qualitative Assessment	Minor or Slightly Negative	Moderately Negative
	Score/ Impact Level	3	2
	Preference	Preferred	Least Preferred
Archaeology, Architectural and Cultural Heritage	Summary	These options would not result in any negative direct or indirect impacts upon the archaeological, architectural or cultural heritage resource.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score / Impact Level	4	4
	Preference	Preferred	Preferred
Air Quality	Summary	Slight reduction in traffic volumes due to modal shift from private car to active modes.	
	Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
	Score/ Impact Level	5	5
	Preference	Preferred	Preferred
Climate	Summary	Slight reduction in traffic volumes due to modal shift from private car to active modes.	
	Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
	Score/ Impact Level	5	5
	Preference	Preferred	Preferred
Noise and Vibration	Summary	Both options have 0 sensitive receptors. Both options are comparable.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Preferred	Preferred
Population	Summary	Provides an active travel alternative to a busy road. Provides for improved journey amenity due to separation from vehicular traffic.	
		Use is less likely for people cycling to businesses and	Use is more likely for people travelling to businesses and

Criteria	Scoring	Option 1 (West)	Option 2 (East)
		education facilities in the morning.	education facilities in the morning, but the Option provides for no connection for journeys west.
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Preferred	Preferred
Material Assets – Agricultural	Summary	Land is of good quality. Viability is medium. There would be 2 highly sensitive enterprises. Landtake is insignificant.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Preferred	Preferred
Material Assets – Non-Agricultural	Summary	No residential, commercial or amenities would be impacted. A gas pipeline located at the R405/ Ballygoran View junction. UPC services located parallel to the R405. Option 1 is Preferred due to Option 2 having more impacts on services/utilities.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/ Impact Level	3	3
	Preference	Preferred	Least Preferred
Waste	Material Balance	Import of 800m^3	Import of 700m^3
	Summary	From a constructability and sustainability perspective, options that finely balances the excavated cut and placed fill material volumes are preferred. Both options are Preferred.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/ Impact Level	3	3
	Preference	Preferred	Preferred
Environment Result		**Preferred**	**Least Preferred**

6.7.3.4 Integration

Under the heading of Transport Integration, both options would facilitate improved active travel comfort levels and safety.

Land Use Integration, Geographical Integration and Other Government Policy Integration are not differentiators.

Table 6.63: R405 Ballygoran Road - Active Travel Assessment (Transport Integration Summary)

Integration	**Option 1 (West)**	**Option 2 (East)**
Overall Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
Overall Score / Impact Level	5	5
Preference	**Preferred**	**Preferred**

6.7.3.5 Accessibility and Social Inclusion

Both options would provide improved access to services such as health, education and employment for vulnerable road users.

Table 6.64: R405 Ballygoran Road - Active Travel Assessment (Accessibility and Social Inclusion)

Accessibility and Social Inclusion	**Option 1 (West)**	**Option 2 (East)**
Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
Score / Impact Level	4	4
Preference	**Preferred**	**Preferred**

6.7.3.6 Physical Activity

Both options would provide enhancements to existing pedestrian and cyclist facilities. Both options satisfy this criteria, therefore Physical Activity is not a differentiator. Both options are Preferred.

Table 6.65: R405 Ballygoran Road - Active Travel Assessment (Physical Activity)

Physical Activity	**Option 1 (West)**	**Option 2 (East)**
Qualitative Assessment	Moderately Positive	Moderately Positive
Score / Impact Level	6	6
Preference	**Preferred**	**Preferred**

6.7.3.7 R405 Ballygoran Road - Active Travel Assessment - Multi-Criteria Analysis (MCA) - Summary

In accordance with TII PAG Unit 7.0, the overall multi-criteria analysis compiles the outcome of each of the assessments detailed below into one overall matrix. The Stage 2 multi-criteria project appraisal matrix is presented hereunder.

Table 6.66: R405 Ballygoran Road - Active Travel Assessment - Multi-Criteria Analysis (MCA) – Sub-Criteria Summary

Criteria		Option 1 (West)	Option 2 (East)
Safety	Collision Reduction	Preferred	Preferred
	Security	Preferred	Preferred
	Engineering Geometry	Preferred	Preferred
Economy	Efficiency and Effectiveness	Preferred	Least Preferred
	Wider Economic Impacts	Preferred	Preferred
	Funding Impacts	Preferred	Preferred
Environmental	Biodiversity	Preferred	Least Preferred
	Soils and Geology	Preferred	Least Preferred
	Hydrogeology	Preferred	Preferred
	Hydrology	Preferred	Preferred
	Landscape and Visual	Preferred	Least Preferred
	Archaeological, Architectural and Cultural Heritage	Preferred	Preferred
	Air Quality	Preferred	Preferred
	Climate	Preferred	Preferred
	Noise and Vibration	Preferred	Preferred
	Population	Preferred	Preferred
	Material Assets – Agricultural	Preferred	Preferred
	Material Assets – Non-Agricultural	Preferred	Least Preferred
	Waste	Preferred	Preferred
Integration	Transport Integration	Preferred	Preferred
	Land Use Integration	Preferred	Preferred
	Geographical Integration	Preferred	Preferred
	Other Government Policy Integration	Preferred	Preferred

Criteria		**Option 1 (West)**	**Option 2 (East)**
Accessibility and Social Inclusion	Deprived Geographical Areas	Preferred	Preferred
	Vulnerable Groups	Preferred	Preferred
Physical Activity		Preferred	Preferred

Table 6.67: R405 Ballygoran Road - Active Travel Assessment - Multi-Criteria Analysis (MCA) – CAF Criteria Summary

Criteria	**Option 1 (West)**	**Option 2 (East)**
Safety	Preferred	Preferred
Economy	Preferred	Least Preferred
Environmental	Preferred	Least Preferred
Integration	Preferred	Preferred
Accessibility and Social Inclusion	Preferred	Preferred
Physical Activity	Preferred	Preferred
Overall Result	**R405 Ballygoran Road - Option 1 (West) is marginally Preferred. However, Option 2 (East) is still a viable option. Further detailed data collection and evaluation should be carried out at the next phase.**	

6.7.4 Junction 6 Celbridge

6.7.4.1 Safety

Collision Reduction

Option 1 would follow vulnerable road users' desire line from residential properties to key attractors to the south of the M4, including schools and commercial premises. Therefore, Option 1 is preferred due to providing safer facilities on the desire line.

Table 6.68: Junction 6 Celbridge - Active Travel Assessment (Safety – Collision Reduction)

Safety	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Moderately Positive	Minor or Slightly Positive
Score / Impact Level	6	5
Preference	**Preferred**	**Least Preferred**

Security

With both options, the security of active travel users would be improved due to the segregation created between active travel users and vehicular traffic. In addition, the presence of dedicated vulnerable road user facilities on the primary desire line increases the preference of Option 1.

Table 6.69: Junction 6 Celbridge – Active Travel Assessment (Safety – Security)

Safety	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Moderately Positive	Minor or Slightly Positive
Score / Impact Level	6	5
Preference	**Preferred**	**Least Preferred**

Engineering Geometry

Both options would seek to be fully compliant with relevant standards and guidelines. Engineering geometry would not be a differentiator, therefore both options are Preferred.

Table 6.70: Junction 6 Celbridge – Active Travel Assessment (Safety – Engineering Geometry)

Safety	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Moderately Positive	Moderately Positive
Score / Impact Level	6	6
Preference	**Preferred**	**Preferred**

6.7.4.2 Economy

Transport Efficiency and Effectiveness (Cost and Preliminary Economic Benefit)

The Option 1 cost estimate is circa €4.9 million and the Option 2 cost estimate is circa €5.0 million. Therefore, Option 1 is Preferred from a cost perspective.

Table 6.71: Junction 6 Celbridge – Active Travel Assessment (Economy – Option Comparison Estimates (OCE's)

Economy Criteria	Scoring	Option 1 (West)	Option 2 (East)
Option Cost	Summary	€4.9 million	€5.0 million
	Preference	Preferred	Least Preferred
Preliminary Economic Benefit	Summary	Both options would provide enhanced active travel facilities at the Junction 6 Overbridge. However, Option 1 would provide enhanced integration and accessibility, compared to Option 2, therefore Option 1 is Preferred.	
	Preference	Preferred	Least Preferred
Overall Qualitative Assessment		Minor or Slightly Negative	Minor or Slightly Negative
Overall Score / Impact Level		3	3
Preference		**Preferred**	**Least Preferred**

Wider Economic Impacts

Wider Economic Impacts is not a differentiator, therefore both options are Preferred.

Table 6.72: Junction 6 Celbridge – Active Travel Assessment (Economy – Wider Economic Impact)

Economy – Wider Economic Impacts	Option 1 (West)	Option 2 (East)
Overall Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
Overall Score / Impact Level	4	4
Preference	**Preferred**	**Preferred**

Funding Impacts

The future funding mechanism for the active travel interventions is not known at this stage. There is only a marginal difference between the two options from a cost perspective. As such, both options are Preferred.

Table 6.73: Junction 6 Celbridge – Active Travel Assessment (Economy – Funding)

Economy – Funding Impacts	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
Score / Impact Level	3	3
Preference	**Preferred**	**Preferred**

6.7.4.3 Environment

Table 6.74: Junction 6 Celbridge – Active Travel Assessment (Environment)

Criteria	Scoring	Option 1 (West)	Option 2 (East)
Biodiversity	Summary	Both options impacts on 2 areas of wooded vegetation, mostly established junction embankment wooded area as well as some motorway verge grassland. Option 1 would, in terms of direct KER interactions and quality and extent of proposed habitat loss, be Preferred.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/Impact Level	3	3
	Preference	Preferred	Least Preferred
Soils and Geology	Summary	From a Soil Deposits perspective, Option 1 would be Moderately Negative while Option 2 would only be Minor or Slightly Negative. From a Contaminated Sites perspective, Option 1 would be Minor or Slightly Negative while Option 2 would be Not Significant or Neutral. Therefore, Option 2 is Preferred. The other Soils and Geology sub-criteria are not a differentiator.	
	Qualitative Assessment	Moderately Negative	Moderately Negative
	Score/ Impact Level	2	2
	Preference	Least Preferred	Preferred
Hydrogeology	Summary	There are no karst features within the study area. There are no groundwater sources, including industrial or public supply boreholes, or source of protection areas within the study area. There are no sites of potential groundwater contamination associated with licensed facilities identified within the study area. There are no areas of potential groundwater flooding within the study area. There are no hydro-ecology sites identified within the study area.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/ Impact Level	3	3
	Preference	Preferred	Preferred
Hydrology	Summary	No connection to the Rye Water Valley SAC. Imperceptible pollution risk expected during construction or operation because of the M4 level and proposed overbridge. Imperceptible	Low risk of impacting the Rye Water Valley SAC. Imperceptible pollution risk expected during construction or operation because of the M4 (flood level) and proposed overbridge.

Criteria	**Scoring**	**Option 1 (West)**	**Option 2 (East)**
		increase in flood risk to the works.	Imperceptible increase in flood risk to the works.
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Preferred	Preferred
Landscape and Visual	Summary	There would be an impact on roadside planting but no other notable impacts on landscape fabric and there would be no impact on character.	
		There are no nearby sensitive visual receptors to the west of the junction and no significant visual effects are expected	Indirect impacts expected on nearby sensitive visual receptors at Harpur Lane with potential significant visual effects particularly during construction.
	Qualitative Assessment	Minor or Slightly Negative	Moderately Negative
	Score/ Impact Level	3	2
	Preference	Preferred	Least Preferred
Archaeology, Architectural and Cultural Heritage	Summary	Both options would have a direct, negative, slight impact on fragmented demesne landscape associated with Castletown House (DL2).	
		No other impact	Direct, negative, significant impact on remains of burnt mound (AH19) that may extend into the footprint of the option.
	Qualitative Assessment	Minor or Slightly Negative	Moderately Negative
	Score / Impact Level	3	2
	Preference	Preferred	Least Preferred
Air Quality	Summary	Slight reduction in traffic volumes due to modal shift from private car to active modes	
	Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
	Score/ Impact Level	5	5
	Preference	Preferred	Preferred
Climate	Summary	Slight reduction in traffic volumes due to modal shift from private car to active modes	
	Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive

Criteria	Scoring	Option 1 (West)	Option 2 (East)
	Score/ Impact Level	5	5
	Preference	Preferred	Least Preferred
Noise and Vibration	Summary	Both options have 0 sensitive receptors. Both options are comparable.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Preferred	Preferred
Population	Summary	Provides for active travel alternative avoiding a busy junction. Provides for improved journey amenity due to separation from vehicular traffic.	
		N/A	The journey amenity gain is greater for people employed at the Liffey Business Campus.
	Qualitative Assessment	Moderately Positive	Major or Highly Positive
	Score/ Impact Level	6	7
	Preference	Least Preferred	Preferred
Material Assets – Agricultural	Summary	Land is of good quality. Viability is medium. No highly sensitive enterprises. No agricultural landtake.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Preferred	Preferred
Material Assets – Non-Agricultural	Summary	No residential, commercial or amenities would be impacted. A medium pressure gas pipeline located at tie-in of Option 2 and the R449. Watermain located at tie-in of Option 2 and the E449. UPC services located at the tie-in of Option 2 and the R449. BT services adjacent to the R449 to the north of the site may be impacted. Option 1 is Preferred due to Option 2 having more impacts on services/utilities.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/ Impact Level	3	3
	Preference	Preferred	Least Preferred
Waste	Material Balance	Import of 13,000m^3	Import of 12,000m^3
	Summary	From a constructability and sustainability perspective, options that finely balances the excavated cut and placed fill material volumes are preferred. Therefore, Option 2 is Preferred.	

Criteria	Scoring	Option 1 (West)	Option 2 (East)
	Qualitative Assessment	Moderately Negative	Moderately Negative
	Score/ Impact Level	2	2
	Preference	Least Preferred	Preferred
Environment Result		**Preferred**	**Least Preferred**

6.7.4.4 Integration

Under the heading of Transport Integration, both options would facilitate improved active travel comfort levels and safety. However, Option 1 would provide enhanced integration with the key attractors in the area such as schools and commercial areas, therefore Option 1 is Preferred.

Land Use Integration, Geographical Integration and Other Government Policy Integration are not differentiators.

Table 6.75: Junction 6 Celbridge – Active Travel Assessment (Transport Integration Summary)

Integration	Option 1 (West)	Option 2 (East)
Overall Qualitative Assessment	Moderately Positive	Minor or Slightly Positive
Overall Score / Impact Level	6	5
Preference	**Preferred**	**Least Preferred**

6.7.4.5 Accessibility and Social Inclusion

Both options would provide improved access to services such as health, education and employment for vulnerable road users. Option 1 would include enhanced accessibility to schools and commercial areas, because it would be directly on the desire line for vulnerable road users.

Table 6.76: Junction 6 Celbridge – Active Travel Assessment (Accessibility and Social Inclusion)

Accessibility and Social Inclusion	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Moderately Positive	Minor or Slightly Positive
Score / Impact Level	6	5
Preference	**Preferred**	**Least Preferred**

6.7.4.6 Physical Activity

Both options would provide enhancements to existing pedestrian and cyclist facilities. Both options satisfy this criteria, therefore Physical Activity is not a differentiator. Both options are Preferred.

Table 6.77: Junction 6 Celbridge – Active Travel Assessment (Physical Activity)

Physical Activity	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Moderately Positive	Moderately Positive
Score / Impact Level	6	6
Preference	**Preferred**	**Preferred**

6.7.4.7 Junction 6 Celbridge – Active Travel Assessment – Multi-Criteria Analysis (MCA) – Summary

In accordance with TII PAG Unit 7.0, the overall multi-criteria analysis compiles the outcome of each of the assessments detailed below into one overall matrix. The Stage 2 multi-criteria project appraisal matrix is presented hereunder.

Table 6.78: Junction 6 Celbridge – Active Travel Assessment – Multi-Criteria Analysis (MCA) – Sub-Criteria Summary

Criteria		Option 1 (West)	Option 2 (East)
Safety	Collision Reduction	Preferred	Least Preferred
	Security	Preferred	Least Preferred
	Engineering Geometry	Preferred	Preferred
Economy	Efficiency and Effectiveness	Preferred	Least Preferred
	Wider Economic Impacts	Preferred	Preferred
	Funding Impacts	Preferred	Preferred
Environmental	Biodiversity	Preferred	Least Preferred
	Soils and Geology	Least Preferred	Preferred
	Hydrogeology	Preferred	Preferred
	Hydrology	Preferred	Preferred
	Landscape and Visual	Preferred	Least Preferred
	Archaeological, Architectural and Cultural Heritage	Preferred	Least Preferred
	Air Quality	Preferred	Preferred
	Climate	Preferred	Least Preferred
	Noise and Vibration	Preferred	Preferred
	Population	Least Preferred	Preferred

Criteria		**Option 1 (West)**	**Option 2 (East)**
	Material Assets – Agricultural	Preferred	Preferred
	Material Assets – Non-Agricultural	Preferred	Least Preferred
	Waste	Least Preferred	Preferred
Integration	Transport Integration	Preferred	Least Preferred
	Land Use Integration	Preferred	Least Preferred
	Geographical Integration	Preferred	Least Preferred
	Other Government Policy Integration	Preferred	Least Preferred
Accessibility and Social Inclusion	Deprived Geographical Areas	Preferred	Least Preferred
	Vulnerable Groups	Preferred	Least Preferred
Physical Activity		Preferred	Preferred

Table 6.79: Junction 6 Celbridge – Active Travel Assessment - Multi-Criteria Analysis (MCA) – CAF Criteria Summary

Criteria	**Option 1 (West)**	**Option 2 (East)**
Safety	Preferred	Least Preferred
Economy	Preferred	Least Preferred
Environmental	Preferred	Least Preferred
Integration	Preferred	Least Preferred
Accessibility and Social Inclusion	Preferred	Least Preferred
Physical Activity	Preferred	Preferred
Overall Result	**Junction 6 Celbridge - Option 1 (West) is Preferred**	

6.7.5 R404 Celbridge Road

An active structure is not proposed at the R404 Celbridge Road Overbridge, as a new active travel structure is proposed as part of a separate planning application. Based on this separate planning permission, this new active travel structure will be located in the vicinity of the Wonderful Barn.

This proposed structure would serve vulnerable road users travelling on the R404 with a desire to cross the M4, and therefore eliminating the need for a further active travel structure at the R404 Celbridge Road Overbridge as part of the Maynooth to Leixlip Project.

6.7.6 Junction 5 Leixlip

6.7.6.1 Safety

Collision Reduction

Both Option 1 and Option 2 would remove vulnerable road users for the existing overbridge to a dedicated active travel structure. This would result in a potential decrease in collisions. Both options are Preferred.

Table 6.80: Junction 5 Leixlip – Active Travel Assessment (Safety – Collision Reduction)

Safety	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Moderately Positive	Moderately Positive
Score / Impact Level	6	6
Preference	**Preferred**	**Preferred**

Security

With both options, the security of active travel users would be improved due to the segregation created between active travel users and vehicular traffic. Both options are Preferred.

Table 6.81: Junction 5 Leixlip – Active Travel Assessment (Safety – Security)

Safety	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Moderately Positive	Moderately Positive
Score / Impact Level	6	6
Preference	**Preferred**	**Preferred**

Engineering Geometry

Both options would seek to be fully compliant with relevant standards and guidelines. Engineering geometry would not be a differentiator, therefore both options are considered Preferred.

Table 6.82: Junction 5 Leixlip – Active Travel Assessment (Safety – Engineering Geometry)

Safety	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Moderately Positive	Moderately Positive
Score / Impact Level	6	6
Preference	**Preferred**	**Preferred**

6.7.6.2 Economy

Transport Efficiency and Effectiveness (Cost and Preliminary Economic Benefit)

The Option 1 cost estimate is circa €3.3 million and the Option 2 cost estimate is circa €2.7 million. Therefore, Option 2 is Preferred from a cost perspective.

Table 6.83: Junction 5 Leixlip – Active Travel Assessment (Economy – Option Comparison Estimates (OCE's)

Economy Criteria	Scoring	Option 1 (West)	Option 2 (East)
Option Cost	Summary	€3.3 million	€2.7 million
	Preference	Least Preferred	Preferred
Preliminary Economic Benefit	Summary	Both options would provide enhanced active travel facilities at the Junction 5.	
	Preference	Preferred	Preferred
Overall Qualitative Assessment		Minor or Slightly Negative	Minor or Slightly Negative
Overall Score / Impact Level		3	3
Preference		**Least Preferred**	**Preferred**

Wider Economic Impacts

Wider Economic Impacts is not a differentiator, therefore both options are Preferred.

Table 6.84: Junction 5 Leixlip – Active Travel Assessment (Economy – Wider Economic Impact)

Economy – Wider Economic Impacts	Option 1 (West)	Option 2 (East)
Overall Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
Overall Score / Impact Level	4	4
Preference	**Preferred**	**Preferred**

Funding Impacts

The future funding mechanism for the active travel interventions is not known at this stage. There is only a marginal difference between the two options from a cost perspective. As such, both options are Preferred.

Table 6.85: Junction 5 Leixlip – Active Travel Assessment (Economy – Funding Impacts)

Economy – Funding Impacts	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
Score / Impact Level	3	3
Preference	**Preferred**	**Preferred**

6.7.6.3 Environment

Table 6.86: Junction 5 Leixlip – Active Travel Assessment (Environment)

Criteria	Scoring	Option 1 (West)	Option 2 (East)
Biodiversity	Summary	Option 1 would impact on 4 areas of wooded vegetation, mostly established junction embankment wooded area as well as some motorway verge grassland. Option 2 would impact on 3. Notwithstanding the greater number of KERs impacts and the apparent similar area of habitat loss, Option 1 is Preferred as the quality and maturity of vegetation loss for this option is potentially less impactful than Option 2.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/Impact Level	3	3
	Preference	Preferred	Least Preferred
Soils and Geology	Summary	From a Soil Deposits perspective, Option 1 would be Minor or Slightly Negative while Option 2 would only be Not Significant or Neutral. Therefore, Option 2 is Preferred. The other Soils and Geology sub-criteria are not a differentiator.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/ Impact Level	3	3
	Preference	Least Preferred	Preferred

<table>
<tr><th>Criteria</th><th>Scoring</th><th>Option 1 (West)</th><th>Option 2 (East)</th></tr>
<tr><td rowspan="4">Hydrogeology</td><td>Summary</td><td colspan="2">There are no karst features within the study area. There are no groundwater sources, including industrial or public supply boreholes, or source of protection areas within the study area. There are no sites of potential groundwater contamination associated with licensed facilities identified within the study area. There are no areas of potential groundwater flooding within the study area. There are no hydro-ecology sites identified within the study area.
The Liffey Valley pNHA (Site 000128) is located approximately 300m to the north and east of the Junction 5 Leixlip – Option 1. Although the site is outside the study area (250 m from the centre line), the habitat is included as it is located downgradient of Junction 5 Leixlip.</td></tr>
<tr><td>Qualitative Assessment</td><td>Minor or Slightly Negative</td><td>Minor or Slightly Negative</td></tr>
<tr><td>Score/ Impact Level</td><td>3</td><td>3</td></tr>
<tr><td>Preference</td><td>Preferred</td><td>Preferred</td></tr>
<tr><td rowspan="5">Hydrology</td><td>Summary</td><td colspan="2">Imperceptible pollution risk expected during construction or operation because of the M4 level and proposed overbridge. Imperceptible increase in flood risk to the works.</td></tr>
<tr><td></td><td>No connection to the Rye Water Valley SAC.</td><td>Low risk of impacting the Rye Water Valley SAC.</td></tr>
<tr><td>Qualitative Assessment</td><td>Not Significant or Neutral</td><td>Not Significant or Neutral</td></tr>
<tr><td>Score/ Impact Level</td><td>4</td><td>4</td></tr>
<tr><td>Preference</td><td>Preferred</td><td>Preferred</td></tr>
<tr><td rowspan="5">Landscape and Visual</td><td>Summary</td><td colspan="2">There would be an impact on roadside planting but no other notable impacts on landscape fabric and there would be no impact on character.</td></tr>
<tr><td></td><td>No significant visual effects expected due to lack of nearby receptors to the west of the junction.</td><td>Effects on nearby residential receptors expected to be moderate at most due to screening. Preferred option due to slightly less impact on vegetation.</td></tr>
<tr><td>Qualitative Assessment</td><td>Minor or Slightly Negative</td><td>Minor or Slightly Negative</td></tr>
<tr><td>Score/ Impact Level</td><td>3</td><td>3</td></tr>
<tr><td>Preference</td><td>Least Preferred</td><td>Preferred</td></tr>
<tr><td rowspan="2">Archaeology, Architectural and Cultural Heritage</td><td>Summary</td><td colspan="2">This option would not result in any negative direct or indirect impacts upon the archaeological, architectural or cultural heritage resource.</td></tr>
<tr><td>Qualitative Assessment</td><td>Not Significant or Neutral</td><td>Not Significant or Neutral</td></tr>
</table>

Criteria	Scoring	Option 1 (West)	Option 2 (East)
	Score / Impact Level	4	4
	Preference	Preferred	Preferred
Air Quality	Summary	Slight reduction in traffic volumes due to modal shift from private car to active modes.	
	Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
	Score/ Impact Level	5	5
	Preference	Preferred	Preferred
Climate	Summary	Slight reduction in traffic volumes due to modal shift from private car to active modes	
	Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
	Score/ Impact Level	5	5
	Preference	Preferred	Preferred
Noise and Vibration	Summary	Option 1 has 2 sensitive receptors. Option 2 has 3 sensitive receptors. Comparable impacts compared to Option 2 within 50 – 100m. Long term, the impacts are neutral.	
	Qualitative Assessment	Not Significant or Neutral	Minor or Slightly Negative
	Score/ Impact Level	4	3
	Preference	Preferred	Least Preferred
Population	Summary	Provides an active travel alternative. Provides for crossing of the eastbound diverge from the M50, although this could be facilitated by just the alternative of a signalised crossing. Journey amenity would be marginally improved more with Option 1.	
	Qualitative Assessment	Moderate Positive	Slight Positive
	Score/ Impact Level	6	5
	Preference	Preferred	Least Preferred
Material Assets – Agricultural	Summary	Option 1 is Least Preferred compared to Option 2, because there may be agricultural landtake required for Option 1 and not for Option 2.	
	Qualitative Assessment	Not Significant or Neutral	Not Significant or Neutral
	Score/ Impact Level	4	4
	Preference	Least Preferred	Preferred
	Summary	No residential, commercial or amenities impacted. A foul sewer crosses both options. Eir services and UPC services	

Criteria	Scoring	Option 1 (West)	Option 2 (East)
Material Assets – Non-Agricultural		adjacent to Option 2 at R403. Option 1 is Preferred due to Option 2 having more impacts on services/utilities.	
	Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative
	Score/ Impact Level	3	3
	Preference	Preferred	Least Preferred
Waste	Material Balance	Import of $0m^3$	Import of $100m^3$
	Summary	Corridor Option 1 is Preferred, because there is no cut	
	Qualitative Assessment	Not significant or neutral	Minor or Slightly Negative
	Score/ Impact Level	4	3
	Preference	Preferred	Least Preferred
Environment Result		**Preferred**	**Least Preferred**

6.7.6.4 Integration

Under the heading of Transport Integration, both options would facilitate improved active travel comfort levels and safety. Land Use Integration, Geographical Integration and Other Government Policy Integration are not differentiators.

Table 6.87: Junction 5 Leixlip - Active Travel Assessment (Transport Integration Summary)

Integration	Option 1 (West)	Option 2 (East)
Overall Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
Overall Score / Impact Level	5	5
Preference	**Preferred**	**Preferred**

6.7.6.5 Accessibility and Social Inclusion

Both options would provide improved access to services such as health, education and employment for vulnerable road users.

Table 6.88: Junction 5 Leixlip - Active Travel (Accessibility and Social Inclusion)

Accessibility and Social Inclusion	Option 1 (West)	Option 2 (East)
Qualitative Assessment	Minor or Slightly Positive	Minor or Slightly Positive
Score / Impact Level	5	5
Preference	**Preferred**	**Preferred**

6.7.6.6 Physical Activity

Both options would provide enhancements to existing pedestrian and cyclist facilities. Both options satisfy this criteria, therefore Physical Activity is not a differentiator. Both options are Preferred.

Table 6.89: Junction 5 Leixlip - Active Travel Assessment (Physical Activity)

Physical Activity	**Option 1 (West)**	**Option 2 (East)**
Qualitative Assessment	Moderately Positive	Moderately Positive
Score / Impact Level	6	6
Preference	**Preferred**	**Preferred**

6.7.6.7 Junction 5 Leixlip - Active Travel Assessment - Multi-Criteria Analysis (MCA) - Summary

In accordance with TII PAG Unit 7.0, the overall multi-criteria analysis compiles the outcome of each of the assessments detailed below into one overall matrix. The Stage 2 multi-criteria project appraisal matrix is presented hereunder.

Table 6.90: Junction 5 Leixlip - Active Travel Assessment - Multi-Criteria Analysis (MCA) – Sub-Criteria Summary

Criteria		**Option 1 (West)**	**Option 2 (East)**
Safety	Collision Reduction	Preferred	Preferred
	Security	Preferred	Preferred
	Engineering Geometry	Preferred	Preferred
Economy	Efficiency and Effectiveness	Least Preferred	Preferred
	Wider Economic Impacts	Preferred	Preferred
	Funding Impacts	Preferred	Preferred
Environmental	Biodiversity	Preferred	Least Preferred
	Soils and Geology	Least Preferred	Preferred
	Hydrogeology	Preferred	Preferred
	Hydrology	Preferred	Preferred
	Landscape and Visual	Least Preferred	Preferred
	Archaeological, Architectural and Cultural Heritage	Preferred	Preferred
	Air Quality	Preferred	Preferred
	Climate	Preferred	Preferred
	Noise and Vibration	Preferred	Least Preferred
	Population	Preferred	Least Preferred

Criteria		**Option 1 (West)**	**Option 2 (East)**
	Material Assets – Agricultural	Least Preferred	Preferred
	Material Assets – Non-Agricultural	Preferred	Least Preferred
	Waste	Preferred	Least Preferred
Integration	Transport Integration	Preferred	Preferred
	Land Use Integration	Preferred	Preferred
	Geographical Integration	Preferred	Preferred
	Other Government Policy Integration	Preferred	Preferred
Accessibility and Social Inclusion	Deprived Geographical Areas	Preferred	Preferred
	Vulnerable Groups	Preferred	Preferred
Physical Activity		Preferred	Preferred

Table 6.91: Junction 5 Leixlip - Active Travel Assessment - Multi-Criteria Analysis (MCA) – CAF Criteria Summary

Criteria	**Option 1 (West)**	**Option 2 (East)**
Safety	Preferred	Preferred
Economy	Least Preferred	Preferred
Environmental	Preferred	Least Preferred
Integration	Preferred	Preferred
Accessibility and Social Inclusion	Preferred	Preferred
Physical Activity	Preferred	Preferred
Overall Result	**Junction 5 Leixlip - Option 1 (West) is marginally Preferred.** **However, Option 2 (East) is still a viable option. Further detailed data collection and evaluation should be carried out at the next phase.**	

6.8 Transport Analysis

6.8.1 Overview

Detailed transport modelling on the Junction 5, Junction 6 and Junction 7 options was undertaken using the NTA's Eastern Regional Model (ERM) in combination with the Maynooth to Leixlip Project Local Area Model (LAM) developed specifically for the project. This section provides an overview of the performance of the options tested. The Stage 2 detailed transport analysis is contained in the Transport Modelling Report which is included in Appendix 6.4C.

6.8.2 Junction 7 Maynooth (Options)

Junction 7 Maynooth options were analysed under the following headings:

- Flows;
- Delays;
- Maynooth Business Campus - Select Link Analysis;
- Straffan Road Junction; and
- Local/Motorway Flows.

Refer to Appendix 6.4A for more details.

Detailed LINSIG and LAM modelling was carried out for Junction 7 Option 1 and Option 2. A workflow of the modelling carried out is presented below. Refer to Appendix 6.4B for more details.

Figure 6.48: Junction 7 Maynooth – Detailed LINSIG and LAM Modelling

6.8.3 Junction 6 Celbridge (Optimisations)

A pedestrian Level of Service (LOS) analysis was carried out for Junction 6 Celbridge. Refer to Appendix 6.4A for more details.

6.8.4 Junction 5 Leixlip (Optimisations)

A pedestrian Level of Service (LOS) analysis was carried out. Junction flows and a Select Link Analysis were also undertaken. Refer to Appendix 6.4A for more details.

6.9 Cost Benefit Analysis

A detailed Cost Benefit Analysis (CBA) was undertaken in accordance with TII PAG Unit 6.1, on Corridor Option 1 and Corridor Option 2, and also Junction 7 Option 1 and Option 2. The Economic Assessment has been undertaken using TUBA in accordance with TII PAG. The Present Value of Costs (PVC) for the purposes of undertaking the CBA have been generated by converting the Option Comparison Estimates into TUBA cost inputs in accordance with the TII PAG. The assessment has calculated Benefit to Cost Ratio (BCR) values over a 30-year appraisal period (inclusive of residual value) based on the estimated costs for the options.

6.9.1 Corridor Options

A summary of the results for the Corridor options is provided below.

Table 6.92: Detailed Cost Benefit Analysis Summary – Corridor Options

Criteria	Corridor Option 1	Corridor Option 2
Present Value of Benefits (PVB) (€'000)	23,947	49,121
Present Value of Costs (PVC) (€'000)	16,463	23,022
Net Present Value (NPV) (€'000)	8,608	27,223
Benefit to Cost Ratio (BCR)	**1.56**	**2.24**

Corridor Option 1 achieved benefits of €23.9 million and had costs of €16.5 million. Corridor Option 2 achieved benefits of €49.1 million and had costs of €23.0 million. Although Corridor Option 2 had higher costs, the Present Value of Benefits for Corridor Option 2 exceeds that of Corridor Option 1, thus providing Corridor Option 2 with a higher BCR.

The Cost Benefit Analysis for Corridor Option 1 and Corridor Option 2 is contained with the Transport Modelling Report which is included in Appendix 6.4C.

6.9.2 Junction 7 Maynooth

A summary of the results for the Junction 7 options is provided below.

Table 6.93: Detailed Cost Benefit Analysis Summary – Junction 7 Options

Criteria	Junction 7 – Option 1	Junction 7 – Option 2
Present Value of Benefits (PVB) (€'000)	24,832	26,981
Present Value of Costs (PVC) (€'000)	15,664	23,223
Net Present Value (NPV) (€'000)	9,168	3,758
Benefit to Cost Ratio (BCR)	**1.59**	**1.16**

Junction 7 Option 1 achieved benefits of €24.8 million and had costs of €15.7 million. Junction 7 Option 2 achieved benefits of €26.9 million and had costs of €23.2 million. Higher costs for the development of a new junction results in a lower BCR for Junction 7 Option 2.

Junction 7 Option 2 also scores a negative benefit for Consumer User Benefits due to its location further west of the existing junction. This increases the journey length from Dublin to Maynooth and Maynooth to Dublin resulting in a cost, rather than benefits to users of this option.

The Cost Benefit Analysis for Junction 7 Option 1 and Option 2 is contained with the Transport Modelling Report which is included in Appendix 6.4C.

6.10 Preferred Options to Advance to Stage 3

The options to be advanced to Stage 3 (Preferred Options) are presented below.

Table 6.94: Preferred Options to Advance to Stage 3

Corridors	**Option Description**
Corridor Option 1	Bus priority measures within the hard shoulder in both the eastbound and westbound directions
Junctions	**Option Description**
Junction 5 Leixlip	Improve and Optimise Existing Junction - Signalise northern junction (Eastbound Diverge) - Eastbound Diverge to be amended from 1 lane to 2 lanes
Junction 6 Celbridge	Improve and Optimise Existing Junction - Signalise all approaches to the junction - Improve active travel facilities
Junction 7 Maynooth - Option 1	Improve and Optimise Existing Junction - Westbound Diverge to be realigned and signalised - Eastbound Diverge to be realigned and signalised - Maynooth Outer Orbital Route (MOOR) to be incorporated
Active Travel	**Option Description**
R408 Newtown Road Overbridge	New Active Travel Structure to the east of the Existing
Junction 7 Maynooth	New Active Travel Structure to the east of the Existing
R405 Ballygoran Road Overbridge	New Active Travel Structure to the west of the Existing. Option 1 (West) is marginally Preferred. However, Option 2 (East) is still a viable option. Further detailed data collection and evaluation should be carried out at the next phase.
Junction 6 Celbridge	New Active Travel Structure to the west of the Existing
R404 Celbridge Road Overbridge	An active structure is not proposed at the R404 Celbridge Road Overbridge, as a new active travel structure is proposed as part of a separate planning application. Based on this separate planning permission, this new active travel structure will be located in the vicinity of the Wonderful Barn.
Junction 5 Leixlip	New Active Travel Structure to the west of the Existing. Option 1 (West) is marginally Preferred. However, Option 2 (East) is still a viable option. Further detailed data collection and evaluation should be carried out at the next phase.

The above options are intended to work together as a suite of interventions, combined to potentially aid in addressing the need for intervention along the M4/N4 corridor.

7 Stage 3 Preferred Option and Preparation of PABS

7.1 Introduction

Stage 3 of the Phase 2 (Options Selection) process comprises the final detailed appraisal of the preferred options, recommended from Stage 2. This analysis involves the completion of a summary appraisal, as presented in Section 7.2.

7.2 Project Appraisal Balance Sheet of the Preferred Options

7.2.1 Overview

The Project Appraisal Balance Sheet (PABS) is a summary appraisal of project impacts based on the outputs of various forms of assessment carried out during the planning and design stages of project development. The PABS acts as a tool in summarising the expected impacts of the proposed options. The PABS is completed at the end of the Options Selection phase on the preferred options and is subsequently updated throughout the later stages of the project.

The PABS is based on a qualitative and quantitative evaluation of a range of criteria and elements as outlined in the Department of Transport Common Appraisal Framework namely, Environment, Safety, Economy, Accessibility and Social Inclusion, Integration and Physical Activity. A detailed multi-criteria analysis under each of these criteria was undertaken on the Corridors, Junction 7 Maynooth and Active Travel options.

The PABS is comprised of four sections as follows:

7.2.2 PABS Part A

Part A of the PABS contains general project information namely the project title, project reference number, project contact details and a brief description of the project.

7.2.3 PABS Part B

Part B of the PABS deals with the environmental appraisal of the project. The environmental assessments provided in Chapters 5 and 6 are used in the compilation of Part B.

7.2.4 PABS Part C

Part C of the PABS deals with the remaining five criteria for the assessment, namely, Safety, Economy, Accessibility and Social Inclusion, Integration and Physical Activity.

7.2.5 PABS Part D

Part D of the PABS is a summary statement of the assessment which is compiled on the basis of the input to Parts A, B and C.

7.2.6 Completed PABS

A copy of the completed Project Appraisal Balance Sheets are included in the appendices as follows:

- Appendix 7.1 – Corridors;
- Appendix 7.2 – Junction 7 Maynooth;
- Appendix 7.3 – Active Travel;
    - Appendix 7.3A – R408 Newtown Road;
    - Appendix 7.3B – Junction 7 Maynooth;
    - Appendix 7.3C – R405 Ballygoran;
    - Appendix 7.3D – Junction 6 Celbridge; and
    - Appendix 7.3E – Junction 5 Leixlip.

7.3 Additional Testing and Considerations on the Preferred Options

A number of demand management options have been tested or were a consideration on the preferred option.

- The DART+West - consideration on the preferred options in consultation with the National Transport Authority.
- Test Transit Oriented Development - consideration on the preferred options in consultation with the relevant local authority planning departments.
- Test the Mix of Land Uses in close proximity to each other - consideration on the preferred options in consultation with the relevant local authority planning departments.
- Test Alternative Demand Sensitivity Analysis - tested on the preferred options.
- Congestion Charges, Road Pricing and Tolling - consideration on the preferred options.
- Reduced Speed Limits - consideration on the preferred options.
- Variable Speed Limits - consideration on the preferred options.

- Ramp Metering/Junction Access Control Signals - consideration on the preferred options.
- Interchange Facilities Considerations - consideration on the preferred options in consultation with the NTA and relevant local authority planning departments.
- Public Realm and Urban Design Considerations - tested on the preferred options.

7.4 Recommendation of Preferred Options

The recommendation of this Phase 2 Options Report is to advance the preferred options, as outlined in Table 7.1 below and shown in the Chapter 7 drawings contained in Volume B, to meet the project objectives outlined in Chapter 1 of this report. Table 7.2 outlines in summary how the preferred options for the Maynooth to Leixlip Project delivers on the project objectives.

Table 7.1: Recommendation of Preferred Options

Corridors	Option Description
Corridor Option 1	Bus priority measures within the hard shoulder in both the eastbound and westbound directions
Junctions	**Option Description**
Junction 5 Leixlip	Improve and Optimise the Existing Junction - Signalise northern junction (Eastbound Diverge) - Eastbound Diverge to be amended from 1 lane to 2 lanes
Junction 6 Celbridge	Improve and Optimise the Existing Junction - Signalise all approaches to the junction - Improve active travel facilities
Junction 7 Maynooth - Option 1	Improve and Optimise the Existing Junction - Westbound Diverge to be realigned and signalised - Eastbound Diverge to be realigned and signalised - Maynooth Outer Orbital Route (MOOR) to be incorporated
Active Travel	**Option Description**
R408 Newtown Road	New Active Travel Structure to the east of the Existing
Junction 7 Maynooth	New Active Travel Structure to the east of the Existing
R405 Ballygoran Road	New Active Travel Structure to the west of the Existing. Option 1 (West) is marginally Preferred. However, Option 2 (East) is still a viable option. Further detailed data collection and evaluation should be carried out at the next phase.
Junction 6 Celbridge	New Active Travel Structure to the west of Existing
R404 Celbridge Road	An active structure is not proposed at the R404 Celbridge Road Overbridge, as a new active travel structure is proposed as part of a separate planning application. Based on this separate planning permission, this new active travel structure will be located in the vicinity of the Wonderful Barn.

Corridors	Option Description
Junction 5 Leixlip	New Active Travel Structure to the west of the Existing. Option 1 (West) is marginally Preferred. However, Option 2 (East) is still a viable option. Further detailed data collection and evaluation should be carried out at the next phase.

Table 7.2: Preferred Options and Project Objectives

Objective Criteria	Project Specific Objectives	Preferred Options
Economy	• Provide a more reliable and resilient transport solution. • Manage congestion on the M4/N4 corridor. • Provide the infrastructure to enable transport solutions to move more people more efficiently. • Support the protection of the economic prospects of Maynooth, Leixlip, Celbridge, Kilcock, Enfield and their rural hinterland. • Facilitate effective strategic traffic movement, including from regional centres of Athlone and Sligo. • Facilitate effective freight movement.	• The preferred options achieve value for money, with a positive Benefit to Cost Ratio which provide benefits to public transport, active travel and road users alike. • The specific interventions under the headings of corridors, junctions and active travel would improve the operational efficiency and resilience of the overall transport network within the study area. • This would be achieved by improving and optimising the existing road infrastructure at Junction 5 Leixlip, Junction 6 Celbridge and Junction 7 Maynooth. • This would enable the M4/N4 corridor to perform its primary function to facilitate effective strategic traffic movement, including from regional centres of Athlone and Sligo. • As the preferred options are multi-modal, inclusive of the provision of bus services and active travel facilities, they prioritise person throughput over vehicle throughput and will ultimately enhance the overall transportation network within the study area and along the M4/N4 corridor.
Safety	• Enable the provision of a safer travelling environment for all road users, including vulnerable road users.	• The security of road users would be improved as a result of the proposed options along the corridor and particularly at Junction 5 Leixlip, Junction 6 Celbridge and Junction 7 Maynooth. • The preferred options would achieve an improved level of operational efficiency. • The provision of dedicated active facilities at the R408 Newtown Road, Junction 7 Maynooth, R405 Ballygoran, Junction 6 Celbridge and Junction 5 Leixlip would accommodate vulnerable road users in a safer manner.

Objective Criteria	Project Specific Objectives	Preferred Options
Environment	• Facilitate an increase in modal shift from private car to public transport and walking/cycling thus supporting a transition towards low carbon and climate resilience.	• The preferred options for the Maynooth to Leixlip Project would aim to maximising the value and sustainable use of existing infrastructure. • The provision of bus priority measures on the M4/N4 would support a reduction in private car dependency and improve modal choice. It would support a transition towards low carbon and climate resilience and align with government national, regional and local policy. • Detailed assessments of predicted noise impacts will be undertaken during future phases of the preferred options as they get taken forward as separate dedicated bus priority, active travel and junction optimisation projects. • Opportunities exist along the M4/N4 corridor to incorporate noise mitigation measures as part of the improvement works which have the potential to result in positive impacts to existing properties. • Future phases of the preferred options will determine the precise impact, if any, of theses future projects on designated Nature 2000 sites. • Future phases of the preferred options would determine in detail the anticipated environmental impacts and identify any mitigation measures required to minimise these impacts. • Appropriate Assessment Screening and, if required, Appropriate Assessment, will be undertaken to assess any potential implication of the preferred options on designated ecological sites, including the Rye Water Valley/Carton SAC. • The preferred options would not impact on any heritage sites of national importance.

Objective Criteria	Project Specific Objectives	Preferred Options
	• Provide improved accessibility to the GDA public transport network from regions outside of the GDA. • Support improved connectivity for all road users to public transport. • Enable the successful creation of place making and assist in the generation of vibrant communities.	• The components of the preferred options, including bus priority measures, active travel facilities and junction optimisations would improve accessibility to and from the Greater Dublin Area by supporting improved connectivity for all road users to public transport. • The preferred options would improve north-south connectivity across the M4/N4, which currently presents a barrier to inter-community travel. • The provision of improved facilities for active travel in addition to the inclusion of bus service enhancements would encourage more travel independence for vulnerable groups.
	• Provide the infrastructure to support an improved balance of transport modes. • Support greater road-based user integration and connectivity with all other transport modes.	• The preferred options would support the integration of road-based transport with other modes of travel through the provision of bus priority measures. • Further work on the integration of Park and Ride measures within the corridor will be undertaken during future phases of the preferred options, in conjunction with the National Transport Authority. • The enhancements proposed within the preferred options meet the objectives of the TEN-T Network by delivering a more resilient transport corridor by ensuring safe, secure and high-quality standards for both passenger and freight transport. • The project would further strengthen access to Dublin Port in line with the objectives of the Regional Spatial and Economic Strategy. • The preferred options support the objectives of national, regional and local planning policy and be compatible with adopted land-use objectives.

Objective Criteria	Project Specific Objectives	Preferred Options

	• Improve infrastructure in, across and adjacent to the M4/N4 corridor which may form barriers to physical activity and in particular linkage between key local trip attractors including education, work, residential, leisure and natural environment.
	• Support the provision for cycle parking and infrastructure at key public transport nodes and destinations.
	• Support the creation of a healthy environment conducive to active travel.
		• Dedicated pedestrian and cyclist facilities would be provided at the following locations:
		  ○ R408 Newtown Road;
		  ○ Junction 7 Maynooth;
		  ○ R405 Ballygoran;
		  ○ Junction 6 Celbridge; and
		  ○ Junction 5 Leixlip.
		• These interventions would eliminate vulnerable road users from interacting with live traffic at the existing overbridge locations and thereby ensure a more comfortable and spacious environment for active travel users.
		• The active travel strategy for the Maynooth to Leixlip Project aims to provide connectivity between the main communities within the study area and along the corridor. These are Maynooth and Leixlip to the north and Celbridge to the south.
		• The Maynooth to Leixlip Project active travel proposals align fully with the NTA Greater Dublin Area Draft Cycle Network Plan, which sets out the strategy for the development of an integrated cycle network.
		• The completion of cycle parking surveys at key locations in Maynooth, Celbridge and Leixlip would also be included, supporting the provision for cycle parking and infrastructure at key public transport nodes and destinations.