Chapter 3

Consideration of Alternatives

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3 CONSIDERATION OF ALTERNATIVES

3.1 Introduction

The EIA Directive requires that the EIAR contains a description of the reasonable alternatives studied by the developer and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects. In terms of road development, this has been transposed through Section 50(2)(b) of the Roads Act, 1993 – 2023 (as amended), which requires that the EIAR contain the following:

> *"(iv) a description of the reasonable alternatives studied by the road authority or the Authority, as the case may be, which are relevant to the proposed road development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the proposed road development on the environment."*

This chapter of the EIAR builds on the initial considerations in **Chapter 2 – Background and Need for the Scheme**. It provides a description of the alternatives considered during the evolution of the Proposed Scheme through the option selection and design stages, taking into account environmental considerations. This chapter provides an assessment of the following:

- Alternative options based on the N2 Slane Bypass Options Selection Report [RPS for MCC, 2020] (**Section 3.3**);
- Alternative design stage alternatives (e.g. bridge form, pier form) for the Proposed Scheme (**Section 3.4**); and
- Alternative construction stage alternatives – compounds, bridge construction, haul routes – for the Proposed Scheme (**Section 3.5**).

It sets out the main reasons for selecting the chosen option and how environmental considerations were taken into account in deciding on the selected option over other options. During option selection and the design stage, iterative feedback between the environmental assessment team and the engineering design team, influenced the selection of the Proposed Scheme presented in **Chapter 4 – Description of the Proposed Scheme**. The environmental assessment process has helped to avoid, reduce or minimise the impacts of the Proposed Scheme on the environment. A full description of the Proposed Scheme is provided in **Chapter 4**.

3.2 Approach to Consideration of Alternatives

The approach to consideration and assessment of options during the constraints and option selection process for the N2 Slane Bypass has applied the following guidelines for national roads projects:

- Project Management Guidelines [PMG] (TII, Various Dates, and updated December 2020);
- Project Manager's Manual for Major National Road Projects (TII, February 2019);
- Project Appraisal Guidelines [PAG] for National Roads Unit 7.0 – Multi Criteria Analysis (TII, October 2016); and
- Common Appraisal Framework for Transport Projects and Programmes (Department of Transport, March 2016 and updated October 2021).

The TII guidelines set out a phased approach to project development, appraisal and consideration of alternatives leading to the statutory planning process. Of particular relevance to consideration of alternatives is Phase 2 of the TII approach – Constraints, Preliminary Options Appraisal and Shortlisting. Within this key phase, environmental constraints are identified and analysed, feasible options are developed and a multi-criteria analysis (MCA) is undertaken to identify initially a short list, and ultimately a preferred option, to take forward to the statutory planning process.

The development of options has also had regard to the principal policy objectives in relation to development of the Proposed Scheme (refer to **Chapter 2 – Background and Need for the Scheme**) and the outcomes of the planning process for the previous scheme in 2012.

Traffic management options assessed as part of the route option selection process were also considered as part of a wider Slane Public Realm proposal which was being brought forward by MCC. While the public realm considerations post-dated the route options selection for the Slane Bypass, synergies were noted between the removal of HGV/ through-traffic from Slane village and opportunities for public realm enhancements in the village. Consideration was therefore given to integrating elements from the public realm proposals that were dependant on traffic management improvements, into the Proposed Scheme to add value to the overall proposal for the local community involved. For the purpose of the Slane Bypass Scheme, the alternatives considered in relation to the public realm were to include the traffic management elements within the scheme or not. This is set out in **Section 3.6**.

3.2.1 Option Selection Approach

Taking account of the existing constraints and the project objectives, a long list of options was developed. The options were then assessed in a two-stage assessment process before the preferred option was identified as follows:

Stage 1 – Preliminary Options Assessment

A long list of options generated following constraints identification and analysis was initially assessed in relation to their effect on the three key criteria of environment, economy and engineering. This process identified the best options to bring forward to the Stage 2 appraisal. In Stage 1, an initial set of Traffic Management options were also assessed. In this way the best of the Traffic Management options were identified and brought forward for Stage 2 appraisal also. The following scoring mechanism was used under the environment[1], engineering and economy criteria in the analysis:

- **Low** preference *(Red)* was given to options scoring poorly in any criteria.
- **Moderate** preference *(Yellow)* was given to options which were not described as high or low.
- **High** preference *(Green)* was given to options scoring well in any criteria.

Stage 2 – Project Appraisal

The options have been appraised in accordance with national transport planning policy using the Common Appraisal Framework (Department of Transport, 2016) and TII Project Appraisal Guidelines (2016)[2] based on the following six Common Appraisal Framework Criteria (which in turn have several detailed sub-criteria):

- Economy
- Safety
- Environment
- Accessibility & Social Inclusion
- Integration
- Physical Activity

An MCA is carried out on the shortlisted options. The assessment is evidence-based, resulting in the identification of the option which best meets the objectives of the project and balances competing constraints. All appraisal criteria use a standard scale for scoring ranging from 1 (major or highly negative impact) to 7 (major or highly positive impact). A score of 4 represents a neutral or not significant impact. All scores refer to impacts measured relative to the Do-Nothing or Do-Minimum options. The performance of each option in meeting the scheme objectives is then categorised as one of the following:

- **Preferred** – The choice which most fully meets the project objectives.
- **Good** – Where project objectives are met notably better than with the intermediate choices but notably not as well as with the best choice.
- **Intermediate** – Where project objectives are met considerably less well than with the best choice but considerably better than with the worst choice.
- **Poor** – Where project objectives are met notably less well than with the intermediate choices but notably not as well as with the best option.

[1] Sub-criteria were also used for the Engineering and Environment criteria, in line with the Checklist for Preliminary Options Assessment (Engineering & Environment) in Appendix A2.4 of TII's PMG (2010).

[2] Note: The Common Appraisal Framework (2016) was updated in 2021, however the six CAF criteria have not changed.

- **Least Preferred** – The choice which does least to achieve the project objectives.

3.2.2 Design and Construction Stage Alternatives Approach

Design alternatives were evaluated having regard to the following criteria with advantages and disadvantages of each option informing the overall outcome:

- Technical Evaluation;
- Environmental Evaluation;
- Aesthetic Evaluation;
- Economic Evaluation;
- Construction and Buildability Evaluation;
- Hydraulic Evaluation;
- Construction Health and Safety Evaluation; and
- Durability and Maintenance Evaluation.

3.3 Option Selection

The complete Options Selection Report was published in 2020 (RPS for MCC, 2020) and was the subject of public consultation. This document can be accessed at https://n2slanebypass.ie/ and is contained in **Appendix 3.1** Based on the Options Selection Report, this chapter of the EIAR and the associated **Appendix 3.1** provides a description of the alternatives studied, the comparison of environmental effects and an indication of the main reasons for choosing the preferred option in light of other reasonable options available.

3.3.1 Stage 1 Appraisal

3.3.1.1 Stage 1 Options Considered

3.3.1.1.1 Baseline Options Considered

As a starting point, a Do-Nothing and a Do-Minimum Option for the scheme were defined as a baseline or reference future case in which the scheme is not built and against which the alternatives could be compared:

- **Do-Nothing:** The ‘Do-Nothing’ option (i.e. the existing single carriageway) comprises the existing N2 road infrastructure and its ability to meet future demands for traffic and road safety without any upgrade or junction improvement works, other than routine maintenance.
- **Do-Minimum:** The ‘Do-Minimum’ option (i.e. the existing single carriageway with some minor improvements) comprises the N2 alignment in its current form with the incorporation of low-cost improvements or safety schemes, such as signage, resurfacing etc., and routine maintenance accounted for in its current and future ability to meet traffic and safety demands. The Do-Minimum option includes the continuation of existing traffic management measures to manage the operation of Slane Bridge and traffic through Slane village. For the purposes of traffic assessment and modelling, the Do-Minimum scenario includes for the addition of committed road schemes to the future existing road network, as follows:
  - The N52 Ardee Bypass is a planned improvement to the strategic road network that is expected to be built by the opening year and is included in the Do-Minimum future road network; and
  - Improvements to the N51 at Dunmoe, between Slane and Navan will also be completed at which point, it is proposed to raise the speed limit on this section of the N51 from 80 km/h to 100 km/h.

Given the sub-standard conditions of the route through Slane village and the health and safety risk to both through-traffic and local users under the existing road and traffic conditions, the need for improvement of the route at this location was considered clear and, in that context, the implementation of a Do-Nothing scenario was not considered a reasonable alternative from the outset and was not progressed through to Stage 1

Assessment. However, the Do-Minimum scenario was considered a reasonable baseline future scenario taking into account other developments and improvements to the road network which were considered to be committed e.g. those described at the time in the National Development Plan 2018 – 2027 (Department of Public Expenditure and Reform, 2018), under the headings 'Investing in the North-West Region' and 'Accessibility to the North-West'.

Bypass Options Considered

Following the completion of the Constraints Study in 2018, where the natural, physical and external constraints relating to a proposed N2 Slane Bypass were identified, a series of fifteen preliminary bypass route options emerged as being potentially feasible solutions for initial consideration.

The process of identifying the preliminary bypass route option corridors was underpinned by the objective of achieving, in so far as was possible against the framework of constraints and the existing undulating topography, a design conforming to TII design standards for a project of this type. The design speed for all the preliminary route options was taken as 100 km/h and based on the indicative traffic design year flow data, a Type 1 Single Carriageway was considered suitable for the preliminary stage of the assessment. The overall footprint taken for the preliminary bypass route option corridors was a 100 m band i.e. 50 m either side of the preliminary alignment centreline.

From an engineering perspective the aim was to: design feasible preliminary route option corridors with no or as low a number as possible, of relaxations/ departures; reasonable lengths for journey times; best overtaking distances; best cut/ fill balances; least number of watercourses crossed; least effect on properties and landtake; least number of intersections with the local road network; least effect on services/ utilities and, overall, safer transportation routes for motorists that could provide facilities for vulnerable road users; as well as a significant reduction in the number of collisions per year.

Environmentally, the aim was to produce feasible preliminary bypass route option corridors which were sympathetic to the high level of environmental constraints in the study area including the UNESCO Brú na Bóinne World Heritage Property (WHP), the Special Area of Conservation (SAC) and Special Protection Area (SPA) associated with the River Boyne and River Blackwater European sites, and the existing layout of the N2 at Slane village while also minimising impacts on properties.

After consideration of the various constraints, fifteen feasible preliminary bypass route option corridors, varying in length between 3.7 km and 8.2 km, were identified. Some of these corridors tied in to the existing N2 at approximately right angles, whereas other corridors tied in on-line with the existing N2. There were seven corridors to the east of Slane village and eight corridors located to the west of Slane village. The fifteen preliminary bypass option corridors are illustrated in **Figure 3.1**. A description of each alternative is presented in **Appendix 3.2** (extract from the full Option Selection Report, which can be found in **Appendix 3.1**).

3.3.1.1.2 Traffic Management Options Considered

In addition to bypass alternatives, and in line with TII's PAG, the consideration of options at this Stage 1 Assessment also included 'Do-Something' Options which utilised the existing infrastructure, where feasible, through traffic management measures. Six different types of traffic management measures were considered i.e. different ways of bringing about heavy goods vehicle (HGV) traffic reduction in Slane village and at Slane Bridge:

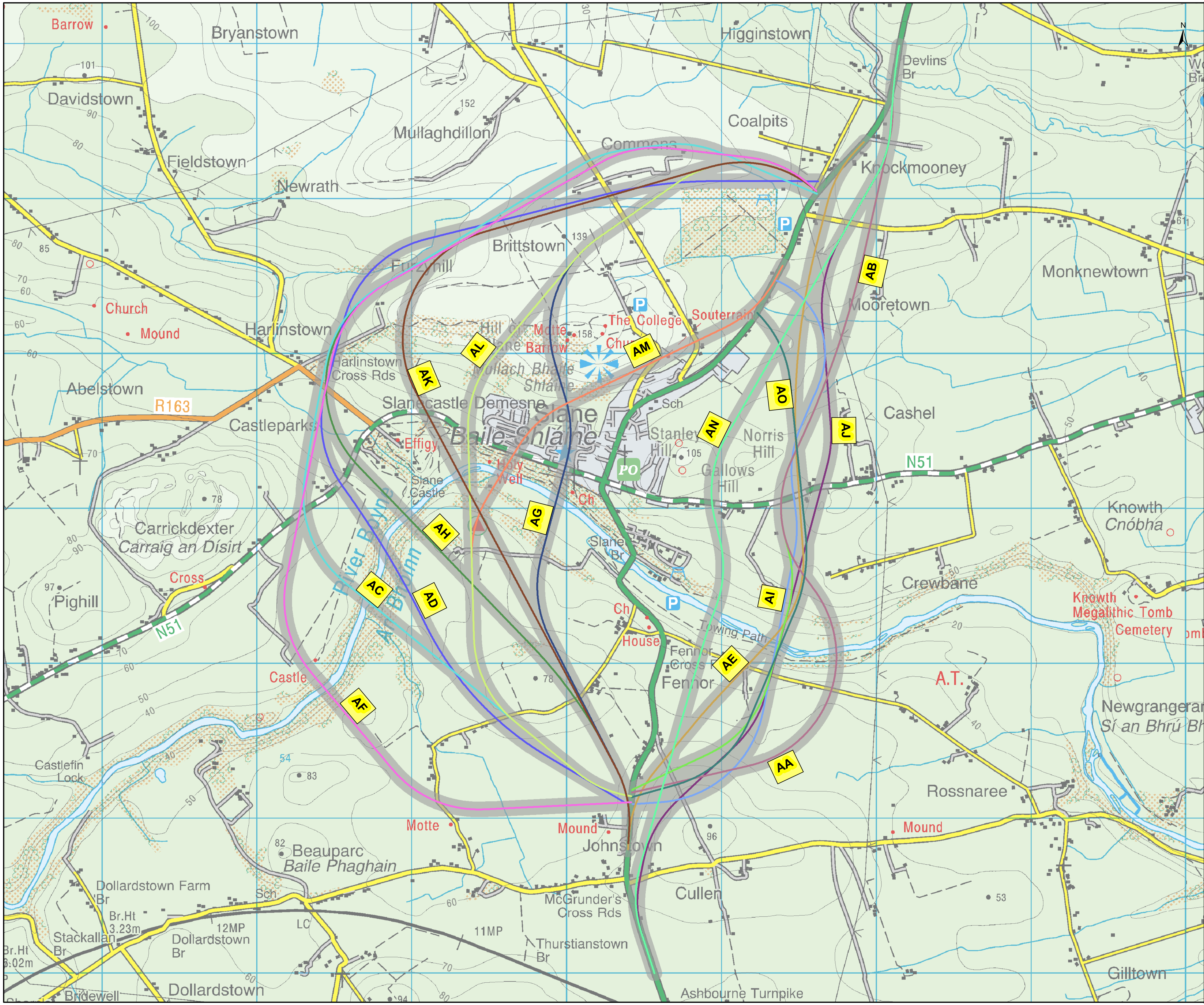
1. Measures 1A, 1B and 1C involving legal prohibition of HGVs (as the vehicle type with the greatest individual significance to the human environment) at locations around Slane, including on the N2 at or near Slane Bridge.
2. Measures 2A and 2B involving new barrier-free tolls at locations around Slane, including on the N2 at or near Slane Bridge.
3. Measures 3A, 3B and 3C involving reduction or removal of existing motorway tolls to attract traffic away from Slane.
4. Measures 4A and 4B involving increases in journey time on the N2 to discourage traffic from choosing this route.
5. Measures 5A and 5B involving schemes to reduce journey times on the principal alternative routes.
6. Measures 6A, 6B and 6C involving attracting journeys away from the car altogether, to other modes of transport.

These measures gave rise to 15 traffic management alternatives. A description of each is presented in **Appendix 3.2** (extract from the full Option Selection Report, which can be found in **Appendix 3.1**).

3.3.1.1.3 Other Options Considered

In addition to the bypass and traffic management options described above, a small number of other potential options were also identified:

- **On-line improvements on the N2:** This type of option would involve an enhanced design improvement of the existing N2 route.
- **Options to replace or supplement the existing Slane Bridge:** This type of option would seek to enhance the operation of the N2 at the existing Slane bridge by providing enhanced capacity at this location to address the ‘bottle neck’ effect at the existing Slane bridge.
- **Tunnel Options:** Would seek to substantially avoid adverse environmental impacts by routing a Slane bypass underground.



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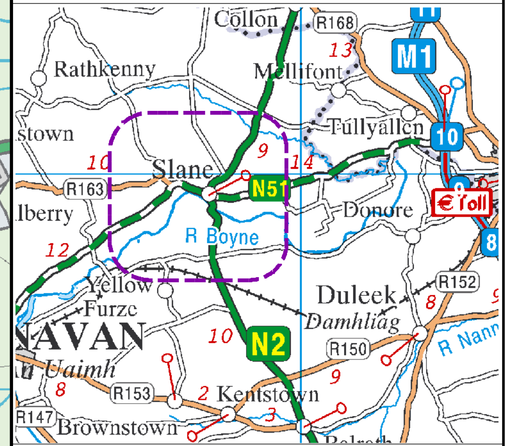

Client

Meath County Council

N2 Slane Bypass and Public Realm Enhancement Scheme

Title

Figure 3.1:

Stage 1 Generation of Preliminary Bypass Options

West Pier
Business Campus,
Dun Laoghaire,
Co Dublin, Ireland.

T +353 (0) 1 4882900
E ireland@rpsgroup.com
W rpsgroup.com/ireland

Issue Details

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3.3.1.2 Stage 1 Assessment

3.3.1.2.1 Bypass Options Assessment

The Do-Minimum and the fifteen preliminary bypass route options were subjected to an MCA under the assessment criteria of Engineering, Environment and Economy using a rating of Low, Moderate or High Preference depending on how an option performed under each of the criteria. A summary matrix of the outcome of this assessment is included at **Table 3-1**. Detailed assessment tables for each criterion are included in **Appendix 3.3** (extract from the full Option Selection Report, which can be found in **Appendix 3.1**).

Table 3-1: Summary of the Stage 1 Assessment of Preliminary Bypass Options

Preliminary Route Option	Engineering	Economy	Environment	Progress to Stage 2 – Yes/No
Do-Minimum	Low	High	Low	No
		Eastern Options		
AA	Low	Moderate	Low	No
AB	Moderate	High	Low	No
AE	High	High	Moderate	Yes
AI	Moderate	High	Moderate	No
AJ	Low	Moderate	Low	No
AN	Moderate	Moderate	High	Yes
AO	High	High	High	Yes
		Western Options		
AC	Moderate	Moderate	Moderate	Yes
AD	Low	Moderate	Low	No
AF	Low	Moderate	Moderate	Yes
AG	Low	Low	Low	No
AH	Moderate	Moderate	Low	Yes
AK	Moderate	Low	Low	No
AL	Low	Moderate	Low	No
AM	Low	Moderate	Low	No

A number of eastern and western options were brought forward for detailed Staged 2 appraisal to ensure the widest consideration of options were considered, given the nature and sensitivities of the area.

Following the Stage 1 Assessment, further refinement of options was undertaken to reflect optimisation opportunities and public consultation feedback (see **Chapter 6 – Consultation**). These refinements resulted in two additional route variants being identified. The first was a variant of Option AN and Option AO[3] on the eastern side. This variant combined the section of Option AN south of the existing N51 with the section of Option AO north of the existing N51. The combining section moves the route further east away from Ledwidge Cottage and Museum, passing to the eastern side of Norris Hill. This variant was recommended to be brought forward for further assessment in Stage 2 of the Option Selection process.

The second variant was a hybrid option comprising the southern section of Option AO north of the River Boyne, the middle section of Option AJ as it crosses the N51 near the townland of Cashel, and finally the northern section of Option AA/AB as it passes through the townlands of Mooretown and Knockmooney, before tying in with the existing N2 near Devlin's Bridge. This hybrid had the benefit over Option AA of being further west from the WHP buffer zone and protected views. It was also further east, away from Ledwidge Cottage and Museum, than the other eastern options by following the line of the central section of Option AJ.

[3] Note: Option AO is the option which best represents the scheme which was previously refused planning permission in 2012.

And finally, by combining with the line of Option AA/AB in its northern section, this hybrid gave rise to a relatively straight alignment overall and the option of an on-line tie-in with the existing N2 north of Slane village. This hybrid was recommended to be brought forward for further assessment in Stage 2 of the Option Selection process.

The Stage 1 Assessment of bypass options resulted in eight bypass options going forward for Stage 2 appraisal – five bypass options to the east and three bypass options to the west of Slane village. The preliminary route option corridors were subsequently renamed for Stage 2 and are presented in **Table 3-4** and illustrated in **Figure 3.2**.

3.3.1.2.2 Traffic Management Options Assessment

The Stage 1 Assessment for Traffic Management Options was a two-stage process, firstly sifting out options which offer little or no tangible benefit to Slane village and were clearly very poor value for money. This resulted in ten of the original fifteen traffic management options identified at the start of the process (see **Section 3.3.1.1**), progressing for further consideration.

The second stage consisted of a more detailed analysis, utilising output from the wide-area traffic model to assess the following aspects in more detail; Predicted traffic relief in Slane; Comparative impact on the wider road network; Economy; and Financial. A summary matrix of the outcome of this assessment is included at **Table 3-2**.

Table 3-2: Summary Assessment of Traffic Management Options

Measure	Economy	Finance	Traffic Relief Slane Village	HGVs Removed from Slane Bridge	HGVs on Local Roads
Various Measures					
1A - 5+axle HGV ban on Slane Bridge	High	Medium	Low	Medium	Low
1B - 4+axle HGV ban Slane village cordon	Low	Medium	Medium	Medium	Medium
1C - All HGV ban Slane village cordon	Low	Medium	High	High	Low
2A - Toll Slane Bridge €7 all heavy vehicles	Medium	Medium	Medium	Medium	Medium
2B - Toll Slane Bridge as M1 all vehicles	Medium	High	Medium	Medium	Medium
3A - Remove Truck toll M1 Drogheda	Low	Low	Low	Medium	High
3B - Remove Truck toll M3 sites	Low	Low	Low	Low	High
3C - Remove all tolls M1 J9 ramps	High	Low	Low	Low	Medium
4B - Disimprove N2 junctions	Low	Medium	Low	Low	Low
5B - Collon N-E bypass	Medium	Medium	Low	Low	Medium

In summary:

- Measure 5B is ineffective in relieving Slane of traffic, and primarily draws heavy vehicle traffic away from the more-suitable M1/N33 route.
- Measure 4B imposes very high delay costs, as well as pushing heavy vehicle traffic onto less suitable roads, and can therefore be discarded.
- Measures 3A, 3B, 3C have potentially high financial costs to the State in compensating the existing toll operator(s). Suggesting that any refinement or combination of these options should focus on removing

only those tolls that need to be removed in order to achieve the desired impact. 3C is the option with the greatest positive economic impact.

- On these cost assumptions, measures 2A and 2B have a generally positive outcome, offering a noticeable level of relief of traffic nuisance in Slane, and a reduction in Heavy Vehicle flow on less-suitable routes.
- 2A has low operating costs because most of the Heavy Vehicles are deterred and so there are few tolls to collect.
- 2B is more economically positive and is the measure that gives the greatest increase in toll revenue. But it was noted above that by tolling all vehicle types it tends to cause congestion problems on the R152 as the principal diversion route.
- Measure 1A is low-cost and economically positive, achieving limited relief of traffic at Slane, and may therefore be a suitable element of a traffic management package. To do more, it would need to be combined with measures that address the >40% of heavy vehicles that are rigid-bodied HGVs.
- Measures 1B and 1C are the most effective in relieving Slane of traffic, but are economically negative, and their wider impact is to put more heavy vehicle traffic onto less-suitable roads.

While these represent feasible options, in the light of the varying results, further modelling was undertaken which involved combinations and variations of the above measures to further refine to identify the 'best' of each type of measure to take forward four reasonable traffic management options into the detailed Stage 2 Appraisal process (refer to **Section 3.3.2**):

- **1AX:** HCV bans on Slane Bridge & Broadboyne Bridge applying to all HGVs and to buses & coaches, modelled with exemptions for businesses in Slane Village. This is a variant on 1A that offers greater relief to Slane Bridge and extends the ban to also apply to Broadboyne Bridge to prevent local diversion of heavy vehicles onto unsuitable local roads. This was referenced as **Variant A1** for Stage 2.
- **1CM:** HCV bans on Slane Bridge & Broadboyne Bridge & on N51 West of Slane, applying to all HGVs and to buses & coaches, modelled with exemptions for businesses in Slane Village. This is a variant on 1C that reduces the costs by reducing the number of ban locations from 5 to 3, with the aim of getting a similar level of benefit at lower cost. This was referenced as **Variant A2** for Stage 2.
- **3X:** Removal of all HGV tolls on M1 and M3 with a ban on 5+axle HGVs at Slane Bridge & Broadboyne Bridge, modelled without exemptions. This is a variant that combines 1A with 3A and 3B, seeking to ban the heaviest vehicles and attract the smaller HGVs away from Slane by means of toll reductions. This was referenced as **Variant A3** for Stage 2.
- **3CX:** HCV ban on Broadboyne Bridge, toll all HCVs at single point near Slane Bridge, and reduce HCV tolls on J9 ramps, modelled without exemptions. This is a variant that combines 2A with 3C. The intention with this variant is a "carrot and stick" approach, which seeks to impose tolls on the HGV route via Slane Bridge and simultaneously reduce tolls on the alternative route via the M1 bridge. It is suggested that the scale of the toll reduction should be such as to make this a revenue-neutral option – that the revenue from the new toll would compensate the toll operator for the loss of revenue at the M1, thus addressing the financial issue which is one of the arguments against toll reduction options. Research from the UK suggests that public support for tolling is significantly greater where revenues are re-invested or schemes are revenue-neutral, than if the scheme is seen taking away money which disappears into general government funds[4]. This was referenced as **Variant A4** for Stage 2.

Further traffic model runs were carried out to further refine the proposed traffic management alternatives. The corresponding results are shown in **Table 3-3**.

[4] Banks N, Bayliss D & Glaister S (2007) "Motoring towards 2050: Roads and Reality", RAC Foundation, December 2007.

Table 3-3: Summary Assessment of Emerging Traffic Management Variants

Measure	Economy	Finance	Traffic Relief Slane Village	HGVs Removed from Slane Bridge	HGVs on Local Roads
Emerging Variants & Combinations					
A1 - Slane & Broadboyne bridges - ban all HGV	Medium	Medium	Medium	High	High
A2 - As for 1AX but also ban at N51 W of village	Medium	Medium	High	High	Low
A3 - Toll Slane bridge, reduce tolls M1 J9 and HCV ban Broadboyne bridge.	High	Medium	Medium	High	Medium
A4 - no HGV tolls M1 & M3 + ban 5+axle articulated vehicles at bridges	Medium	Low	Low	Medium	High

3.3.1.2.3 Other Options Assessment

In terms of other options considered, the option to carry out on-line improvements on the N2 through Slane village was discounted at Stage 1 as the N2 forms one of the principal streets in the village of Slane. It is multi-functional in terms of its use by residents and passing traffic alike. Any upgrade was not considered compatible with the local usage of the road and any measure which would seek to improve existing alignment and gradient would be detrimental to the existing streetscape.

The option to replace or supplement the existing Slane bridge was discounted at Stage 1 as:

- The existing bridge is a protected structure, so any works to increase its capacity would alter the character of the bridge and result is an unsatisfactory mix of new and old construction with little resulting benefit as the constraints of the existing N2 through the village would be retained. The option would provide no traffic relief to the residents of Slane; and
- The construction of a new low-level bridge would be an environmental challenge due to the protected status of the River Boyne and the above constraint within the village would also remain.

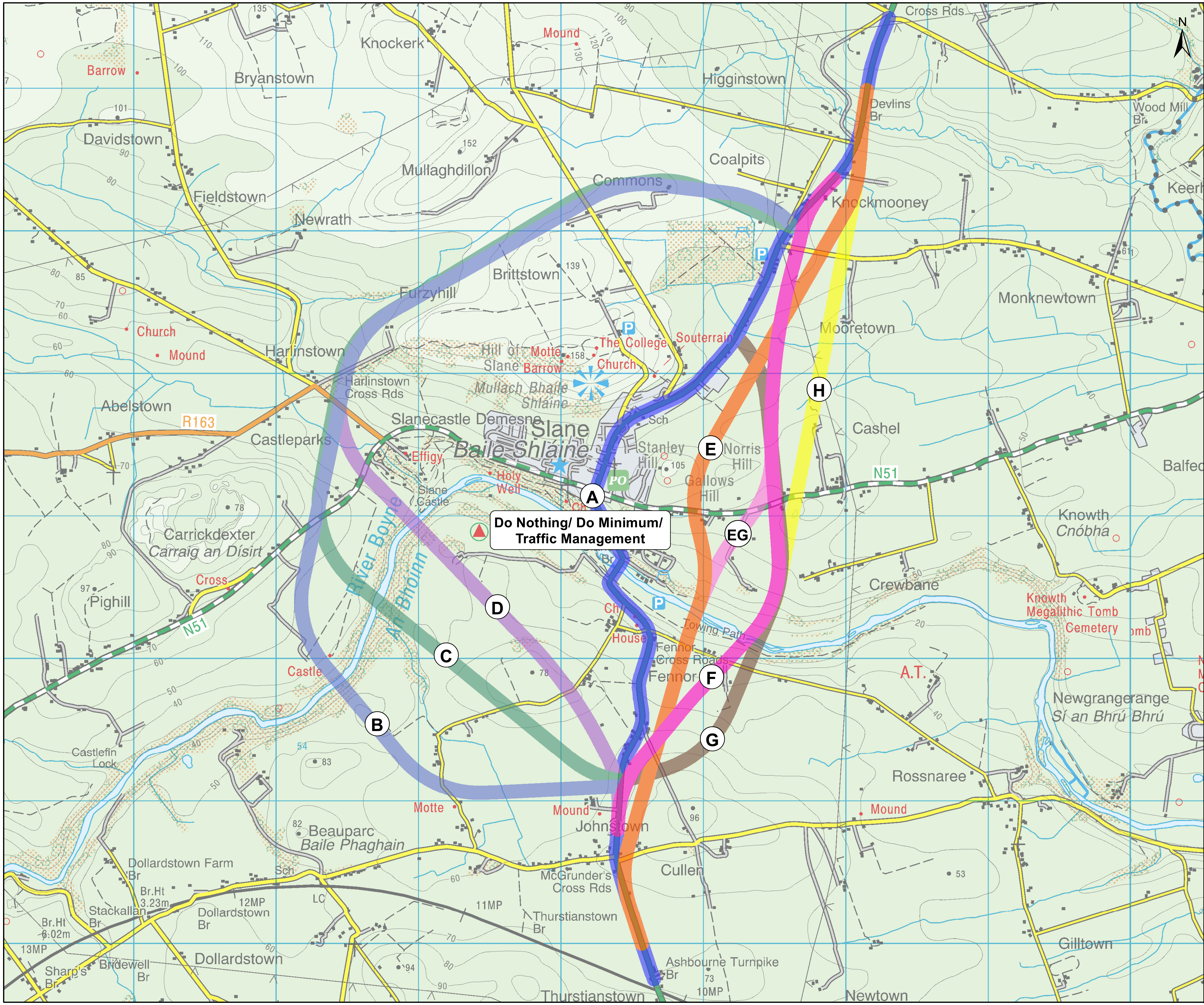
The potential for a tunnel option, while feasible, was discounted at Stage 1 as it was considered to be cost prohibitive, with an estimated to cost in the region of €350 million to construct. This would represent an approximately 700% cost increase over conventional road/bridge solutions, and therefore was not considered a reasonable option.

3.3.1.3 Summary of Stage 1 Outcomes

In total, eight major investment bypass options, along with Traffic Management Options A1, A2, A3 and A4, were recommended for progression to Stage 2 Project Appraisal of Scheme Options. The preliminary route option corridors, along with the Traffic Management Options A1 to A4, were renamed to an Option Selection Reference for Stage 2, and the relevant designation is presented in **Table 3-4**.

Table 3-4: Scheme Options Recommended for Option Selection Process

Preliminary Route Option Reference	Stage 2 Option Selection Reference
Traffic Management Alternative Option A1 *(Traffic)*	Scheme Option A1
Traffic Management Alternative Option A2 *(Traffic)*	Scheme Option A2
Traffic Management Alternative Option A3 *(Traffic)*	Scheme Option A3
Traffic Management Alternative OptionA4 *(Traffic)*	Scheme Option A4
Preliminary Route Option AF *(West)*	Scheme Option B
Preliminary Route Option AC *(West)*	Scheme Option C
Preliminary Route Option AH *(West)*	Scheme Option D
Preliminary Route Option AN *(East)*	Scheme Option E
Preliminary Route Option AE *(East)*	Scheme Option F
Preliminary Route Option AO *(East)*	Scheme Option G
Variant *(Preliminary Route Option AN combined with Preliminary Route Option AO) (East)*	Scheme Option EG
Hybrid *(Combination of Preliminary Route Options AO, AJ and AA/AB) (East)*	Scheme Option H



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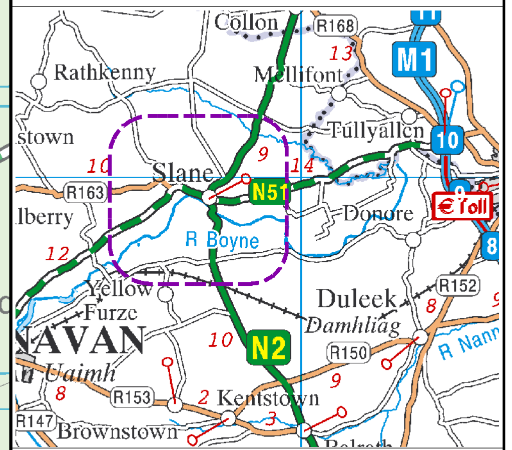

Client

Meath County Council

N2 Slane Bypass and Public Realm Enhancement Scheme

Title

Figure 3.2:

Selection of Bypass Options for Stage 2 Assessment

West Pier
Business Campus,
Dun Laoghaire,
Co Dublin, Ireland.
T +353 (0) 1 4882900
E ireland@rpsgroup.com
W rpsgroup.com/ireland

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Status: A1	**Rev:** C01	**Model File Identifier:** MDT0806-RPS-00-N2-M2-D-XR0002
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Approved: MN		**Projection:** ITM

3.3.2 Stage 2 Appraisal

Each of the eight major investment bypass options and the four traffic management options were subject to a detailed traffic assessment prior to the detailed Stage 2 Appraisal. The outcomes are summarised in **Section 3.3.2.1**.

Following this, the Stage 2 Appraisal under the headings of Environment, Economy, Safety, Accessibility and Social Inclusion, Integration and Physical Activity was undertaken. The principal outcomes of the assessments carried out are summarised in **Sections 3.3.2.2** to **3.3.2.7**.

3.3.2.1 Traffic Impact

The impact of the traffic management options was primarily to reduce HGV traffic in Slane, mostly on the N2. Generally, HGVs were removed from the N2 corridor and many were shown to re-assign to the M1 corridor. However, in switching corridors, there was an increase of HGVs on many of the less suitable local and regional roads across the traffic model area. The traffic management alternatives were shown to not have a significant impact on overall traffic volumes and general traffic levels in Slane remained high.

Western bypass options were found to attract less traffic to the bypass. There was corresponding less positive impact on N2 and N51 east traffic volumes in Slane, though there would be a greater positive impact on the N51 West. There was less traffic attracted to the N2 corridor and correspondingly less traffic reduction on the M1 and the wider road network.

Traffic modelling for the eastern bypass options found these options attracted most traffic to the bypass and to the N2 corridor in the vicinity of Slane. All eastern options significantly reduced N2 traffic in Slane but had a less positive impact on N51 traffic volumes in Slane. As more traffic was attracted to the N2 corridor, traffic on the M1 was found to reduce (less than 5%, not considered to be significant). Traffic also reduced on the wider local road network.

The overall conclusion of the traffic assessment was that eastern bypass options improved the N2 corridor most and hence higher volumes were attracted to the N2 national primary road corridor to the benefit of Slane and other local roads. The western bypass options impacted significantly less in this regard. The traffic management options reduced HGVs on the N2 corridor and in Slane but to the detriment of other less suitable local roads. However, the residual traffic in Slane remained high and continued to negotiate the sub-standard section of road through the village.

3.3.2.2 Environmental Appraisal

The study area for the proposed road includes some very significant natural and cultural heritage features. Natural features include European designated sites, protected species and protected habitats focused around and along the River Boyne. Cultural features include the UNESCO WHP, Slane Castle, Hill of Slane, and three Architectural Conservation Areas (ACAs). These sensitive features increase the complexity of delivering a route option through the study area and given their national, European and international status, decision-making must satisfy legal requirements and obligations associated with the various designations e.g. obligations in relation to the Habitats Directive as transposed.[5] The mitigation hierarchy starts with avoidance and as such routes that avoid or minimise impacts must be preferred over others.

Environmental assessments were undertaken by technical specialists for a range of environmental sub-criteria broadly described under the headings of 'Human Environment' (Air and Climate, Noise, Traffic, Cultural Heritage, Agriculture, Non-Agriculture (including Population / Socio-economic aspects), and Landscape & Visual) and 'Natural Environment' (Ecology, Soils and Geology (including Land), Hydrology & Hydrogeology and Waste).

3.3.2.2.1 Human Environment

The Traffic Management Options A1-A4 were assessed as achieving some positive results in terms of traffic reductions, however, in each traffic management scenario, significant volumes of traffic continued to use the sub-standard road network in Slane and in most cases the diversion of HGVs from the N2 resulted in

[5] Note – Refer to the Legislation, Policy and Guidance section of each EIAR topic chapter.

unacceptable increases in HGVs on the regional and local road network. Option A4 in particular was considered less effective as significant HGV levels remained in Slane.

From a traffic impact point of view, the western bypass options achieved slightly better traffic outcomes compared to eastern bypass options. The eastern bypass options also achieved significant traffic reduction in Slane, though slightly less so compared to the western options as N51 west traffic was unaffected by the provision of eastern bypasses. The eastern options achieved better road network-wide transport benefits and so reduced traffic on other regional and local roads more than the western options. All the eastern bypass options achieved desirable traffic outcomes in Slane and in the wider road network.

All bypass options were found to impact to some degree on the cultural landscape but not uniformly. The study area for the proposed road includes some very significant and culturally important sites, not least the internationally recognised UNESCO Brú na Bóinne World Heritage Property to the east of the study area and the regionally and locally significant Slane Castle, a protected structure, and the associated architectural conservation area (ACA) to the west. Given these very clear constraints, great effort was made at the early route optioneering stage to avoid and minimise, as far as possible, any negative effects on the heritage sites and features in the study area.

For the UNESCO Brú na Bóinne World Heritage Property, none of the bypass options were assessed as leading to any net enhancement of the Outstanding Universal Value (OUV) of the site. The traffic management options, and western Options B and C were considered to have neutral impacts on the UNESCO Brú na Bóinne World Heritage Property, with western Option D slightly less preferred due to negative impacts resulting from visibility of the southern end of this option from Knowth. The overall impact of all eastern options on the UNESCO Brú na Bóinne World Heritage Property OUV was considered to be a minor adverse impact, but this was of moderate significance, given the recognised international importance of the Brú na Bóinne site. Eastern Options E and EG were preferred over Options F, G and H because of the more distant and partially concealed location for the bridge over the Boyne. Option EG was then preferred over Option E because of the less-prominent route to the east of the Hill of Slane.

All bypass options impacted archaeology and cultural heritage to some degree, with Options B, E and G being least preferred, and Options C, D, F, EG and H being intermediate. Option B was noted to have a slight adverse impact on views from the National Monument of Carrickdexter Cross and would also have significant indirect impacts on two upstanding RMP sites, Carrickdexter Castle and the motte in Thurstianstown. Of the eastern options, Option EG scored slightly better than G, as the bridge for Option G would be visible and pass over the Boyne Navigation towpath at the point where views towards Knowth (a National Monument) and the UNESCO Brú na Bóinne World Heritage Property first become possible. In contrast, the bridge for Option EG would be more distant from the World Heritage Property and partially concealed behind the landform (visible only at its southernmost end from Knowth). While Option E shared the benefits of the same crossing point as EG, the substantial cutting required would be an adverse visual change in views, including those towards the UNESCO Brú na Bóinne World Heritage Property from the Hill of Slane (also a National Monument).

For architectural heritage, the eastern options were preferred over the western options, and were broadly similar as they fell outside any ACA and had no significant adverse impacts on protected structures.

For landscape, the online options were preferred as no new infrastructure was to be located within adjacent greenfield/ sensitive landscape settings, however ongoing existing impacts to a high number of existing receptors in Slane village was not recognised. Of the bypass options, there was little difference between them in terms of landscape impacts, however there was a slight preference for Option EG as it was one of the shortest options across the landscape, it reduced the visual impact on protected views, and benefited from the long section in cutting between existing N2 and River Boyne crossing. There was little difference noted between the remaining options.

For agriculture, the western options were considered least preferred given the greater number of dairy enterprises to the west (up to 4 no. compared to 2 no.). This type of agricultural enterprise is more sensitive to severance than others enterprise types such as tillage. There was also greater landtake required with the western options compared to the eastern options which were generally shorter. Some severance was still recorded with the eastern options, but the impacts were less for Options G and EG.

3.3.2.2.2 Natural Environment

The Traffic Management Options A1-A4 were assessed as preferred for ecology as they did not involve additional landtake or a new bridge over the River Boyne and its associated European site designations – the River Boyne and River Blackwater SAC and the River Boyne and River Blackwater SPA.

All bypass options traversed both European sites and in addition, all of the western options also traversed the Boyne Woods proposed Natural Heritage Area. The presence of the Annex I Priority Habitat of alluvial woodland was a significant feature in the study area. The habitat occurs as fragmentary patches along the River Boyne. The western options impacted on the Priority Habitat and were assessed as having a highly negative impact while the eastern Options E and EG avoided impact due to the location of the River Boyne crossing and the nature of the habitat that occurs there. There was considerable evidence of otter activity, an Annex II species (and Qualifying Interest species from the SAC) noted from watercourses for all options. Kingfisher, the special conservation interest for the SPA, has been sighted during surveys on the Boyne and is known to occur along its length, with potential nesting habitat identified in the corridors for Options G and H.

All bypass options also impacted on water bodies to some degree, with the eastern bypass Options F, G and EG performing marginally better compared to the other bypass options. Option F crossed only two water bodies (Rivers Boyne and Mattock) while G and EG crossed only the Boyne. The other options had a further two or three additional crossings of watercourses including the Thurstianstown Stream, Castleparks Stream, River Mattock and tributary, and River Devlin.

For soils and geology, all of the bypass options traverse the Boyne Valley County Geological Site and there are no major differences between the options. For hydrology and hydrogeology, in terms of fluvial flooding, Options G and EG are preferred due to the single river crossing (Boyne), and the comparatively shorter length of flood zone crossed. All options also impacted similarly on locally important aquifers to some degree, but in the context of the wider regional hydrogeology, impacts are considered to be minor.

The options have varying potential for waste generation based on the cut/fill balance, with some options requiring more cut compared to others. Options B and D were slightly preferred in this regard as they came closest to the zero balance, while Option E was least preferred due to the greater volume of material which would be generated compared to the other bypass options.

3.3.2.3 Economic Appraisal

The Economy appraisal took account of journey time savings on the N2 near Slane and transport efficiency and cost effectiveness. Options were assessed in terms of their Benefit to Cost Ratio (BCR).

Generally, eastern bypass options were less costly than western bypass options, as generally the eastern options were shorter. Traffic management options were relatively inexpensive to implement compared to bypass options, though traffic management option A4 would require a substantial compensation to be paid to the toll operator on the M1. In terms of transport efficiencies and monetised benefits, the eastern bypass options generated the highest benefits, whereas the traffic management options generated very little transport efficiency and monetised benefit.

The outcome of the cost-benefit analysis was that the traffic management options offer either negative or low positive BCRs, suggesting poor value for money. The BCRs for the eastern bypass options ranged from 3.15 to 4.57 compared to the western options which ranged from 2.52 to 2.91. Option G had the best BCR at 4.57.

To consider the bypass options in comparison to the lowest cost bypass option (Option G), an incremental analysis was carried out. This considered the value of the additional benefits to the additional costs relative to the lowest cost option. In this analysis Option EG emerged from this analysis as an option which also offered good value for money as the value of the additional benefits that accrue are 12.3 times greater than the additional cost.

In terms of journey time savings on the N2 through Slane, the eastern bypass options gave the highest time savings.

Options G and EG emerged as the best choices from an economic perspective. Option G had the lowest costs and offered the best BCR. Option EG was more expensive than Option G but it provided additional benefits over Option G which marginally exceeded the additional costs.

3.3.2.4 Safety Appraisal

The Safety appraisal took account of the recommendations from the Road Safety Impact Assessment and the Road Safety Audit as well as a network wide calculation of overall road safety benefit.

The Road Safety Impact Assessment concluded that the Do-Nothing and Do-Minimum scenarios were not long-term sustainable options from a safety perspective. The traffic management alternatives would achieve some road safety benefit in Slane but do nothing to address the inherent road safety risks through the village due to the sub-standard condition of the N2. Retained traffic volumes in Slane would remain high on the N2 in Slane and the diversion of HGVs from the N2 was likely to migrate collisions to other parts of the road network. Additionally, the Road Safety Audit considered the condition of the alternative routes which would be used by HGVs which divert from the N2 corridor. The assessment concluded that diversion of HGVs to these routes had the potential to increase the frequency of collisions.

From the network wide safety analysis, the bypass options resulted in slight positive safety benefit, whereas the calculated benefit from the traffic management alternatives was either negative or very slight positive.

The conclusion of the safety assessment was that bypass options for Slane are preferred.

3.3.2.5 Accessibility and Social Inclusion Appraisal

The Accessibility and Social Inclusion assessment considered whether options affect the ability of people with differing availability of transport to access facilities, particularly vulnerable groups. Options which reduced traffic congestions and remove significant HGVs from Slane village would improve the ability of the communities in and around Slane to access the facilities, amenities and employment opportunities in the village. Bypass options and Option A2 were considered to be slight positive in this regard.

3.3.2.6 Integration Appraisal

The Integration assessment considered how well the proposed investment fits with transport and non-transport policy. Consideration was given to transport network integration, transport strategy, land use integration, geographical integration and other government policy. In many cases, policy ‘fit’ is not sensitive to the details of the project, so under many of the sub-criteria, all bypass options received the same score. The conclusion of the integration assessment was that all bypass options best fit with national, regional and local policy.

3.3.2.7 Physical Activity Appraisal

Under the Physical Activity assessment, all bypass options were preferred as these enhanced opportunities for increased walking and cycling in and around the village, particularly accessing the existing ramparts walkway along the River Boyne.

3.3.2.8 Preferred Option

Collating the results of the Stage 2 appraisal of the options brought forward under the various appraisal headings, the Emerging Preferred Route was identified as Option EG. The overall framework appraisal matrix is presented in **Table 3-5** and the Emerging Preferred Route is presented in **Figure 3.3**. Detailed assessment tables are included in **Appendix 3.4** (extract from the full Option Selection Report, which can be found in **Appendix 3.1**). The rationale for selecting Option EG, including an indication of the main reasons for choosing it, taking into account the effects of the proposed road development on the environment, are presented below.

3.3.3 Summary and Rationale for Choosing Option EG

None of the traffic management options were considered appropriate alternatives to a bypass solution in terms of **traffic** impact with regard to achieving the required improvement of the N2 corridor or achieving the best traffic and environmental improvement within Slane village.

Traffic management options were preferred overall in terms of **environmental** impact as they limited landtake in the sensitive receiving environment and also provided some relief of the traffic in Slane village albeit not achieving the full traffic benefits afforded by the bypass options. HGV traffic removed from the N2 through Slane would use alternative local and regional roads increasing traffic impact and noise and reducing air quality along these other less suitable routes. Also, these options were rated as intermediate under the headings of architectural heritage and non-agricultural properties due to the substantial traffic volumes remaining in the village.

The western bypass options in the context of terrestrial ecology and the qualifying interests of the River Boyne and Blackwater SAC, were assessed as having potential for a highly negative impact on confirmed Annex I Priority Habitat of Alluvial Woodland. The impact on Priority Habitat was a very strong indicator that less impactful options must be considered in preference. Three of the eastern bypass options (F, G and H) were assessed as having potential for direct impact on Annex I Priority Habitat within the SAC. Options E and EG were the only eastern options identified as not having a direct impact.

Western options were preferred in relation to World Heritage as they were located sufficiently distant from the Brú na Bóinne World Heritage Property to limit impact on the setting and outstanding universal value of the UNESCO site. However, in terms of architectural heritage, Slane Castle was directly impacted by the western options. It was also noted the dairy farm enterprises have generally larger land parcels on the western side of Slane and as such severance, viability, and landtake impacts were significantly more adverse for the western options compared to eastern options. The Heritage Impact Assessment carried out to inform the optioneering with regard to impacts on the World Heritage Property, indicated that the eastern options were feasible, despite slight adverse impacts of moderate significance being reported on the Outstanding Universal Value of the complex. Options E and EG were identified as slightly preferred among the eastern options owing to the distance and better screening of the proposed River Boyne bridge crossing from the monument at Knowth. Option EG was overall preferred for the eastern bypass options due to the less prominent route to the east of the Hill of Slane. The eastern options performed better under architectural heritage in general, routing away from the Slane Mills ACA while also significantly reducing traffic in Slane, which improved the setting of Slane village ACA.

The eastern options had less adverse impact on agriculture as they were generally shorter routes, impacting on fewer dairy farms than the western options.

All bypass options were found to have a negative impact on landscape and visual as they all traversed designated Landscape Character Areas (LCA), would all impact on protected views and would all be visible from various dwellings. Of the bypass options, there was an overall slight preference for Option EG as it was one of the shortest routes across the landscape, was substantially in cut and was better screened from certain important views including views from Knowth and the Hill of Slane.

Under many of the environmental headings, the eastern options were found to have the least adverse impact. However, the Heritage Impact Assessment for the UNESCO Brú na Bóinne World Heritage Property assessed that the eastern options would have a minor adverse impact of moderate significance on the Outstanding Universal Value of the UNESCO Brú na Bóinne World Heritage Property. Within eastern bypass options, Options E and EG were slightly preferred, owing to the better screening of the bridge crossing and being further away from the UNESCO Brú na Bóinne World Heritage Property.

Generally, **economic** analysis indicated that the eastern bypass options were less costly than the western bypass options, as generally the eastern options were shorter. Options G and EG emerged as the best choices overall from an economic perspective and Option EG, although more expensive, provided additional benefits over Option G.

The bypass options resulted in slight positive **safety** benefit, whereas the calculated benefit from the traffic management options was either negative or only very slight positive. The traffic management options were not considered long-term sustainable options from a safety perspective.

All bypass options were considered to demonstrate **integration** with national, regional and local policy however the traffic management options were assessed as poor to intermediate fit at best particularly with regard to integration with the strategic network and maximising the value of the N2.

All bypass options were also considered to perform better than traffic management options in terms of **physical activity** as they all afford more opportunities to improve cycling and pedestrian facilities within and in the environs of Slane village. The traffic management options would continue to see a significant volume of traffic passing through the village reducing opportunities to enhance active transport features. This was also relevant in terms of **accessibility**. Bypass options were considered to be slightly positive in this regard with Option A2 of the traffic management options also resulting in a slight positive outcome.

Table 3-5: Option Appraisal Matrix

Option	Economy	Environment	Safety	Integration	Accessibility & Social Inclusion	Physical Activity
Traffic Alternative A1	Least Preferred	Good	Least Preferred	Poor	Least Preferred	Least Preferred
Traffic Alternative A2	Least Preferred	Good	Least Preferred	Least Preferred	Preferred	Least Preferred
Traffic Alternative A3	Poor	Good	Least Preferred	Intermediate	Least Preferred	Least Preferred
Traffic Alternative A4	Least Preferred	Good	Least Preferred	Poor	Least Preferred	Least Preferred
Option B	Intermediate	Least Preferred	Preferred	Good	Preferred	Preferred
Option C	Intermediate	Least Preferred	Preferred	Good	Preferred	Preferred
Option D	Intermediate	Least Preferred	Preferred	Good	Preferred	Preferred
Option E	Good	Poor	Preferred	Preferred	Preferred	Preferred
Option F	Preferred	Least Preferred	Preferred	Preferred	Preferred	Preferred
Option G	Preferred	Intermediate	Preferred	Preferred	Preferred	Preferred
Option H	Preferred	Intermediate	Preferred	Preferred	Preferred	Preferred
Option EG	Preferred	Good	Preferred	Preferred	Preferred	Preferred

The study area for the proposed N2 bypass includes very significant natural and cultural heritage features. These sensitive features increase the complexity of delivering a bypass route option through the study area, and given their national, European and international status, decision-making must have regard to legal requirements and obligations associated with the various designations. The mitigation hierarchy starts with avoidance and as such routes that avoid or minimise impacts on these have been preferred over others.

Noting the above, it was concluded that eastern bypass Option EG offered the best balance of effects and emerged as the preferred option from the consideration of alternatives process for the following reasons:

- In overall terms, Option EG was rated as 'Good' under the environment assessment criterion and was identified as preferred under the other criteria.
- Option EG offered the best balance in terms of reducing the impacts of the existing road on the human environment in Slane and minimising impacts on the wider natural and cultural environment.
- The impact on the UNESCO Brú na Bóinne World Heritage Property was somewhat mitigated with Option EG by screening views from Knowth and by being the furthest eastern bypass from the World Heritage Property.
- The proposed bridge crossing for Option EG avoids direct impact on Annex I Priority habitat and it is the preferred eastern option for landscape and visual and archaeological and cultural heritage.
- Option EG is a relatively shorter route with less landtake compared to most other options.
- Option EG was further improved through alignment adjustments that avoided direct impact on the enclosure site north of the N51, altering the N51 link road to avoid the frontage to Ledwidge Cottage and reducing severance and property impacts by completing the southern tie-in to the N2 further north.

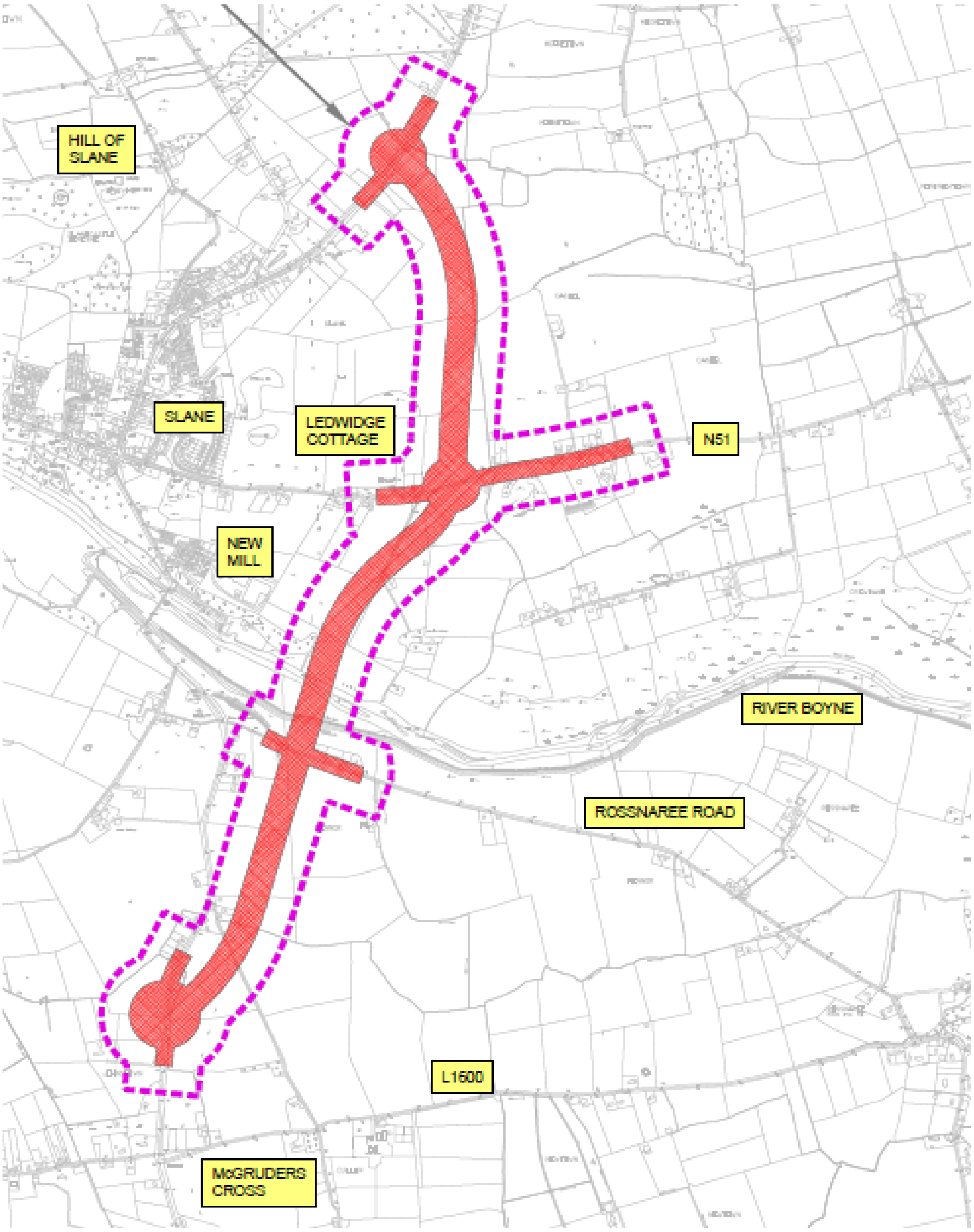


Figure 3.3: Emerging Preferred Option

3.3.4 Further Refinement of Preferred Bypass Option

3.3.4.1 Consideration of East-West Bypass Option in Conjunction with Option EG

Feedback received from the public consultation process included residents' concerns that a north-south bypass on its own would not provide sufficient traffic relief in the village. It was felt that traffic travelling both west to north and west to east would continue to pass through the village. It was suggested that this traffic could be removed from the village by providing an east-west bypass as well as a north-south bypass. A supplemental study was undertaken to assess the feasibility of such a proposal.

Four east-west bypass options as well as a Do-Minimum option (refer to **Figure 3.4**) were assessed under the headings of Environment, Economy, Safety and Engineering. The Do Minimum scenario consisted of the preferred north-south bypass option on its own while each east-west bypass option assessed also included the preferred north-south bypass. The MCA is summarised in **Table 3-6** below.

Table 3-6: East-West Bypass Option Appraisal Matrix

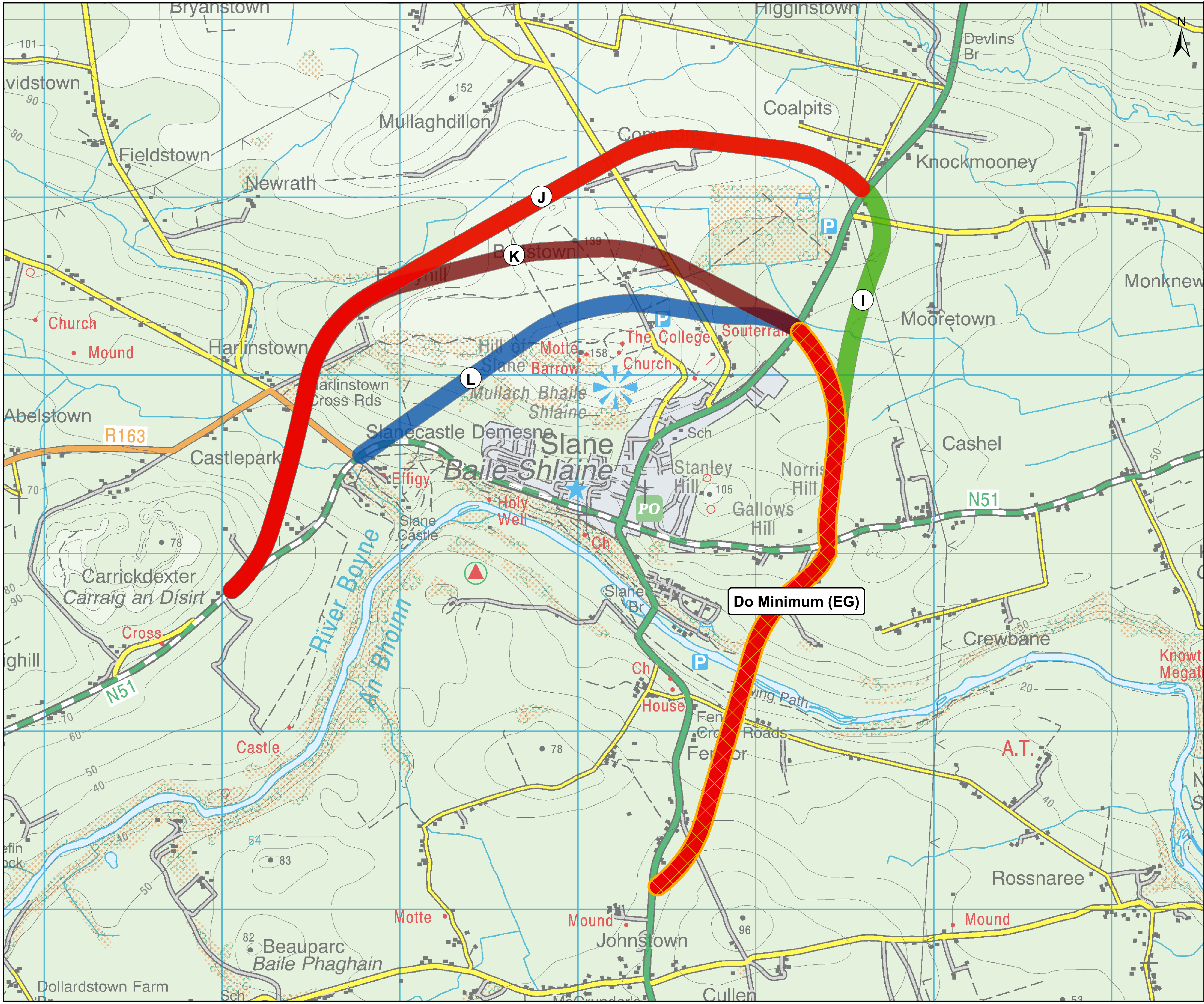
Option	Engineering	Environment	Economy	Safety
Do Minimum	Preferred	Intermediate	Preferred	Preferred
Option I	Preferred	Intermediate	Least Preferred	Preferred
Option J	Preferred	Intermediate	Intermediate	Preferred
Option K	Preferred	Intermediate	Intermediate	Preferred
Option L	Preferred	Least Preferred	Intermediate	Preferred

Under the Engineering and Safety criteria, there was little to differentiate between the Do-Minimum (a north-south bypass only) and Options I, J, K and L.

Under Environment, Option L was least preferred as it has the greatest negative impact on the Hill of Slane, the greatest severance of Slane Castle demesne and furthermore it generated a very significant volume of excess earthworks material. All the other options were ranked as intermediate as each would have an overall negative impact on the environment. The Do-Minimum option involving a north-south bypass only would be the least impactful of the options as it was the shortest option.

Under Economy, the Do-Minimum offered the best value for money. Providing an east-west bypass with a north-south bypass would typically increase the cost but not the benefits to the same extent.

Taking account of the MCA, the Do-Minimum (north-south bypass only) emerged as the preferred option. This option offers best value for money at a reduced negative impact to the environment, particularly the natural environment compared to the other options. The benefit of further reductions in traffic in Slane with east-west bypasses in place is counteracted by increased environmental impact, most notably ecological, landscape and visual and agricultural impacts and a significant increase in cost.



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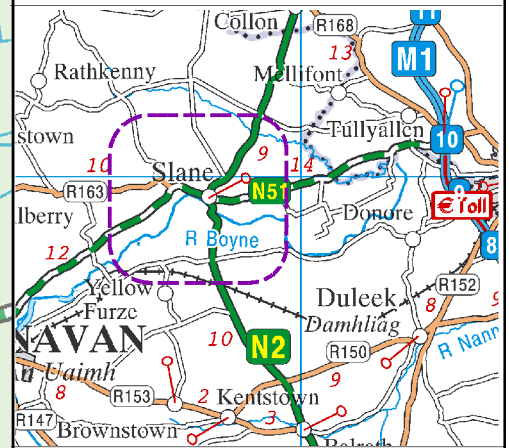


Client

Meath County Council

N2 Slane Bypass and Public Realm Enhancement Scheme

Title

Figure 3.4:

Stage 2 Appraisal – Enhanced East-West Bypass Options with a North-West Component

rps
West Pier Business Campus, Dun Laoghaire, Co Dublin, Ireland.
T +353 (0) 1 4882900
E ireland@rpsgroup.com
W rpsgroup.com/ireland

Issue Details

File Identifier: MDT0806-RPS-00-N2-DR-Z-AG-3066

Status:	Rev:	Model File Identifier:
A1	C01	MDT0806-RPS-00-N2-M2-D-XM0115 to MDT0806-RPS-00-N2-M2-D-XM0118

Drawn: NO'N	Date: 16/05/2023
Checked: AG	Scale: 1:20,000 (A3)
Approved: MN	Projection: ITM

NOTE:

3.3.5 Preliminary Boyne Bridge Design Considerations

Having determined the preferred bypass option, high-level bridge options were considered as part of the Stage 2 process. A bridge carrying the major investment bypass option over the River Boyne valley would be required. A three-span arrangement was initially put forward to reduce the number of piers situated in the valley thus decreasing the bridge's visual and ecological impact and to provide a clear central span over the River Boyne. Two options were considered most suitable for the proposed bridge arrangement, with the intention to avoid this structure being a 'statement' bridge:

- **Option 1:** In-situ post-tensioned concrete box girder constructed by balanced cantilever method.
- **Option 2:** Steel/ concrete composite multi-girder bridge with main elements lifted into place by crane.

The options were examined considering cost, constructability, materials and importantly their impact on the heritage sites of the surrounding historic Boyne Valley. Although the construction techniques and materials required for each option differ, the final aesthetics of the bridge would be very similar.

Each of the options was considered from construction stage and throughout the lifecycle of the bridge. The need for minimal impact of construction works on the valley environment was a major determining factor. Option 1 would provide an effective method of constructing a bridge of this span arrangement over a valley with materials readily available in close proximity to the site. Each option would require maintenance throughout its design life however, the requirement is more onerous for Option 2. Option 1 was therefore determined to be the preferred option at Option Selection stage.

Detailed bridge design alternatives were considered during the design evolution; refer to **Section 3.4.1** and **3.4.2** below.

3.3.6 Other Design Considerations – Consideration of Preferred Cross-section

At Stage 2 Option Selection Stage, it was assumed that the N2 Slane bypass would be provided as a Type 1 Single Carriageway. In accordance with TII Standard DN-GEO-03031 Rural Road Link Design, this type of road would provide a Level of Service D at two-way flows corresponding to 11,600 vehicles per day.

As required under the TII Project Management Guidelines, at the commencement of Phase 3 Design, an incremental analysis was carried out. This is a process of assessment which looks at the costs and benefits of completing the project with incremental increases in quality and level of service. In this case, the incremental analysis considered the proposal to construct the proposed bypass to the higher standard of a dual carriageway.

A higher standard of provision is considered to be justified if the incremental benefits exceed the incremental costs and if the higher standard can be provided without significant additional impact on the environment.

The option of a single carriageway bypass versus a dual carriageway bypass was tested for the low, central and high growth traffic scenarios as outlined in **Table 3-7** below.

Table 3-7: Forecast Flows on the Proposed Scheme

Vehicles per day AADT in Design Year 2041	Growth scenario	Single Carriageway	Dual Carriageway
Bypass North of N51	Low	11000	11250
	Central	11550	11800
	High	12450	12650
Bypass South of N51	Low	12050	13050
	Central	12600	13600
	High	13450	14700

Table 3-7 shows that in all growth scenarios, forecast traffic flows on the scheme for both the single carriageway and the dual carriageway option are at the level where both options warranted consideration. While a dual carriageway is not required for capacity reasons, (a single carriageway road can carry the predicted volumes), the level at which the benefits of the higher standard, including road safety benefits

outweigh the costs is the key factor in the decision as to whether a higher scheme level of service is appropriate. The decision therefore is primarily an economic one (benefits versus cost), provided that any increased environmental impact is not significant.

The predicted journey time savings in 2041 assuming central growth, for traffic that uses the full length of the bypass, are presented in **Table 3-8** below.

Table 3-8: Forecast Journey Time Savings due to the Proposed Bypass

Saving in Minutes				
Central-2041		Single	Dual	*% Difference*
AM	Northbound	5.02	5.26	*4.8%*
	Southbound	5.01	5.35	*6.8%*
PM	Northbound	8.79	9.21	*4.8%*
	Southbound	4.03	4.24	*5.2%*

The results of the journey time savings show that increasing the level of provision from a single-carriageway scheme to a dual-carriageway scheme increases the journey time savings by approximately 5% to 7%, with the largest difference being in the southbound direction in the AM peak period.

In terms of cross section and footprint, the typical width of a Type 1 Single Carriageway is 18.3 m compared to 21.5 m for a Type 2 Dual Carriageway. Note also that the single carriageway option would require climbing lanes for a substantial proportion of its length, a typical width requirement of 19 m. Given the project constraints, the horizontal and vertical alignment of the two options would also be the same. The increased width of the dual carriageway would result in proportionally greater site clearance, earthworks, road pavement and bridge deck areas and a proportional increase in land acquisition would also be required but the differences are not considered significant.

An initial incremental analysis was carried out utilising Phase 2 Feasibility Working Costs. The cost benefit analysis was undertaken using the Transport User Benefit Analysis (TUBA) software and the results are summarised in **Table 3-9** below. The limited differences in the cross section of the two options results in a cost difference between that is not excessive. It can be seen that both single and dual carriageway options provide broadly similar Benefit to Cost Ratio (BCR) values.

Table 3-9: TUBA Results for Option EG – Single and Dual Carriageway Options

€ m	Single Carriageway			Dual Carriageway		
	Low	Central	High	Low	Central	High
Present Value of Benefits	161.04	186.04	276.58	167.63	196.82	309.02
Costs - Total Scheme Budget						
Present Value of Costs	33.05			37.26		
Comparison						
Benefit to Cost Ratio	4.87	5.63	8.37	4.50	5.28	8.29

Incremental Analysis

Taking the results from **Table 3-9**, the incremental Present Value of Costs (PVC), the extra cost of building the scheme to dual carriageway standard is €4.21 m. The comparison with the incremental Present Value of Benefits (PVB), the extra road user benefit obtained thereby is as set out in **Table 3-10**.

Table 3-10: Incremental Analysis Calculation

	Low	Central	High
PVB single	**161.04**	**186.04**	**276.58**
PVB dual	**167.63**	**196.82**	**309.02**
PVB increment	6.59	10.78	32.44
PVC increment	4.21	4.21	4.21
Incremental BCR	1.57	2.56	7.71

The higher-level investment is economically justified as the higher investment in a dual carriageway standard under all growth scenarios results in an incremental BCR greater than 1.

Environmental Consideration

The following environmental aspects were considered with regard to the type of carriageway for the N2 bypass:

- Given the environmental sensitivity – particularly the ecological impacts on the River Boyne habitats and the landscape impacts in terms of the views from the World Heritage Property – a dual carriageway could only be justified if there was not a significant difference in environmental impact between the two options.
- As noted above, the project constraints are such that the horizontal and vertical alignment of either a dual carriageway or a single carriageway option would be the same. The most notable difference would be the overall width of the scheme, with the dual carriageway being between 2.5 m to 3.2 m wider, depending on single carriageway climbing lane requirements.
- The environmental appraisal of the two options indicated a marginal preference for the option with the least sized footprint i.e. the Type 1 Single Carriageway, as would be expected. However, as other than the width of the scheme, all other aspects would essentially be the same e.g. junctions, bridge crossings, drainage provisions (e.g. attenuation ponds), fencing, road lighting, road signs no significant difference in impact between the two options was noted. The overall effects on biodiversity, archaeology, material assets and landscape in particular were essentially the same for both options.
- The dual carriageway option was found to provide marginally better traffic impact outcomes by further improving the N2 corridor as a transport corridor and providing greater traffic relief in Slane village. However, the additional traffic attracted to the N2 corridor is small and the dual carriageway attracts more traffic from the existing N2 in Slane. Overall, the differences in traffic effects between the options was found to be marginal and significantly below the 25% additional traffic that is generally considered to result in noticeable different traffic noise.

On this basis it was concluded that the dual carriageway option would not result comparatively in a significant increase in the environmental impacts between a Type 1 Single Carriageway and a Type 2 Dual Carriageway.

Road Safety Consideration

National road safety policy (refer to **Chapter 2**, **Section 2.2.1.8 Road Safety Strategy 2021-2030 – Our Journey Towards Vision Zero**) emphasises the national objective to aim for a 50% reduction in serious accidents and deaths in the next ten years, and zero by 2050.

Statistically, motorways and dual carriageways are safer than single carriageway roads. The following statistics (provided by TII’s Safety Division) are relevant to the choice between a dual carriageway and a single carriageway:

- Dual Carriageways are three times safer than single carriageways in terms of injury collisions.
- Approximately 40% of all fatalities on national roads each year are as a result of head-on collisions; for every fatal head-on collision, another two people are injured or killed. Dual carriageways significantly reduce the possibility of head-on collisions.
- 92% of fatalities and 86% of serious injury collisions occur on single carriageway national roads.

While the above statistics would typically apply to open road conditions, in the case of the Slane bypass, the Proposed Scheme consists of a 3.5 km dual carriageway set in the context of the wider N2 single carriageway context. Additionally, the scheme includes for three at-grade roundabout junctions. Therefore, the statistics quoted would not necessarily be fully applicable for the proposed scheme but the principle that the scheme would reduce head-on collisions remains.

The following safety aspects were considered with regard to the type of carriageway for the N2 bypass:

- Dual carriageways provide safer overtaking opportunities than single carriageways. In the case of the single carriageway for the proposed N2 bypass, the curvilinear nature of the proposed alignment and the presence of three at-grade roundabouts in relatively close proximity (relative to open road conditions), it is likely that full over-taking forward visibility would be very limited and much of the route would be designated non-overtaking, noting that climbing lanes where provided would provide uphill overtaking. The single carriageway would provide less safe overtaking opportunities than a dual carriageway option.
- Providing a dual carriageway scheme along the N2 route which will remain a single carriageway outside the bypass limits would result in inconsistency of cross-section which could be a potential safety hazard as drivers pass from one relatively high standard to a lesser standard road, where the safe speed may be lower. This would not be the case for the Proposed Scheme as a roundabout is provided at the point where dual gives way to single, thus facilitating speed reduction and for clear driver messaging, ensuring the change in standard is communicated.
- The dual carriageway bypass would provide dedicated safe overtaking opportunities which could reduce the incidence of unsafe overtaking on nearby sections of the N2 approaching the village.

On this basis it was concluded that the dual carriageway option would provide greater safety benefits than a Type 1 Single Carriageway.

Overall Conclusion

On the basis of this above appraisals, the proposed N2 Slane Bypass has been developed as a Type 2 dual carriageway as it is concluded that the dual carriageway provides optimum benefits, is economically justified and would not result in any significant increase in the impact on the environment compared to the Type 1 Single Carriageway.

3.4 Design Stage Alternatives

Given the sensitivities of the receiving environment for the Proposed Scheme, including the UNESCO World Heritage Property of Brú na Bóinne and the River Boyne and River Blackwater SAC and SPA, a number of design options were considered to avoid and reduce the potential for negative effects. The key considerations related to:

- The form of the Boyne Bridge crossing;
- The design of the Boyne Bridge piers;
- The design of overbridges for the scheme; and
- The design of the shared cycle and pedestrian bridge for the scheme.

An examination of the alternatives together with engineering, cost and environmental analysis under each heading is provided below.

3.4.1 Boyne Bridge Form Design Options

A variety of broad structural forms for the Boyne crossing were considered in an initial scoping exercise to identify the most appropriate form of the bridge before providing additional design consideration. The initial scoping included consideration of long span (clear span), multi-span (two and three span) and infill options, which are discussed below.

Long Span (Clear Span) Bridge Forms

Long span bridges (e.g. cable-stay and suspension) were considered to examine whether such a bridge could practically be used to carry the N2 across the entire Boyne Valley, without the need for a footing or foundation constructed within the valley. This would reduce the potential for impacts on the European sites[6] during the construction of the Boyne Crossing. These bridge forms would all be regarded as landmark structures and would be highly visible in the landscape and usually form the centrepiece of a major river crossing. The following long-span options were considered:

- **Long Span Option 1 – Current Vertical Alignment:** This option comprised a two-pylon cable-stayed structure. This option is based on the same vertical alignment being considered for the overall bypass scheme with one pylon positioned to the north of the valley and the other pylon positioned at the southern end between the canal and Rossnaree Road. Landmark bridges of this nature are generally designed to have additional lighting along the cable and pylons. The high-level pylons, cables and lighting have potential negative impact on local wildlife and bird flight paths. They also have highly negative impacts visually for local landowners, particularly the residential properties along Rossnaree Road which would be in close proximity to the high-level pylon at the southern end of the valley.
- **Long Span Option 2 – Higher Vertical Alignment:** This option has a higher vertical alignment that would not require significant excavation on the approaches compared to the Long Span Option 1 but would require the construction of approach embankments. It also comprises a two-pylon cable stayed structure, based on both pylons being positioned outside of the River Boyne and River Blackwater SAC and SPA with the southern pylon positioned to the south of Rossnaree Road. The structure would span across the Rossnaree Road as well as the Boyne Valley. It should be noted that a cable stay bridge of this scale would be one of the largest of its kind in the world and would be by far the biggest bridge ever constructed in Ireland.

Conclusion: In considering the objectives of the Meath County Development Plan (MCC, 2021), as well as the proximity to the UNESCO World Heritage Property of Brú na Bóinne, and the significant construction operations immediately adjacent to the River Boyne and River Blackwater SAC and SPA, it was concluded that a landmark high-level long span bridge form was not a feasible or practical solution for the proposed Boyne crossing.

Infill Bridge Forms

Options were considered which examined whether parts of the Boyne valley could be infilled, thus requiring a shorter length of bridge crossing:

- **Infill Option 1:** An Infill embankment with adjacent single-span and two span bridges was considered. This option would involve filling in some of the Boyne Valley area between the river and the canal, then a single span bridge of 40 m to span the canal and towpath, plus a two-span bridge (75 m per span) of 150 m length to span the river and northern end of the valley. This option achieves the required headroom clearance to the canal and towpath. The single- and two-span bridges would likely be of pre-stressed concrete beam and steel multi-girder construction respectively. This option raised potential flooding issues, and flood relief culverts would be required though the embankment between the Boyne and the canal. The poor ground conditions were also likely to require the fill embankment to be piled, further complicating the construction of this option. Flood culverts and piled embankments would reduce the potential cost savings initially expected with this option. The primary reason this option was not progressed further was the desire to minimise the construction works in and impact on the SAC and SPA. The fill embankments would reduce foraging routes for mammals particularly the otter and the increased construction work in the valley increases risk of adverse impact on water quality during the construction phase. This option was not progressed further due to its negative environmental impact.
- **Infill Option 2:** Infill embankments with two adjacent single-span bridges were considered. This option would involve filling in the Boyne Valley between the river and the canal and also the northern end of the valley, construction of a single-span 40 m bridge over the canal and towpath, and a single-span 75 m bridge over the river. This option was similar to the previous option with the added advantage of simplifying the longer bridge to a single span structure. The negative environmental impact associated with the previous option however would also be increased by the further filling in of the valley to the north of the Boyne. This option was not progressed further due to its negative environmental impact.

[6] It should be noted that the boundary of the River Boyne and River Blackwater SPA broadly covers to the banks of the River Boyne whereas the boundary of the SAC has a wider footprint and extends beyond the river's banks in many areas. At the proposed bridge crossing location, it extends up to and along the Rossnaree Road.

- **Conclusion:** In considering the infill options, it was concluded that the environmental impacts including increased flood risk, proximity to the European sites, and the nature of the construction required, infill options would not be considered further.

Two and Three Span Bridge Forms

Two and three-span bridge arrangements were considered to examine whether the number of spans and associated piers/permanent footings required within the area of the SAC could be kept to a minimum:

- **Two Span Bridge:** This option considered a twin span bridge with an overall length of 250 m. The structural depth required to achieve these span lengths would mean the headroom requirements over the canal and towpath would not be possible to achieve. The proportions of a low-level bridge with the required structural depths would also impact negatively on the aesthetic. Construction of this option would be impractical due to the length of cantilever required (balanced cantilever construction) or the assembly and erection of such large steel sections. For these reasons this option was not considered feasible.
- **Three Span Bridge:** This option considered three spans with an overall length of 280 m. Similar to the two-span option, the structural depth required to achieve the span lengths would mean the headroom requirements over the canal and towpath would not be possible to achieve without raising the road alignment significantly. The proportions of a low-level bridge with the required structural depths would also impact negatively on the aesthetic. In-situ, post-tensioned concrete box girder constructed via balanced cantilever was considered the best construction method for this option. However, it was considered to be impractical due to the length of cantilever required. This form of construction also requires significant in-situ concrete works taking place across the valley and over the watercourse, increasing the risk of concrete spillage to the river. For these reasons this option was not considered feasible.

Conclusion: In considering the proportions of a low-level bridge with the required structural depths as well as construction constraints, neither the two nor three span options were considered further.

Four Span Bridge Forms

Four span bridge forms were considered to address some of the engineering/headroom issues identified with the two and three span forms:

- **Four Span Bridge:** A four span bridge form presents good structural form and bridge aesthetic in terms of scale, open aspect and span-to-depth proportions, albeit with some increase in the scope of construction work to be carried out within the area of the SAC. The overall bridge length of a four-span arrangement (260 – 275 m) remains comparable to the two and three-span forms (250 m and 280 m respectively). The temporary disruption to the valley floor for the construction of a four-span bridge was also considered comparable to the two and three span options considered, as access and hardstanding areas required for construction would be similar. The two and three span options therefore would not entail less temporary disruption over the four-span option. In addition, while a four-span bridge would introduce more permanent footings to the Boyne Valley, it was considered less intrusive than the infill options considered and enabled the required headroom clearance for the canal and towpath.

Conclusion: In consideration of the above, a four-span bridge was therefore identified as the preferred form arrangement.

Five variations of the four-span bridge form were assessed. These variations are described below with a summary evaluation between the alternatives, having regard to several criteria. More detailed advantages and disadvantages are presented in **Appendix 3.5**.

- **Option 1 – Four span constant depth steel box girders:** A four span twin steel box girder bridge made composite with a reinforced concrete deck slab, with a total bridge length of 260 m. The composite box girders are a constant 3.2 m deep overall. This represents a feasible option with an uncomplicated structure, achieves good symmetry and proportions with a relatively open aspect. This option could be incrementally launched across the valley. The substructure consists of cast in-situ reinforced concrete piers and abutments supported by bored pile foundations. This option requires some filling in of the northern side of the Boyne Valley. A twin ladder deck arrangement was also considered for this option, however the structural depth required would have been greater and therefore a box girder arrangement was preferred.
- **Option 1A – Four span varying depth steel plate girders:** Option 1A has the same span arrangement, length and substructure as Option 1. The superstructure comprises steel plate girders

made composite with a reinforced concrete deck slab. The girder depth varies from 4 m at the intermediate supports to 2.15 m away from the supports thus increasing clearance while also improving aesthetics. This option requires some filling in of the northern side of the Boyne Valley. The varying depth multi-girder deck would be erected by crane from outside of the River Boyne 10 m exclusion zones. Access for a very large crane between the canal and the river and north of the river would therefore be required.

- **Option 2 – Four span constant depth steel box girders with extended northern span:** Similar to Option 1, this is a four-span twin steel box girder bridge made composite with a reinforced concrete deck slab, and a total bridge length of 275 m. The composite box girders are a constant 3.5 m deep overall. This represents a feasible option with an uncomplicated structure. This option has an extended northern span to avoid having to partially fill in the northern side of the Boyne Valley. This option could be incrementally launched across the valley. The substructure consists of cast in-situ reinforced concrete piers and abutments supported by bored pile foundations.
- **Option 2A – Four span varying depth steel plate girders with extended northern span:** This option matches the span arrangement, length and substructure of Option 2 with a similar varying depth steel multi-girder superstructure as Option 1A. The girder depths are similar to Option 1A except for the northern span which would require a deeper girder due to the longer end span. This option would again be erected by crane from outside of the River Boyne 10 m exclusion zones, so access for a very large crane between the canal and the river and north of the river would therefore be required. The extended northern span again avoids having to partially fill in the northern side of the Boyne Valley.
- **Option 3 – Four span varying depth concrete box girder:** A four-span concrete box girder option with three sections of varying depths spanning the majority of the Boyne Valley achieving good aesthetics and a shorter shallower constant depth span achieving good clearance to the towpath and the canal at the southern end of the bridge. The span arrangement gives a total bridge length of 275 m. The bridge consists of an in-situ, post tensioned concrete box girder structure, constructed via balanced cantilever method. The substructure consists of cast in-situ reinforced concrete piers and abutments supported by bored pile foundations. This option spans the entire Boyne Valley.

Summary of the Evaluations

- **Technical Evaluation:** The four span options being considered for the Boyne Crossing were similar from a technical perspective with associated advantages and disadvantages for each. Issues included the symmetry of the span arrangement, the nature of the materials used in terms of maintenance requirements in the SAC and SPA, proximity to the ecology buffer zone 10m setback and depth of structure at the midsection. Options 1 and 1 A were considered to hold better symmetry with Options 2 and 2A extending to the end of the northern section of the valley. This has the effect of removing the symmetry and structural efficiency of the side spans.
- **Environmental Evaluation:** Specialist environmental criteria in relation to landscape, archaeological heritage, architectural heritage and world heritage used to inform the evaluation determined that the bridge should have the following features: be a low-level bridge structure; have minimal cross-section; have abutments positioned as far north as possible; span as much of the valley as possible; and have a varying depth profile. Options 2A and 3 were therefore slightly preferred in terms of visual impact with Options 1 and 2 seen as the least desirable. The ecology evaluation concluded that all options being considered, once completed, should have minimal permanent impact on the Qualifying Interests of the River Boyne and River Blackwater SAC and SPA. However, the construction of a bridge of this scale within an SAC and immediately adjacent to a sensitive SPA has a high risk of environmental impact and significant mitigation would be needed to ensure there is certainty of no adverse effects on site integrity.
- **Aesthetic Evaluation:** Specialist consideration was given to the aesthetics of the bridge, acknowledging that there is subjectivity to such an evaluation. Focus was therefore on the symmetry and slenderness of the structure in midspan regions. The symmetrical and varying depth options were considered more aesthetically pleasing. The clean lines of a box girder were considered more appropriate in an urban environment where more people would have close up views of the structure from the underside. A curved soffit or varying depth girder is preferred for multi-span bridges of this scale, particularly given the receiving environment and landscape of the Boyne Valley. Therefore, it was concluded that the symmetry and varying depth soffit of Option 1A and Option 3 had clear aesthetic advantages over the other options.
- **Economic Evaluation:** In considering the economic evaluation of the proposed options, the out-turn cost certainty was considered. The scale of the bridges proposed means some cost-uncertainty is

associated with each of the options. Options 1 and 2 have medium cost certainty. Although relatively uncomplicated structures are proposed for each, the specialist nature of bridge launching has an element of cost uncertainty associated with it. Option 1A and 2A have higher cost certainty as steel plate girders are a relatively well-known form of structure and there is considerable experience of this form of construction particularly in the UK. Option 3 has medium cost certainty due to the scale of the bridge and the highly specialist nature of the balanced cantilever construction method.

- **Construction and Buildability Evaluation:** Advantages and disadvantages were identified for each of the three primary construction methods considered for the five proposed bridge options. All require a contractor experienced with bridge construction of this scale. There will be significant foundation construction within the Boyne Valley and the superstructure construction will be a large-scale operation for all three methods. Options 2 and 2A are less desirable when compared to Options 1 and 1A due to the extended northern span. All options require the construction of five substructures that are supported by piled foundations and all options have two piers between the canal and the River Boyne so there will be significant construction works in this area for all options.
- **Hydraulic Evaluation:** Hydrology was considered as part of the options evaluation. The proposed options introduce a negligible hydraulic constraint into the River Boyne channel as none of the options include a footprint within the river channel and all options maintain an additional 10 m setback to the river channel on both banks to provide a buffer for ecological purposes. All five options achieve significant clearance (at least 8 m) to the river channel. Options 1 and 1A require the northern end of the Boyne Valley to be filled in over a distance of approximately 15 m, the increase in flooding risk due to this fill is negligible. The present day 1 in 100 year flood level (1% AEP) is 13.7 mAOD, with the ground levels of the floodplain ranging from 12 mAOD to 12.5 mAOD. Theoretically, Option 3 has a very slight lower hydraulic impact due to its intermediate pier supports being further back from the edge of the river channel than the other options; the difference is however negligible.
- **Construction Health and Safety Evaluation:** All of the options will require some form of traffic management on Rosnaree Road during the works period. In-stream works are not required or permitted for any of the proposed options. All options will require access to the area of land between the River Boyne and the Boyne Canal and to the northern side of the river during the construction stage. A temporary access bridge over the canal along with temporary piling and works platforms in this area will be required.

  All options require piled foundations, which limits the size of excavations needed for foundations. Piling operations and construction of pile caps will be constructed near existing ground level. Inspection of the bridge superstructure can be undertaken safely from the bridge itself, from the ground below the bridge and from the river using boat access when required. Inspection of abutments and bearings can be undertaken from ground level and appropriate access for inspection will be provided in the design. The likely significant maintenance operations required during the life span of the bridge will vary depending on the chosen option. The primary maintenance operation for each option will be the replacement of expansion joints and bearings. Each maintenance operation required are commonplace in the industry and management of the related health and safety issues is well understood.
- **Durability and Maintenance Evaluation:** All options are of similar durability require similar maintenance. All option with the exception of Option 3 would be fabricated from weathering steel which means that maintenance painting will not be required over the lifetime of the structure. Weathering steel structures are designed with a sacrificial thickness for corrosion and therefore can be regarded as very durable once located away from marine environments. The exposed concrete faces of Option 3 require nominal maintenance over the entire lifespan; concrete is recognised as being a durable material with little maintenance required.

  For all options, specialist access equipment is required to access the box girder internal cells to facilitate future inspection and maintenance. Other elements such as deck surfacing will need maintenance and replacement after 20 years. Option 3 has 15 bearings in total, Options 1 and 2 have 20 bearings in total, and Options 1A and 2A have 30 bearings in total. Bridge bearings and movement joints will need to be inspected and maintained regularly and replaced after 50 and 20 years respectively; to facilitate these works permanent access will be required to the piers and abutments for all options.

3.4.1.1 Preferred Bridge Form Design

An assessment of the preferred option was undertaken under a number of criteria. **Option 1A** (see **Figure 3.5** and **Volume 3 – Technical Drawings,** drawing **MDT0806-RPS-ST01-N2-DR-D-BR0210-01**) is considered the preferred option, as it most adequately addresses the following constraints:

- Is a low-level non landmark structure;
- The structure is considered safe and useable for all users;
- The structure is cost effective and buildable;
- The structure avoids geotechnical faults and set back zones while providing sufficient headroom clearance to the River Boyne channel and the Boyne canal and towpath;
- The structure has aesthetic merit with minimal negative visual impact on the local landscape and views from the World Heritage Property at Brú na Bóinne, the Hill of Slane and Slane Bridge; and
- Construction stage environmental impacts are similar in nature compared to the other options.

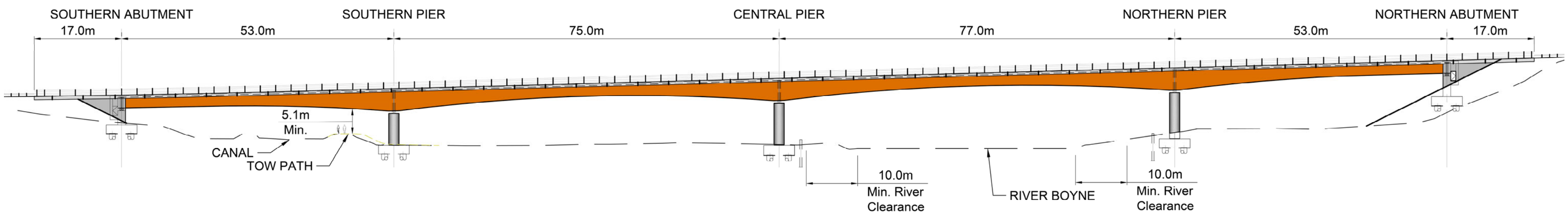


Figure 3.5: Preferred Bridge Option

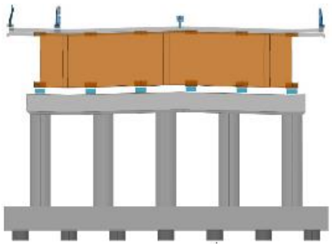
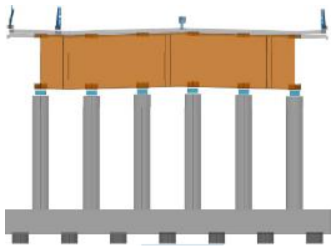
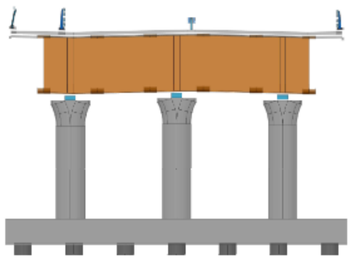
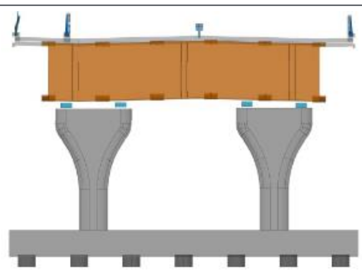
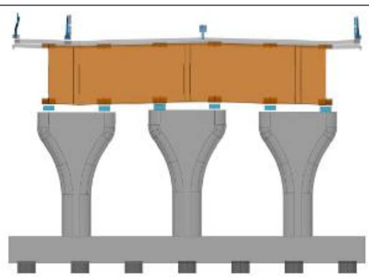
3.4.2 Boyne Bridge Pier Design Options

As noted in the preceding section, the Boyne Bridge will be designed as four-span structure to achieve key constraints as outlined in **Section 3.4.1**. In addition to the form the bridge, options for the pier design have also been considered as one of the main design elements in delivering a low-profile and visually unobtrusive bridge, given the various sensitivities of the landscape/visual, amenity and heritage settings.

Summary of Bridge Pier Options

Five pier design options were initially proposed by the design team which were considered technically and structurally feasible, differing mainly on aesthetic grounds as set out in **Table 3-11**.

Table 3-11: Bridge Pier Design Options

Pier Design Option	Description	Design Overview
Option 1	5 no. piers and a crosshead	
Option 2	6 no. piers and no crosshead	
Option 3	3 no. piers supporting a diaphragm[b]	
Option 4	2 no. leaf piers supporting a diaphragm[b]	
Option 5	3 no. leaf piers supporting girders	

[a] A crosshead is a thickening of the top of a cross-wall (part of a pier) to provide seating for the ends of the bridge girders.

[b] A diaphragm is a structure for transferring the lateral forces being applied onto vertical structures, i.e. the piers.

Summary of the Evaluations

- **Technical Evaluation:** There is negligible difference between the various options presented from a technical perspective. All 5 pier options are considered viable solutions for supporting the superstructure.

  Environmental Evaluation: Option 3 was considered the most favourable option based on a landscape and visual evaluation as it would present the least visual impact on the landscape of the valley. Consequently Options 1 and 2 were considered the least desirable as they would have the most visual impact. Similarly, Option 3 presents the least extent of work required within the SAC area and was therefore slightly preferred from an ecology perspective. Outside of the ecology and landscape and visual evaluation, there is negligible difference between the various options presented from an environmental perspective.
- **Aesthetic Evaluation:** Although aesthetics can be regarded as somewhat subjective Option 3 was considered to be the most desirable aesthetically while also having the advantage of the minimal visual impact on the landscape as described above.
- **Economic Evaluation:** There is negligible difference between the various options presented from an economic perspective.
- **Construction and Buildability Evaluation:** There is negligible difference between the various options presented from a construction and buildability perspective.
- **Hydraulic Evaluation:** There is negligible difference between the various options presented from a hydraulic perspective.
- **Construction Health and Safety Evaluation:** There is negligible difference between the various options presented from a construction health and safety perspective.
- **Durability and Maintenance Evaluation:** Option 3 is the most desirable option from a durability and maintenance perspective due to the reduced number of bearings associated with this option. Option 4 is therefore the second best, and all other options are considered equal. Bridge bearings will need to be inspected and maintained regularly and replaced after 50 years. The exposed concrete faces of all proposed options will require nominal maintenance over the structure's entire lifespan. Concrete is recognised as being a durable material with little maintenance required.

3.4.2.1 Preferred Bridge Pier Design

Option 3 (see **Figure 3.6**) was considered the preferred option as it has a less 'cluttered' appearance beneath the bridge deck and allowed for more permeable views through the structure. The design team subsequently re-examined Option 3 in more detail to improve its technical feasibility and modified the design to include for slightly thicker columns, with some of the flared appearance of Options 4 and 5. Following this refinement, Option 3 remained preferred.

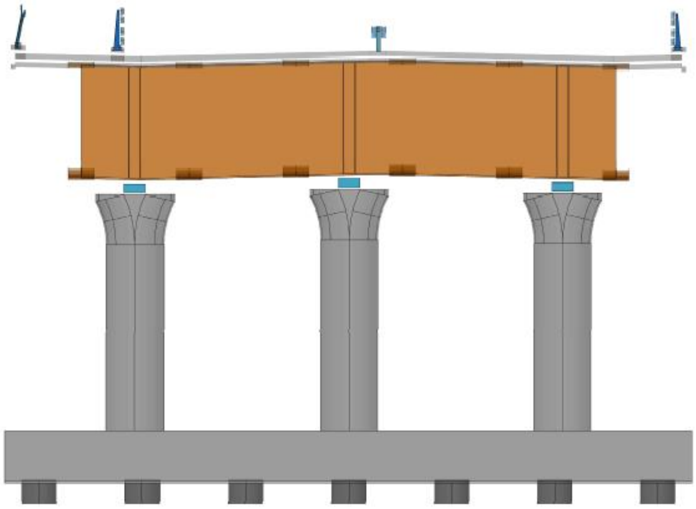


Figure 3.6: Preferred Boyne Bridge Pier Design

3.4.3 Overbridge Design Options

Three overbridges on the scheme are required to carry two farm accommodation tracks and Local Road L16002 (Rossnaree Road) over the proposed N2 Slane Bypass primary route. Three viable overbridge options were examined:

- **Option 1 – Single span steel composite:** A single span steel multi-girder deck bridge made composite with a concrete deck slab. This represents a feasible option with an uncomplicated structure. The single span achieves an open aspect and would have a varying depth profile with a shallower girder depth at midspan and deeper girders at the integral abutments. This option would be lifted into position. The substructure would be reinforced concrete abutments cast in-situ and supported by shallow foundations.
- **Option 2 – Three span steel composite:** A three-span steel ladder deck bridge made composite with a concrete deck slab. This represents a feasible option with an uncomplicated structure achieving good symmetry and proportions. This option could be lifted or incrementally launched into position. The substructure will be reinforced concrete piers and abutments cast in-situ and supported by shallow foundations.
- **Option 3 – Three span prestressed concrete:** A three span prestressed concrete bridge made composite with a concrete deck slab. This represents a feasible option with an uncomplicated structure with extensive experience in Ireland of similar structures. It achieves good symmetry and proportions. This option would be lifted into position. The substructure will be reinforced concrete piers and abutments cast in-situ and supported by shallow foundations.

All three options are integral structures, with a reinforced concrete diaphragm making the deck integral with the substructure. A summary of the evaluation is set out below.

Summary of the Evaluations

- **Technical Evaluation:** All Options provides a technical solution to satisfy the constraints and all the requirements of the brief. Option 1 achieves an open aspect appearance and has a reduced the structural depth at mid-span, while the span arrangement of Options 2 and 3 provide good overall symmetry and a structurally efficient ratio of end span to main. However, Options 1 and 2 comprise steel composite forms which are not commonly used in Ireland as there is no steel manufacturing industry here. Although the materials could be imported and the girders fabricated here, it is more likely that the girders would be fabricated overseas and transported to Ireland by sea. Option 1 would require a significantly greater lifting operation to position the superstructure. With Option 3, pre-stressed concrete beam bridges are the most common form of bridges of this scale in Ireland and the construction methodology is well-understood; there are no significant technical disadvantages associated with this option.
- **Environmental Evaluation:** None of the options proposed options are expected to have an adverse effect on the local environment. The scale of these three structures is minimal in relation to the entire scheme and the difference between the options from an environmental perspective is negligible.
- **Aesthetic Evaluation:** None of the proposed options are expected to have a significant aesthetic impact on local views. Each option will have understated details. Transverse deck cantilevers will overhang and shadow the main structural members, disguising the structural depth of the bridge, giving a slimmer, less intrusive appearance. Option 1 offers an attractive curved soffit with a varying depth girder. Options 2 and 3 offer similarly satisfactory proportions and symmetry. If a painted steel option was chosen, the painted ladder deck of Option 2 has aesthetic advantages over Option 3, however the monolithic concrete appearance of Option 3 is more commonly used and familiar in Ireland,
- **Economic Evaluation:** The common nature of the bridges proposed means there is reasonable cost-certainty associated with each of the options. Options 2 and 3 have high-cost certainty; these uncomplicated structures are commonplace in Ireland, particularly Option 3, and are familiar to a large number of contractors. Option 1 has medium cost certainty, lower than Option 2 due to the larger span and significant lifting operations required to install it.
- **Construction and Buildability Evaluation:** All options considered are readily constructible by a contractor suitably experienced in bridge construction of this scale and form.
- **Durability and Maintenance Considerations:** Options 1 and 2 could be fabricated from weathering steel which means that maintenance painting will not be required over the lifetime of the structure. Weathering steel structures are designed with a sacrificial thickness for corrosion and therefore can be

regarded as very durable away from marine environments. If a painted structure is preferred, it will require nominal maintenance over the first 20 years after which maintenance painting of the steel work will be required. It is expected that full repainting will be required after 25-30 years. The exposed concrete faces of Option 3 would require nominal maintenance over its entire lifespan. For all options, other elements such as deck surfacing will need maintenance and replacement after 20-25 years.

3.4.3.1 Preferred Overbridge Option

An assessment of the preferred option was undertaken under a number of criteria. **Option 3,** a three-span prestressed concrete beam and slab overbridge, is considered the preferred overbridge option as it most adequately addresses all of the constraints which are summarised as:

- The structure is considered safe and useable for all users;
- The structure is cost effective; and
- The option is buildable and is a well-known and understood form of construction in Ireland.

The typical general arrangement of such an overbridge is shown in **Figure 3.7** for the Rossnaree Road location. The two access overbridges will have similar arrangements and details; refer to the technical drawings for the specific details for each bridge in **Volume 3**, drawings **MDT0806-RPS-ST03-N2-DR-D-BR0103-01**, **MDT0806-RPS-ST04-N2-DR-D-BR0103-01 & 02** and **MDT0806-RPS-ST05-N2-DR-D-BR0103-01 & 02**

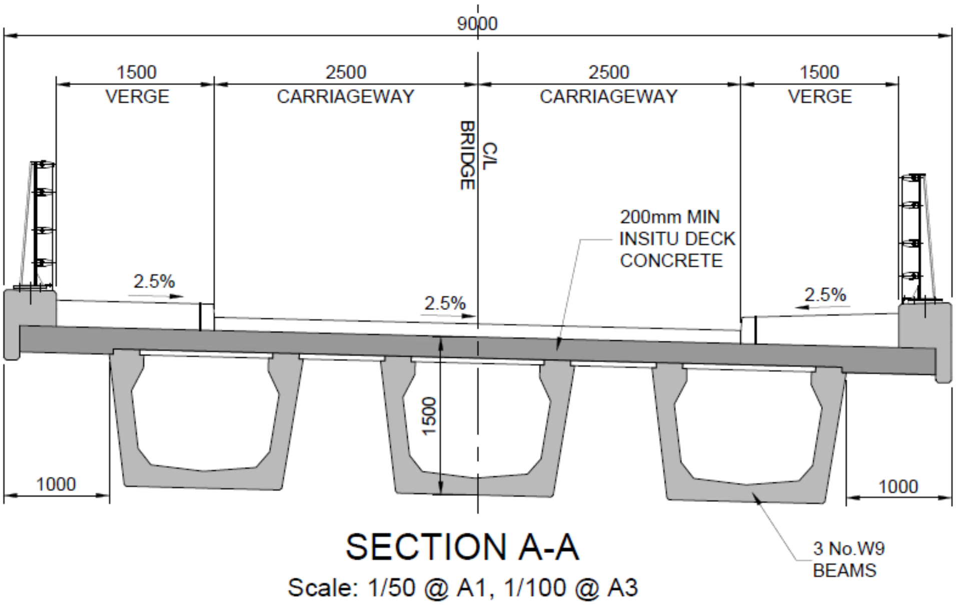


Figure 3.7: Preferred Overbridge Option

3.4.4 Shared Use Cycle and Pedestrian Bridge Design Options

As part of the Proposed Scheme, a Shared Use Cycle and Pedestrian Bridge is proposed to link the existing Boyne Canal Towpath to the new N2 Slane Bypass route. Given the protected nature of the existing bridge, it was considered inappropriate to construct additional cantilevered boardwalks onto the bridge. A new pedestrian/cyclist bridge adjacent to the existing bridge could be feasible but this would entail constructing another structure within the SAC/SPA and the associated potential impact on the qualifying interests and was therefore not considered reasonable.

The Boyne Canal towpath will potentially form part of the proposed Boyne Greenway. The proposed bridge will span over the Boyne Canal which forms part of the Boyne Navigation.

In considering what the preferred solution may comprise, a variety of structural forms for the Shared Use Cycle and Pedestrian Bridge were considered:

- **Option 1 – Short span steel truss:** A single span steel Warren truss bridge. A Warren truss consists of upper and lower horizontal chord members connected by diagonal web members at 30 and 60 degrees forming a truss based on equilateral triangles. The two bottom members are connected with transverse members forming a “U-Frame” to provide the 3 m wide deck. This option has a shorter span than the other options considered at approximately 16 m. Option 1 represents a feasible option with an uncomplicated structure. The substructure consists of reinforced concrete abutment walls running parallel to edge of the canal and wingwalls containing the approach embankments. This option minimises superstructure member size due to the shortened span.

- **Option 2 – Long span steel truss:** A single span steel Warren truss bridge similar to Option 1. This represents a feasible option with an uncomplicated structure. This option has a span of approximately 30.6 m with reinforced concrete bankseat sub-structure at the top of the approach embankments and piled foundations. This arrangement offers a satisfactory aesthetic with an open aspect.
- **Option 3 – Steel arch:** A single span low profile steel arch. The steel arch represents a structurally efficient feasible option with the deck supported directly from the arch via both struts and hangers. The pure arch form is aesthetically pleasing giving a light appearance and open aspect. The span, substructure and foundation arrangement for this option are similar to Option 2.
- **Option 4 – Steel box:** A single span steel box girder bridge. This represents a feasible option with an uncomplicated structure. The bridge has a comparably large structural depth as the structure is all located below deck level and the structural depth needs to ensure that dynamic performance requirements are met. A varying depth soffit reduces the structural depth at midspan and improves the aesthetic of this option. The span, substructure and foundation arrangement for this option are similar to Option 2.

Summary of the Evaluations

All four options are single span structures, with steel deck plates and reinforced concrete substructure and piled foundations

- **Technical Evaluation:** All options provide a technical solution to satisfy the constraints and all the requirements of the brief. The shorter span of Option 1 allows for more slender members in the superstructure and a reduced lifting operation and size of crane required for positioning of the superstructure. The truss offers an easy solution to fabricate using square and rectangular hollow sections. This type of fabrication is relatively common in Ireland and would not present undue challenges to fabricate. The structure’s diagonal members and top chords are structural components but also provide additional containment to pedestrians and cyclists using the bridge compared to Options 3 and 4. The shorter span and more significant substructure required for this option results in a more closed in structure which is less desirable both from an aesthetic point of view as the structural members would obscure sightlines to the east and west along the canal, and for the experience of the canal users. The proximity of the canal to the substructure and foundation construction may increase the risk of damaging the puddle clay lining of the canal and therefore increase the need for temporary works and precautionary measures during construction.

  The superstructure for Option 2 is similar to Option 1 and shares some of the advantages of fabrication and containment of that option. The span arrangement with bankseat substructures at the top of the approach embankments results in a desirable aesthetic. As the structural members are primarily above deck level Option 2 provides the most headroom and open aspect to the canal compared to the other options. It also means that the height of the approach embankments is minimised. Compared to Option 1, the longer span of Option 2 would result in heavier members as well as a larger crane and lifting operation being required for the position of the superstructure. As the structural members are primarily above deck level, Option 2 is considered less desirable for users of the bridge as the structural members would obscure sightlines to the east and west along the canal.

  The low-profile arch of Option 3 is both structurally efficient and aesthetically pleasing. While the other options will require bearings and movement joints to cater for thermal movements (with a fixed end and a free end where movement is allowed) the arch of Option 3 is integral with the foundations and caters for thermal movements through bowing of the arch. It is likely the arch would need only minimal cursory joints between the deck and the approach embankments and therefore has a lower maintenance requirement. Fabrication of Option 3 is more complex than Options 1 and 2 due to the curvature of the arch and use of circular hollow sections, which require more complex joints. Option 3 is likely to require larger foundations to resist the horizontal thrust from the arches, whereas foundations for the other options will need to resist predominantly vertical loads only.

Option 4 could be made integral which would remove the need for bearings and expansion joints with thermal movements catered for by bowing at midspan but also through compression in the box girder. A single span structure of this form will have a comparably large structural depth and is the only option which has its entire structure depth below deck level. This also means that the approach embankments need to be higher with more material needed and a larger earthworks footprint within the SAC. Fabrication of a closed box girder is more difficult and expensive than other options due to the complexities associated with access to the welds inside the box. For an integral option, the steel plate sizes would be consequently larger with more stiffening required to prevent buckling. This would increase the capital cost of this option.

- **Environmental Evaluation:** As the location of the Proposed Scheme crosses the River Boyne and River Blackwater SAC and SPA, there is potential for impacts with all options, particularly during the construction phase. The construction footprint needs to be viewed cumulatively with the construction footprint of the Boyne Crossing and temporary and permanent drainage infrastructure which will also be located within/adjacent to the European sites and includes proposed discharge into the River Boyne. The structure position is well removed from the edge of the Boyne River. The scale of the Shared Use Cycle and Pedestrian Bridge is minimal in relation to the entire scheme. Option 1 is considered the least desirable option from an environmental perspective. The substructure of this option includes in-situ reinforced concrete works in close proximity to the edge of the canal which increases the risk of concrete material entering the watercourse and potentially reaching the River Boyne. The construction of Option 1 foundations also increases the risk of damage to the canal's puddle clay lining.[7] This could have harmful effects on the water quality in the canal and require in-stream works, which will otherwise be avoided to repair the lining. The difference between Options 2 to 4 from an environmental perspective is negligible.
- **Aesthetic Evaluation:** None of the proposed options are expected to have a significant aesthetic impact on the local views. The Shared Use Cycle and Pedestrian Bridge will be in close proximity to the new Boyne Crossing and will not be visible from the east of this new bridge. Each of the four options will contrast with the relatively larger proposed Boyne Crossing Bridge.
- **Economic Evaluation:** The whole life cost of Option 3 and Option 4 (integral option) were identified as the most favourable as they will only require minimal cursory joints and no bearings. The other options will have more significant joints as well as bearings all of which will require periodic maintenance and replacement.
- **Hydraulic Evaluation:** The proposed Shared Use Cycle and Pedestrian Bridge will span over the Boyne Canal which forms part of the Boyne Navigation. The proposed options will have minimal impact on the hydraulics of the Boyne Canal. The Inland Waterways Association of Ireland (IWAI) – Boyne Navigation Branch have, as a primary objective, the restoration of the canal from Drogheda to Navan. Headroom requirements for any new bridge over the canal will be to match the headroom under the existing N2 Slane Bridge which provides approximately 3.6 m vertical clearance, and each option provides the minimum clearance.
- **Construction and Buildability Evaluation:** All options considered are readily constructible by a contractor suitably experienced in bridge construction of this scale and form. No issues have been identified that would not be inherent in comparable bridge schemes completed elsewhere in Ireland. Access for construction will be provided by the temporary access tracks already required for the construction of the Boyne Crossing. Each option will require cast in-situ reinforced concrete piled foundations and substructure elements. The superstructure of all four proposed options will be prefabricated off site, including deck surfacing and parapets, transported to site and lifted into position by crane. The construction sequence of each option will therefore be similar. The Option 1 substructure requires more in-situ concrete works and piling in closer proximity to the existing canal which will require greater temporary works to ensure there is no damage to the canal's puddle clay lining. Option 3 will likely require the largest foundations to resist the horizontal thrust from the arches.
- **Durability and Maintenance Evaluation:** Options 1, 2 and 3 comprise a painted steel structure which would require nominal maintenance over the first 20 years, after which maintenance painting of the steel work will be required. Option 4 differs slightly in that it could potentially be fabricated from weathering steel which means that maintenance painting would not be required over the lifetime of the structure,

[7] Such linings are found in certain water bodies (such as canals and reservoirs) and are comprised of a watertight, low hydraulic conductivity material (a mixture of clay and water). This lining is used to maintain these water bodies on permeable ground.

however the structure could also be painted. For Options 1, 2 and 3 (and Option 4 if painted), it is expected that full repainting would be required after 25-30 years. Other elements such as deck surfacing, expansion joints and bearings will need maintenance and replacement after 20-25 years. If Option 4 were made integral, it would have minimal joints and no bearings that require maintenance and replacement. For durability of all options, careful deck design incorporating water-shedding details is essential to improving the durability. If a painted finish is selected, maintenance of the protective paint finishes over the lifespan of the bridge is critical to durability of the structure.

3.4.4.1 Preferred Shared Cyclist and Pedestrian Bridge Option

Based on the evaluations undertaken, Option 3, comprising a single-span low-profile steel arch bridge with an open aspect, was considered the preferred option as it most adequately addressed all of the constraints. The typical general arrangement of the shared cyclist and pedestrian bridge is shown in **Figure 3.8**.

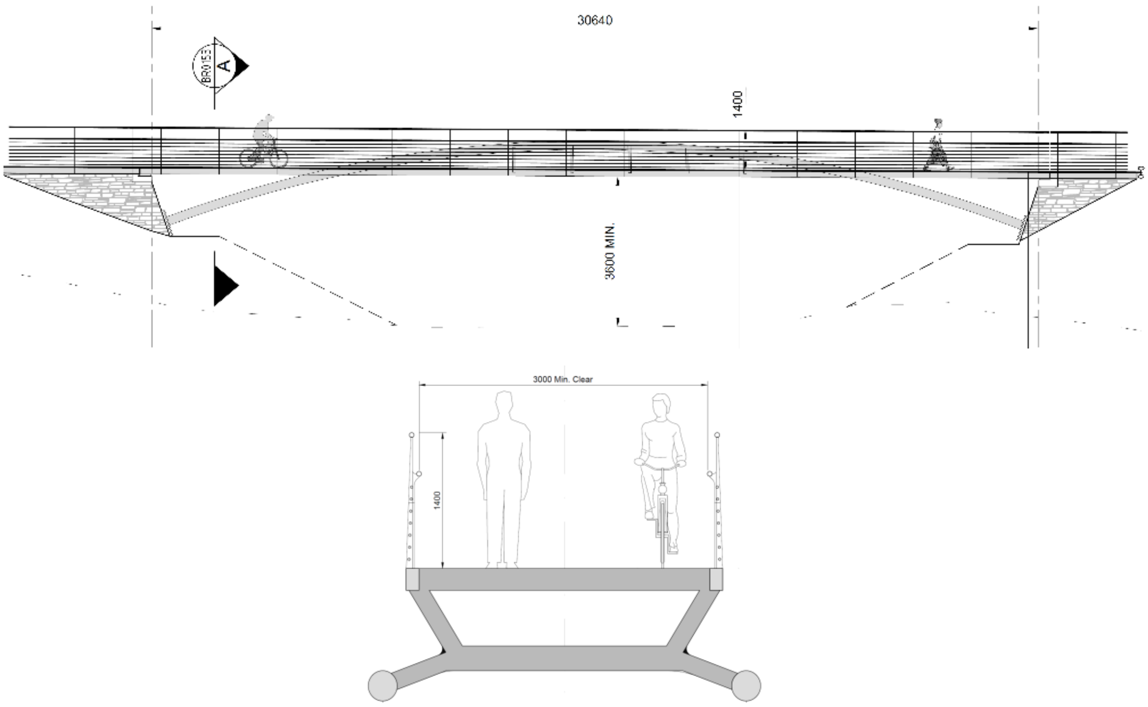


Figure 3.8: Preferred Shared Cyclist and Pedestrian Bridge Option

3.5 Construction Alternatives

3.5.1 Construction Compound Locations

A main construction compound and a satellite compound will be required during the construction phase for the Proposed Scheme to provide office and welfare facilities for site staff and also to provide facilities for material storage, laydown and maintenance of construction plant, and material testing. An office for the employer's representative and assistant staff will also be located within the main construction compound. A number of key considerations for determining the most suitable sites for the main and satellite compounds included:

- Access to the road network;
- Suitability of location for construction operations;
- Transport routes for construction traffic;
- Availability of utility connections e.g. water, electricity, telecommunications and foul drainage;
- Landtake required and impact on landowner; and
- Environmental impact including proximity to River Boyne and River Blackwater SAC and SPA.

The selection of a preferred main compound location influences the preferred location of the satellite compound e.g. if the main compound is located to the north then a satellite compound to the south would be more beneficial for construction management. As such, **Section 3.5.1.1** identifies the options for the main compound and the key considerations in reaching a preferred solution. **Section 3.5.1.1.8** then addresses the satellite compound location.

3.5.1.1 Main Compound Options

Three potential locations were identified for the main construction compound as listed below and shown on **Figure 3.9**:

- **Option 1:** Main construction compound located adjacent to N2, north of Slane, near northern end of proposed bypass.
- **Option 2**: Main construction compound located adjacent to N51, east of Slane, near proposed N51 Roundabout junction.
- **Option 3:** Main construction compound adjacent to N2, south of Slane, near southern end of proposed bypass.

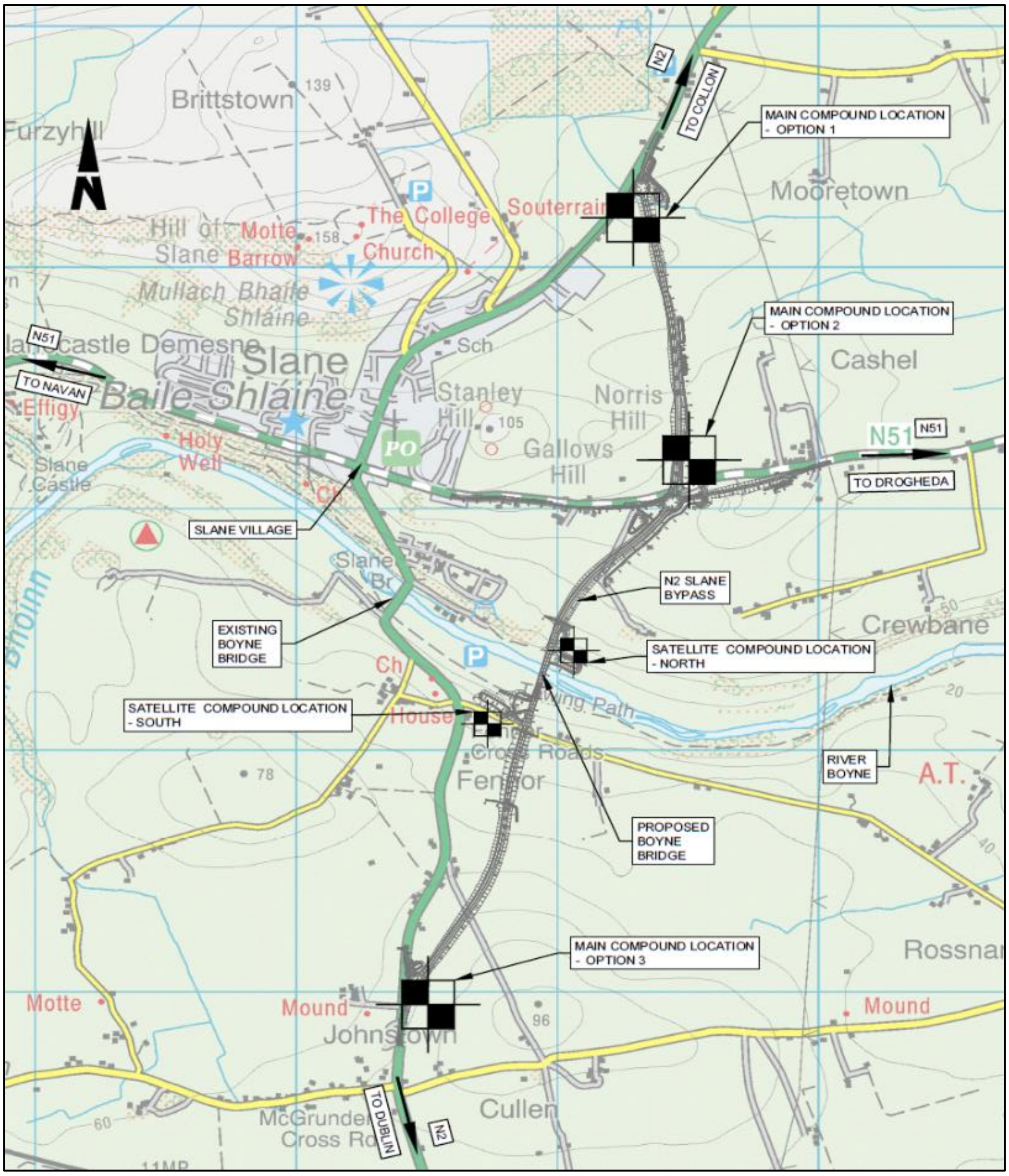


Figure 3.9: Locations Considered for Construction Compounds

The following sections discuss the key considerations listed above with regard to each of the potential construction compound options.

3.5.1.1.1 Access to Road Network

It was considered a necessity that the main construction compound should have direct access to the national road network i.e. the N2 or N51. The access arrangements for the potential main construction compounds were considered as follows:

- **Option 1:** Temporary access would be provided off the southbound side of the existing N2, north of Slane.
- **Option 2:** Temporary access would be provided off the eastbound side of the existing N51, east of Slane. This would then become the permanent maintenance access for Ponds 5A and 5B via Access Track 2.
- **Option 3:** Temporary access would be provided off the southbound side of the existing N2, south of Slane.

3.5.1.1.2 Suitability of Location for Construction Operations

Noting that the majority of the scheme is located to the north of the River Boyne but that the majority of bridge construction activities will take place from the south side of the river, the interface between the main compound and the main construction works was considered for each of the three options as follows:

- **Option 1:** Located near the northern end of the bypass, approximately 1.2 km north of the N51 and approximately 2.0 km north of the proposed Boyne bridge crossing.
- **Option 2:** Located near the proposed N51 roundabout junction, approximately 1.2 km south of the northern end of the scheme and approximately 0.8 km north of the proposed Boyne bridge crossing.
- **Option 3:** Located near the southern end of the bypass, approximately 1.2 km south of the proposed Boyne bridge crossing.

3.5.1.1.3 Transport Routes for Construction Traffic

Consideration of transport routes to and from the man construction compound was based on the following assumptions:

- Excavated earthworks to be removed from the site will be transported directly from the excavation site to a designated site access/egress point for onward transport to a nominated location off-site. This material will not be stored at the main compound or anywhere else on site;
- Imported material, e.g. concrete, sub-base material, blacktop etc., will be delivered straight to the location on site where it is required;
- Structural steel for Boyne Bridge crossing will be delivered straight to the site of the bridge structure; and
- Some material such as reinforcing steel and precast concrete units will be stored at the main compound.

Therefore, it is considered that limited material will be delivered to the compounds and that the majority of traffic travelling to/from the compounds will be generated by commuting site personnel.

Table 3-12 below summarises the potential traffic routes for each main construction compound option, considering the north, south and west traffic origins/destinations.

Table 3-12: Potential Traffic Routes for Main Compound Options

Traffic Origin / Destination	Potential Traffic Route to / from Main Compound		
	North	**South**	**West**
Option 1	N2	N2 through Slane	N51/N2, turning at junction in Slane
Option 2	N51 via M1	N51 via M1	N51 through Slane
Option 3	N2 through Slane	N2	N51/N2, turning at junction in Slane

3.5.1.1.4 Availability of Utility Connections

Available utility records and survey information indicate that there are no foul sewers located in the vicinity of any of the compound options. **Table 3-13** summarises the potential utility connections that would be available for each main construction compound option. The circumstances regarding potential utility connections for the main construction compound are similar for all three options.

Table 3-13: Potential Utility Connections for Main Compound Options

Utility	Potential Connection		
	ESB	**EIR**	**Water**
Option 1	ESB Network at existing N2	EIR Network at existing N2	Watermain at existing N2
Option 2	ESB Network at existing N51 (*Note: may require connection across road*)	EIR Network at existing N51	Watermain at existing N51
Option 3	Adjacent HV ESB line	EIR Network at existing N2	Watermain at existing N2

3.5.1.1.5 Temporary Landtake required and Impact on Landowners

The following has been assumed when estimating the approximate temporary landtake required for the main construction compound:

- 8 no. units required for contractor's office space and welfare facilities.
- Office space, welfare facilities and canteen/meeting room to be provided for 1 no. senior resident engineer and 4 no. assistant resident engineers.
- 50 no. vehicle parking spaces to be provided.
- Approximately 0.5 ha of additional lands to be provided for plant/material storage and plant maintenance.

The estimated landtake and impact on landowners considered for each main compound option is as follows:

- **Option 1:** Requires temporary acquisition of approx. 1 ha of tillage lands. The scheme also requires permanent land acquisition which severs this holding. It should be noted that, if this land is temporarily acquired, the remaining land available for agricultural use in this particular field would be only approximately 39% of the current field size (approx. 71% of field remaining if additional lands not temporarily acquired). This would impact the viability of tillage farming in this field while the additional land is temporarily acquired and therefore likely to require compensation for the landowner. It is considered that the provision of the new temporary access to the N2, will allow the existing field access to be retained for the landowner's use only.
- **Option 2:** It is proposed to locate the main compound in grazing lands severed by the proposed scheme which are to be handed back to the landowner. It is considered appropriate to temporarily acquire all of these severed lands, totalling approx. 1.2 ha, as any remaining lands not used for the compound would be of insufficient size to be viable for agricultural use. It is noted that, if these lands are not temporarily acquired for the compound and if they are to be handed back to the landowner for use

during the construction phase, the temporary access proposed for the compound to the N51, will need to be provided for the landowner's use.

- **Option 3:** Requires temporary acquisition of approx. 1 ha of tillage lands. There is no permeant landtake from this landowner.

It considered that the provision of the new temporary access to the N2, as discussed will allow the existing field access to be retained for the landowner's use only.

3.5.1.1.6 Environmental Considerations

The following considerations were identified in relation to the potential environmental impact of each main compound option:

- **Option 1:** The nearest private dwelling to the main construction compound is located approximately 100m to the south-west of the site. It considered that the potential impact from the construction compound on any adjacent properties would be negligible. No archaeological features were noted for this site. The shortest distance to the River Boyne and River Blackwater SAC is approx. 1.6 km and to the River Boyne and River Blackwater SPA is 1.7 km.
- **Option 2:** There are private dwellings adjacent to the eastern boundary of the field in which the main construction compound is proposed however construction activities shall not be permitted in the area immediately adjacent to these dwellings and noise/visual screening measures will be provided to offset any potential impact on the properties. Results of the geophysical survey, carried out to identify archaeological features, indicate that there is a potential enclosure site to the west of the compound location, as well as an extensive enclosure complex in the north, with part of a possible associated field system extending into the compound site. If any excavations are required for the compound works, these may impact potential archaeological features. As such these excavations shall be carried out under suitable archaeological supervision. The shortest distance to the River Boyne and River Blackwater SAC is approx. 776 m and the River Boyne and River Blackwater SPA is 892 m.
- **Option 3:** The nearest private dwelling to the main construction compound is located approximately 150m to the south-west of the site. It considered that the potential impact from the construction compound on any adjacent properties would be negligible. No archaeological features were noted for this site. The shortest distance to the River Boyne and River Blackwater SAC is approx. 1 km and the River Boyne and River Blackwater SPA is 1.2 km.

3.5.1.1.7 Preferred Main Construction Compound Location

In consideration of the assessments carried out, **Option 2** was identified as the preferred option for the location of the main construction compound. It is considered that the key benefits of Option 2 include the following:

- Relatively central location of main compound between the northern end of the bypass and the proposed Boyne bridge crossing, noting that the majority of the scheme works are to the north of the River Boyne.
- Traffic from the north and south to travel to/from the main compound via the M1/N51, and therefore avoid travelling through Slane village. Also, traffic from the west can travel straight through Slane without requiring a turning movement at the junction in the village.
- Temporary acquisition of the lands for the main compound should not excessively impact the landowner's agricultural operations.
- Environmental considerations associated with Option 2 can be mitigated through a combination of screening and environmental supervision.
- Satellite compound located to the south of the Boyne is preferable given that the majority of works for the bridge construction shall take place on southern side of the river. This satellite compound will also service the other works to be constructed to the south of Rossnaree Road.

3.5.1.1.8 Satellite Compound

In addition to the main construction compound, it is considered that a smaller satellite compound will also be required to facilitate the construction of the Boyne Bridge crossing and other works on the south side of the river. As with the main compound, it shall not be permissible for any satellite compounds to be located within the River Boyne and River Blackwater SAC or River Boyne and River Blackwater SPA.

As the preferred Main Compound is Option 2 to the north, it was proposed that a satellite compound would be provided in the lands on southern side of Rossnaree Road to the east of the proposed bypass alignment.

3.5.2 Boyne Crossing – Temporary Working Platform Options

To facilitate the construction of the proposed bridge crossing of the River Boyne, four temporary working platforms are required to provide a suitable foundation for cranes, piling rigs, excavators and other plant and machinery to operate from. The platforms will be used by large crawler cranes that will lift in the bridge girders, by piling rigs installing the bridge foundation piles and by excavators undertaking the digs for the bridge foundations. The platforms will be in place for approximately two years before being decommissioned.

Two platforms will be located to the south of the River Boyne (WP1 and WP2) and two to the North (WP3 and WP4). Working Platform WP2 and WP3 will be located closest to the river within the flood plain and the River Boyne and River Blackwater SAC and SPA. Working Platforms WP1 and WP4 will be located above the flood plain on the valley sides. The valley sides have slopes up to 28 degrees (> 1V:2H) in places. The flood plain is relatively flat, waterlogged, and the existing ground levels are approximately 1 m above the river level in times of normal flow.

The site and nature of the work poses several constraints that will require careful management during the construction, operation and decommissioning of the working platforms. These constraints generally impact WP2 and WP3 and to a lesser extent WP1 and WP4. The main constraints include:

- Working within SAC and SPA while ensuring the protection of the qualifying interests. Direct and indirect impacts may result from construction disturbance, loss of habitat, silt/fuel run-off and changes to the hydrological balance;
- Potential flooding for 1% Annual Exceedance Probability (AEP) i.e. 1 in 100 year flood level;
- Upstream and downstream effects on flood water resulting from the construction of the platforms;
- Waterlogged ground and the potential for water inrush within excavations and subsequent water and spoil removal;
- Provide overall stability to allow piling rigs, cranes and other plant and machinery operate safely;
- Soft ground and settlement potential of the platforms; and
- Steep ground requiring benching.

3.5.2.1 Viable Bridge Construction Platforms Considered

Several options were considered that could provide access and a suitable working platform that is fit for purpose, while minimising environmental impacts to the greatest extent possible. These comprised:

- **Option 1 – Conventional Working Platform Wrapped in Geotextile:** Comprises a working platform constructed from compacted fill which is then fully encapsulated in a geotextile wrap or high-density polyethylene (HDPE) liner to prevent silt loading of nearby watercourses during precipitation/ flooding events. The platform would be constructed to a height above the 1 in 100 year flood level (plus 20% climate change factor, plus freeboard). **Figure 3.10** shows a typical arrangement.

Figure 3.10: Typical Arrangement of Geotextile Placement / Wrapping

- **Option 2 – Traditional Working Platform:** Comprises a working platform constructed from compacted rockfill which would be considered the traditional method of construction for a temporary working platform. The platform would be constructed to a height above the 1 in 100 year flood level (plus freeboard). **Figure 3.11** shows the typical arrangement of rockfill working platform under construction.

Figure 3.11: Typical Traditional Working Platform

- **Option 3 – Bunded Working Platform:** Comprises a working platform that is surrounded by a bund. The bund provides the protection against flooding and in this way, machinery can operate at a lower level within the bund. The working platform is water-proofed by incorporating a welded HDPE liner within the bund and under the inner working platform. **Figure 3.12** shows and example of a bunded working platform. A variation would include a hydrocarbon separation geotextile to provide filtration of the internal water while allowing natural seepage back into the ground. This would reduce the amount of water to be pumped out and treated. The external bunds would be wrapped in a welded HDPE to prevent the ingress of external flood water. Culverts would need to be incorporated within the structure to prevent the upstream and downstream damming effects.

Figure 3.12: Typical Arrangement of a Bunded Working Platform

- **Option 4 – Modular Pontoons/Floating Causeway/Platform (Unifloat/ Linkflote/ Rigifloat):** A series of structurally-linked pontoons to provide a rigid platform and causeway to work from. The size of pontoon can be scaled to suit the loading requirements. For example, light traffic and material storage to larger excavators, lorries, pilling rigs and cranes. The construction works would only be operational when the pontoons are resting on the ground and not afloat. **Figure 3.13** shows typical examples.

Figure 3.13: Examples of Modular Pontoons / Floating Causeways / Platform

- **Option 5 – Bailey Bridge with Pontoons:** As per Option 4 above, however the pontoons act as floating piers to support the bailey bridge; see **Figure 3.14**. An alternative to using pontoons would be to use gabion/reno mattresses to create temporary piers.

Figure 3.14: Example of Bailey Bridge with Pontoon Piers

- **Option 6 – Reno/Gabion Mattress Baskets:** Similar to Option 2 however the rockfill will be contained within gabion or Reno mattresses; see **Figure 3.15** for examples. Reno mattresses are filled with stones to form flexible, permeable, monolithic structures such as riverbank protection and channel linings for erosion control projects. Given the sensitivity of this site to sediment run-off potential, it is additionally proposed that only washed coarse stone with a specified hardness would be utilised for this construction.

Figure 3.15: Examples of Gabion baskets and Reno mattresses

- **Option 7 – Temporary Sheet Piles/Cofferdams:** Comprises the installation of cofferdams either discretely at the excavations for the bridge piers or alternatively to enclose the full footprint of the working platforms. Properly constructed cofferdams provide for water-proofed working areas. See **Figure 3.16** for an example of a coffer dam.

Figure 3.16: Example of Coffer Dam

3.5.2.2 Assessment of Options

The main construction, operation and decommissioning effects associated with the working platforms which may pose a risk to the receiving environment are summarised as follows:

- An increase in river flows and flood levels upstream;
- Silt entering the River Boyne via connected watercourses or via overland flow;
- Hydrocarbons entering the River Boyne via connected watercourses or via overland flow;
- Other construction plant and materials entering the River Boyne in extreme flood events;
- Potential settlement of the platform creating a permanent depression that holds water;
- Erosion of soils due to excavations; and
- Following removal of a platform, the underlying soils may be susceptible to scouring and erosion from flood waters and intense rainfall.

A constraints and opportunity assessment were undertaken for each of the bridge platform options under the criteria of Engineering, Flooding, Environmental and Geotechnical. An overview is presented below, and full tables are presented in **Appendix 3.6**. A tabulated summary of the options assessment is outlined in **Table 3-14**.

Summary of the Evaluations

Option 1 is a tried and trusted methodology and solution. The installation of culverts would allow floodwater pass through. The use of geotextile would control silt generation during operational phase and temporary silt fences could be used during decommissioning of the platforms. The approach would also cope very well with differential settlements. However, it would also provide an impediment to the flow of the river in times of flood and thereby increase flood levels upstream which may exacerbate impacts to properties. The construction of the geotextile wrap would be subject to strict quality control as any defect would allow flood waters to breach the platform and result in the erosion of the fill materials. Significant environmental and health and safety risks would be associated with such a breach.

Option 2 is similar to option 1 in that it is a tried and trusted methodology and solution. The installation of culverts would allow floodwater pass through, and the use of geotextile would control silt generation during operational phase and temporary silt fences could be used during decommissioning of the platforms. The approach would also cope very well with differential settlements. However even with culverts, the platform would still be a barrier to flood water causing damming and influencing upstream and downstream flood levels. The solution would require a run-off collection and storage facility to prevent sediment laden surface run-off reaching the river. Pumping and treatment of this run-off would also be required. Option 2 would entail a large footprint.

Option 3 would allow all machinery to operate at a lower level. Welded HDPE liner would make the working area waterproof and contain any surface contaminants within the confines of the platform. Sumps would also be incorporated to collect oil and material spills. The use of geotubes for bunds is also possible with this option and this would lock up sediment and reduce/prevent silt run off from bund. The option would act as a lagoon during heavy rainfall events which would have implications on programme if pauses in works were required while the platform was being dewatered. Option 3 would also entail a large footprint.

Option 4 is largely an untried and untested solution for use on land and thereby increases project risk. This option would not impede the flow of the river in times of flood. However, many anchor blocks would be required to tether the platform to prevent it from floating away in times of flood. A number of significant excavations within the SAC would be required to install the anchor blocks. Founding these blocks on hummocky/uneven ground would likely destabilise the platform allowing it to rock thereby rendering it unfit for purpose. The mechanical connections between pontoons may also be compromised. To overcome this, the ground surface would first need to be prepared by excavating peaks and filling troughs and hence would defeat the purpose of why this system is being proposed in the first instance.

Option 5 offers many benefits by reducing many of the potential environmental impacts such as minimising footprint that is resting on the ground surface, located outside the river's edge (under normal flow conditions) by 10m, and not restricting the up- and downstream movement of otters within the fields away from the river's edge. However, it offers insufficient versatility for the operation of plant and machinery while constructing the main bridge and would be overly restrictive to be feasible as a practical solution. Furthermore, the very high loads associated with the piling rigs and cranes lifting the main bridge girders into place would require the bridge deck to be supported by significant structural foundations. Replacing the pontoons with piers would require them to be either piled or excavated into the natural soils to be founded on a suitable bearing stratum. Subsequently this would require significant environmental controls as the potential environmental impacts would be significantly higher than those associated with Option 6. This option would not easily facilitate the construction of the foundation and piles on its own.

Option 6 offers clear advantages from the engineering, environment, flooding and geotechnical perspective. The platform can be constructed at a low level using large clean rockfill with a high porosity which would allow flood water pass through and over it thereby not adversely increasing flood levels upstream for a 1% AEP flood event. The use of reno mattresses utilises cages filled with clean, large rocks. These can be filled outside of the SAC boundary, eliminating silt fines being generated or washed into the SAC in the event of rain or flooding. Careful management protocols and by excluding fuel storage, refuelling and the maintenance of plant from within the SAC. Geotextiles or geogrids may need to be incorporated between mattresses to increase the stability of the platform. The rock fill required for the baskets would be significant and would have a transport and carbon footprint. The risk of hydrocarbon loss to the environment can be carefully managed, and repairs, refuelling and maintenance of plant can be undertaken in the site compounds.

Option 7 offers two potential solutions. It is not deemed practical to provide a cofferdam around the full perimeter of the working platform. This would have the advantage of sealing off the works from the SAC and eliminating the potential for sediment or hydrocarbons to escape and enter the River Boyne. However, a cofferdam of this size would act as a dam to the river in times of flooding and would exacerbate flooding upstream and the impact to properties. Furthermore, flow velocities around the end of the cofferdam would be increased and in turn scour and erosion of the main river channel would be intensified.

The cofferdam provides a suitable solution to contain the excavation and piling works at the bridge pier locations. These are localised areas, but of sufficient size to allow workers, plant and machinery operate. The sheet piles would extend to a height above the peak 1% AEP flood level thereby sealing off the works from flood waters and eliminate the potential for sediment or hydrocarbons to escape and enter the River Boyne. Following completion of the bridge pier construction, the cofferdam can remain in place until such time the ground within the cofferdam is rehabilitated.

The proposed measures are designed to greatly reduce flood and environment risks. The low risk of hydrocarbon contamination entering the SAC is reduced significantly by further eliminating any reasonably anticipated pathway. As such, operations that pose an elevated hydrocarbon risk would be excluded from taking place within the SAC. Similarly, any works that may generate elevated levels of sediment (i.e. filling of reno mattresses) can be reasonably be carried out outside of the SAC. Excavation works within the SAC which would generate sediment would be contained within watertight cofferdams.

Table 3-14: Working Platforms Option Assessment Summary

Working Platform Options	Impact Potential: SAC Qualifying Interests and Flooding										Impact			Overall Rank	Legend
	Salmon		River Lamprey		Otters		Badgers*		Flooding		Engineering			1 = Best	
	Direct	Indirect	Direct	Indirect	Direct	Indirect	Direct	Indirect	Property	Erosion	Construction	Operation	Removal	7 = Worst	Potential Impact
Option 1 – Conventional Working Platform Wrapped in Geotextile	○	◑	○	◑	◑	◑	○	◑	●	◕	◕	◔	◕	6	
Option 2 – Traditional Working Platform	●	◕	●	◕	◑	◕	○	◑	●	◕	○	◔	◕	7	○ None to Neglible
Option 3 – Bunded Working Platform	○	◔	○	◔	◑	○	○	◑	●	◕	◕	◑	◕	4	◔ Low
Option 4 – Modular Pontoons/Floating Causeway/Platform (Unifloat/Linkflote/Rigifloat) with anchors	○	◕	○	◔	◕	○	○	◑	○	○	◕	●	◕	3	◑ Low to Medium
Option 5 – Bailey Bridge with Pontoons & Anchors or Piers with Foundations	○	◑	○	◑	◔	○	○	◑	○	○	◕	●	◑	2	◕ Medium to High
Option 6 – Gabion Mattress Baskets (low level)	○	◔	○	◔	◔	○	○	◑	○	○	◔	◔	◔	1	● High
Option 7 – Temporary Sheet Piles / Coffer Dams (Full Platform)	○	○	○	○	◕	○	○	◑	●	◕	●	◑	●	5	

* = Badgers relocated prior to commencement of work

3.5.2.3 Preferred Bridge Construction Working Platform Option

Option 6 constructed at a lower level is the preferred option due to its simplicity of construction, engineering fit-for-purpose and the lower potential impact it offers. The overall design intent of the WP is to meet the engineering requirements while overcoming the environmental constraints present at the crossing point. The proposed platform design achieves this is as follows:

- The platform can be constructed at a low level using large clean rockfill with a high porosity which will allow flood water pass through and over it thereby not adversely increasing flood levels upstream for a 1% AEP flood event. Furthermore, this will not significantly increase flows and thereby reduce the potential for related bank erosion.
- The use of reno mattresses, which are specifically designed for erosion control, riverbank protection and channel linings, utilise cages filled with clean large rocks. These will be filled outside of the SAC and lifted into place thereby eliminating silt fines being generated or washed into the SAC in the event of rain or flooding. Additionally, careful management protocols, such as wheel washing prior to entering the SAC will reduce the potential further.
- There will be very low risk of hydrocarbon loss to the environment as a result of careful (monitored) management protocols, including the exclusion of fuel storage, refuelling and plant maintenance at the work platform or anywhere within the SAC boundary. Stationary plant and equipment will be positioned on drip trays. All on-site plant and equipment will undergo daily checks for any signs of leakage, e.g., hydraulic fluid lines, with any necessary repairs and maintenance taking place in a dedicated, off-site work compound.
- Careful materials management procedures which risk-assess adverse weather conditions will significantly reduce the risk of the materials being washed from the platform and having an impact on the qualifying interests.
- With this option, the potential of sediment washing from excavations and impacting the qualifying interest will be eliminated by using sheet piled cofferdams around the bridge piers. This will be a watertight structure which will prevent any sediment laden water from escaping.
- The potential risk of sediment being washed from beneath the working platform following its removal will be reduced through staged decommissioning and immediate re-sodding (or hydro-seeding) during the drier summer months when the 1% AEP flood event for a given month is far less significant as both peak flow velocities and water levels are greatly reduced should an event occur.
- Settlement of the platform is significantly reduced the thinner it is. The thicker the platform the greater the depression that will be left behind once removed. Option 6 offers a thin platform which is generally <1.5 m in thickness and maximum associated settlements are anticipated in the order of 250 mm. However, this is not uniform across its footprint as the underlying ground is hummocky and characterised by subtle rises and falls. As such, settlements of this order will hardly be noticeable to the eye, particularly once vegetated. It is proposed to re-sod the area as the platform is removed in stages and as such, the addition of the sod will largely fill any shallow depressions left by the platform.

3.6 Public Realm Alternatives

3.6.1 Initial Considerations

3.6.1.1 Description of Options Considered

On completion of the initial option selection assessment for the proposed N2 Slane Bypass, options were considered within Slane village to assess how best to manage the residual traffic passing through the village. Initially, an analysis was carried out to establish the potential impact that any changes to the configuration/ control of the N2/N51 junction would have on the operating performance of the junction the following scenarios were assessed.

- **AM Peak, Inter-Peak, PM Peak:** No Bypass in place;
- **AM Peak, Inter-Peak, PM Peak:** With just the N2 north-south Bypass in place, including a ban on heavy vehicles at Slane Bridge;

- **AM Peak, Inter-Peak, PM Peak:** With both the N2 north-south Bypass and an N51 east-west bypass (refer to **Section 3.3.4.1**) in place, including a ban on heavy vehicles on Slane bridge and also on the N51 between Slane village and Slane Castle.

Each of these scenarios were considered in the context of 'without public realm' and 'with public realm' measures implemented in the village.

The 'without public realm' scenario considers the existing situation in Slane, with the N2/N51 junction modelled as a signal-controlled junction, based on the current lane configurations.

The 'with public realm' scenario has the streets within the village centre modelled as a traffic-calmed area modelled with 25kph free flow speed, reflecting proposed speed reduction measures. The N2/N51 junction is modelled as signal-controlled junction, with single-lane approach from each direction.

3.6.1.2 Results of the Analysis

3.6.1.2.1 No Bypass in Place

In the case of the proposal to implement public realm changes in Slane without a bypass in place, the analysis found that traffic reassigns from the N2 corridor to the M1 corridor, which would be an acceptable alternative route. However, the analysis also shows that east-west traffic from the N51 will re-assign to the L-1600 (Boyne Road)/L-1601 local roads, south of the River Boyne and onto the Broadboyne bridge to the west of Slane. This reassignment of traffic from a national road to a local road is not appropriate traffic management. Typically, the local routes would not be of an acceptable standard to cater for an increase in strategic traffic flow.

Additionally, the reduction in the capacity of the existing junction in the 'with public realm' scenario, increases peak hour congestion at the junction, resulting in significantly increased delays occurring.

3.6.1.2.2 North-South Bypass in Place

In the scenario where an N2 north-south bypass is in place, the implementation of public realm amendments to the junction in Slane has the impact of reducing the traffic flow significantly on the N51 especially eastbound. Traffic re-assigns to the L1600 (Boyne Road)/L1601 local road network in lieu of the N51. The scale of the increase in traffic on the local roads is significant at approx. 3,000 vehicles per day. As noted above, it is not proper traffic management to divert traffic from a national road onto a local road, which is unsuitable to cater for this level of additional strategic traffic flow.

In terms of the operating performance of the junction, the provision of a N2 North-South Bypass will reassign sufficient traffic flow from the N2/N51 junction to result in the junction performing below practical capacity in all periods, 'with' or 'without the public realm' measures. The scale of queueing will reduce to circa five/six vehicles on the approach arms and the delays are predicted to be circa one minute during all modelled periods.

In this scenario, it is feasible to introduce public realm improvements in Slane village. However, these proposals would need to include for particular traffic management measures to best manage the residual traffic demand west-to-north and east-to-west. These traffic management measures should not be restrictive so as to encourage the diversion of significant volumes of N51 traffic away from the national road onto less suitable local roads. Also, the measures should not be so favourable to east-west movements so as to encourage significant traffic increases on the N51 through the village.

3.6.1.2.3 North-South and East-West Bypass

In the context of providing both a north-south bypass and also an east-west bypass of Slane, the provision of public realm works is predicted to generate a situation where only insignificant levels of local traffic are left utilising the junction in Slane.

The junction is predicted to operate well below capacity with insignificant queuing and therefore providing the maximum scope to introduce a public realm and pedestrian friendly junction and environment. In addition, the provision of both bypasses will prevent the reassignment of strategic traffic to the substandard local road network. The public realm scheme would work at its optimum with both a N2 North-South Bypass and N51 East-West Bypass in place.

Note, for other reasons as described in **Section 3.3.4.1** above, an east-west bypass element of the scheme has been assessed to not be a preferred option in favour of a north-south solution which offers best value for money at a reduced negative impact to the environment, particularly the natural environment. The benefit of further reductions in traffic in Slane with an east-west bypass in place is counteracted by increased environmental impact, most notably ecological, landscape and visual and agricultural impacts, and a significant increase in cost.

3.6.2 Residual Traffic Management Options

Following the recommendation from the east-west bypass option assessment, the options assessment moved to address proposed traffic management options within Slane to address traffic from east to west, north to west, and vice versa. Four traffic management (TM) options in the village of Slane were compared to the following:

- Do-Minimum with no north-south bypass in place and with the existing traffic arrangements in the village; and
- Do-Minimum with a north-south bypass in place with optimisation of the existing signal-controlled junction in Slane and an HGV ban on the existing Boyne bridge.

The four TM options assessed were broadly:

- **TM Option 1:** Signal-controlled with the proposed sequencing and phasing of the traffic lights favouring the higher traffic volumes travelling east-west;
- **TM Option 2:** N2/N51 Junction in Slane to become a priority junction, with the east-west N51 forming the major arms and the northern and southern approaches from the superseded N2 giving way;
- **TM Option 3:** N2/N51 Junction in Slane as per Option 2, but additional traffic calming measures added to reduce free flow speeds through the junction This scenario also included an HGV ban on the N2 North and reduced free flow speeds in the surrounding vicinity; and
- **TM Option 4:** N2/N51 Junction in Slane is modelled as in Option 3 but without a ban on HGV on the N2 North.

Following analysis the preferred traffic management option for Slane village included the following measures:

i. Removal of the left turn slip roads and traffic signalisation at the existing junction;
ii. Reconfiguring as a priority junction with the major arms in the east-west direction;
iii. Signalised pedestrian crossings on the N51 with zebra crossings on the existing N2;
iv. Speed ramps on the N51 eastern approach and at the junction to ensure the dominant east to west traffic flows travels through the village at a safe speed;
v. HGV ban on the existing Boyne bridge; and
vi. HGV ban on the N2 north of the N2/N51 junction.

It was therefore recommended that the proposed traffic management measures be implemented at the same time as a north-south N2 Slane bypass. Combining the proposed bypass with the proposed traffic management measures represented the most efficient way to safely cater for the remaining traffic issues in Slane. Traffic management measures are therefore part of the Proposed Scheme.

3.6.3 Public Realm Plan

Following from the analysis described above, it emerged that significant works within the village would be necessary to best manage the residual volumes of traffic in the village when a north-south bypass has been implemented. The scale of proposed works, particularly at the N2/N51 junction and other works to remove existing infrastructure, such as the gantries to control traffic movements on the existing bridge, prompted MCC to prepare a draft Public Realm Plan for Slane.

The Slane Public Realm Plan seeks to take advantage of the removal of significant volumes of traffic from Slane, together with the proposed works to best manage residual traffic, to consider the overall functioning of the village as a more attractive place for people to live, work, visit and socialise.

The public realm elements included in the Proposed Scheme comprise a suite of public realm features in the village including new junction design, tables/ramps with pedestrian crossings; planting; improved accessibility for pedestrians and cyclists and rationalisation of street furniture, undergrounding of services etc. Other elements of the Public Realm Plan, not included in this Proposed Scheme, will be advanced by MCC separately.

3.6.4 Public Realm Enhancement Options

In consideration as to whether or not the Public Realm Measures would be implemented, the following two options were considered:

- **Option 1:** The proposed N2 Slane Bypass including crossing of the River Boyne and N51 improvements; and
- **Option 2:** The proposed N2 Slane Bypass including crossing of the River Boyne and N51 improvements and inclusion of relevant public enhancement measures.

Summary of the Evaluations

- **Environmental Evaluation:** Both options will deliver the benefits to air, noise, population, human health and traffic from reduced through-traffic in the village, including HGVs. Option 2 offers additional long-term benefits by building on the benefits brought by the bypass. Notably Option 2 is preferred for population as the public realm improvements will reduce severance and enable pedestrian and cycle movement on the existing N2 to be safer and more pleasant. This combined with a reduction in vehicular through-traffic would enhance population and human health benefits. Option 2 is also preferred from a landscape and visual perspective and from an architectural heritage perspective as it would deliver an enhancement of the urban fabric and also an enhancement of the architectural heritage setting in the village. Option 2 would have more negative impacts than Option 1 associated with construction. Option 2 would have short-term temporary impacts for sensitive receptors associated with noise, dust, and disruption of access. Impacts to setting and residential amenity during construction stage would also be a feature of Option 2. This would be following the more extensive bypass works in the environs but would follow after when traffic had access to the bypass.
- **Aesthetic Evaluation:** Both options will see a reduction in traffic through the village with improvement to the urban setting however Option 2 includes for a significant change of character and improved public realm for the village centre, in particular on the north-south route. The introduction of planting will help improve the pedestrian experience. The significant reduction of traffic over the existing old bridge will allow this area to be redefined as a destination with potential links along the river.
- **Construction and Buildability Evaluation:** No public realm works are required under Option 1. It is envisaged that under Option 2 the majority of the proposed works will be constructed under stop/go shuttle working with some night working with temporary short-term road closures for critical works. These critical works are likely to include the undergrounding of utilities crossing of existing roads, road resurfacing, and works on the existing Boyne bridge. Local traffic diversions, likely utilising the bypass route, will be in place to facilitate road closures. Option 2 requires the delivery of the bypass in the first instance.

3.6.4.1 Preferred Public Realm Option

An assessment of the preferred option was undertaken under a number of criteria. **Option 2,** inclusion of the public realm elements in the Proposed Scheme is considered the preferred public realm option as offers the greatest potential to enhance the community and cultural benefits within the village setting and has therefore been brought forward as part of the Proposed Scheme.

3.7 NIFTI Hierarchies and Option Selection

The Department of Transport (DoT) has developed a successor high-level strategic framework to its Strategic Investment Framework for Land Transport (SIFLT) published in 2015, the National Investment Framework for Transport in Ireland (NIFTI), published in December 2021 (DoT, 2021). NIFTI is the DoT's framework for prioritising future investment in the land transport network to support the delivery of the National Strategic Outcomes described in the National Planning Framework (NPF) published in 2018 by the Department of Housing, Planning and Local Government (DHPLG) (DoT, 2021).

The option selection process for this scheme was completed in May 2020, with the publication of the Option Selection Report (RPS for MCC, 2020). As such, the selection processes pre-date the publication of NIFTI. Nonetheless, a retrospective application and consideration of the NIFTI intervention hierarchies to the option selection process already completed has been undertaken.

The NIFTI Investment Priorities identify the types of transport interventions that are to be given precedence under the framework. These priorities are supplemented by modal and intervention hierarchies, which will ensure that the most appropriate solution to a given problem or opportunity is deployed. The hierarchies establish the types of solutions that are preferred from both an environmental and cost-effectiveness perspective.

A transport project or scheme sets out to resolve problems identified in the transport network. In the resolution of the problems identified, a project/scheme will set a series of objectives which the proposed solution will be required to achieve. Investment planning is needs-based and objectives-led, and the hierarchies aim to assist in identifying the most appropriate solution to a given problem. Their application in investment planning is to be pragmatic, weighing up trade-offs.

Therefore, the transport problems to be resolved and the objectives to be met provide the basis for the assessment of possible solutions, which are considered in accordance with the hierarchies set out in NIFTI.

3.7.1 Modal Hierarchy

The NIFTI ‘modal hierarchy’ favours active travel, followed by public transport, and then private vehicles. This hierarchy is illustrated in **Figure 3.17** below. The onus will be on project sponsors to demonstrate that a given option is the most environmentally sustainable and cost-effective solution for the issue at hand.

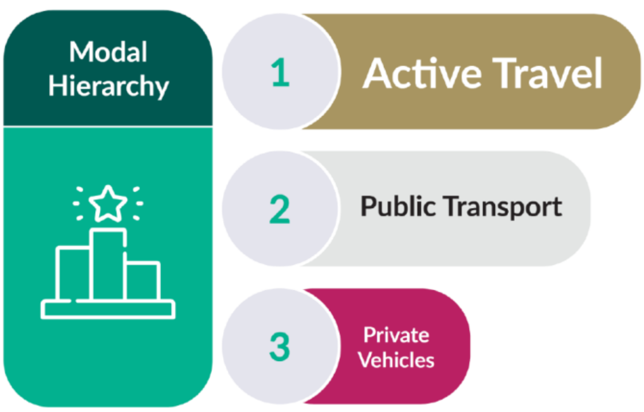


Figure 3.17: National Investment Framework for Transport in Ireland Modal Hierarchy

To enable the National Strategic Outcomes, particularly around decarbonising the transport system and delivering compact growth, a significant shift from low-occupancy private vehicles to more sustainable modes of travel will be required. For this reason, future transport planning will prioritise sustainable modes, while acknowledging that the private car travel will remain an important mode of travel in much of Ireland. Sustainable modes, starting with active travel and then public transport, are encouraged over less sustainable modes such as the private car.

Active travel is the most sustainable mode of travel. Increasing the share of active travel can reduce the carbon footprint of the transport sector, improve air quality, reduce urban congestion, and bring about positive health impacts as a result of increased physical activity. It is also important in enabling access to other mobility options, such as public transport. Public transport refers to buses, light and heavy rail, and shared transport. Bus and rail, by design, are able to transport large volumes of people and therefore increasing levels of usage can have environmental benefits.

Private transport includes cars, motorcycles and mopeds. These are low-occupancy vehicles which occupy road space, and generally have the greatest contribution to poor air quality and congestion. Providing infrastructure to cater for increased traffic volumes and improved journey conditions for these vehicles generally requires upgraded or new road infrastructure.

While this hierarchy covers all uses of the network, the type of transport will be an important consideration for determining the most appropriate investments to address specific needs. The application of the modal hierarchy within transport planning will be flexible and pragmatic and will help ensure that the most appropriate solution to a given problem is implemented.

3.7.2 Intervention Hierarchy

The hierarchy of intervention types has been developed to ensure that investment is proportionate to the problem identified. The NIFTI intervention hierarchy set out four high-level categories of investment. This hierarchy seeks to make the best use of the existing transport assets in the delivery of the NPF. The 'intervention hierarchy' set out in NIFTI is structured under the areas of 'maintain', 'optimise', 'improve' and 'new' as illustrated in **Figure 3.18** below.

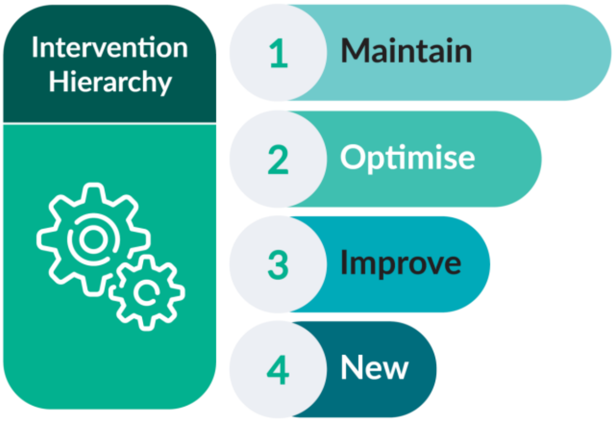


Figure 3.18: National Investment Framework for Transport in Ireland Intervention Hierarchy

Maintaining the existing transport network will be given first priority, followed by maximising the value of the network through optimising its use. Infrastructural investments will only be considered after these two categories have been assessed as inappropriate for the identified problem, with upgrades to existing infrastructure to be considered before new infrastructure. It is important to consider the intervention hierarchy in the context of the specific problem being addressed.

3.7.2.1 Scheme Options

All options considered to address the need for the scheme, measured against the Project Objectives have been rigorously assessed in accordance with TII and Common Appraisal Framework procedures. The options considered and the analysis carried out is presented in detail in the scheme option selection report, (RPS for MCC, 2020). This report includes for a full description of the options assessed, together with detailed analysis and assessment of their impacts and effects.

The following section retrospectively applies the principles and hierarchies of NIFTI to the option selection process already undertaken and completed. An outline of the options considered is presented together with the broad conclusions from the analysis and appraisal processes to demonstrate how the processes carried out comply and align with the processes outlined in NIFTI.

3.7.2.2 Application of NIFTI Hierarchies to the Proposed Scheme

The application of the NIFTI hierarchies in relation to the proposed scheme start with the identification of the transport problems to be resolved (refer to **Chapter 2 – Background and Need for the Scheme**) and the aims to be achieved; these are set out in **Chapter 1 – Introduction and EIA Methodology**, **Section 1.2** (Aims of the Scheme). The application of the NIFTI hierarchies may be thought of as a series of decision points, described in **Figure 3.19** to **Figure 3.24** below.

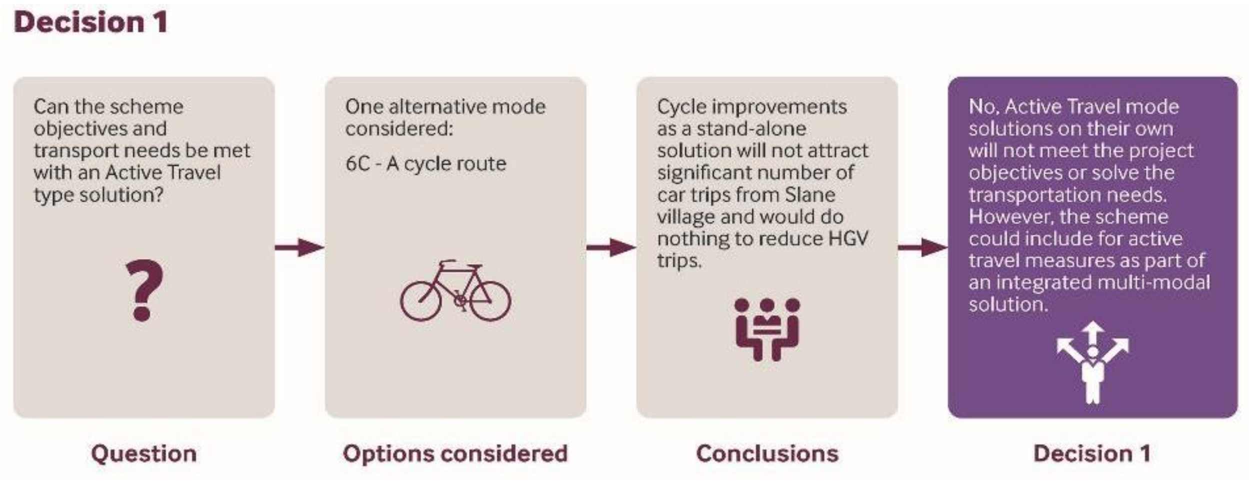


Figure 3.19: NIFTI Decision 1 – Active Travel

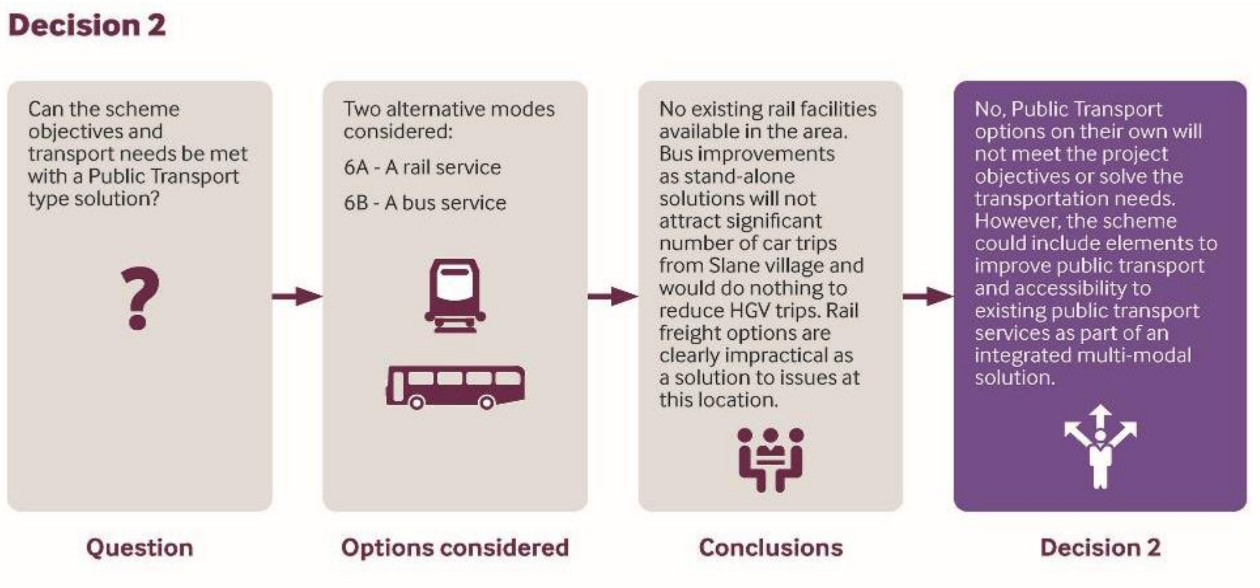


Figure 3.20: NIFTI Decision 2 – Public Transport Solution

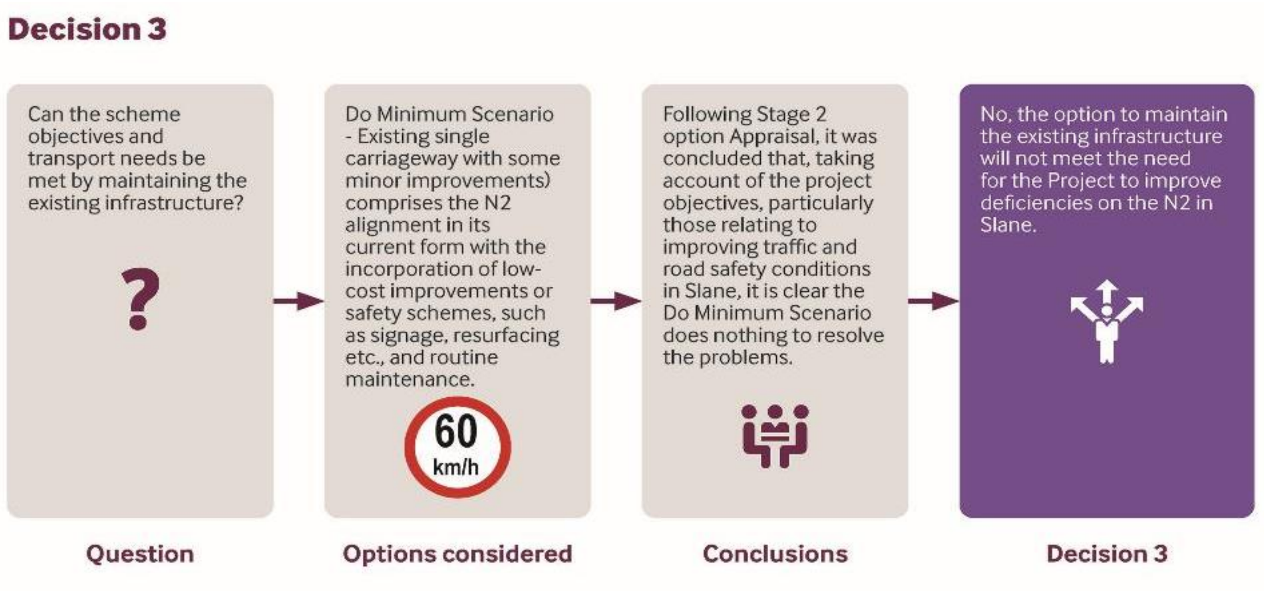


Figure 3.21: NIFTI Decision 3 – Infrastructure Maintenance

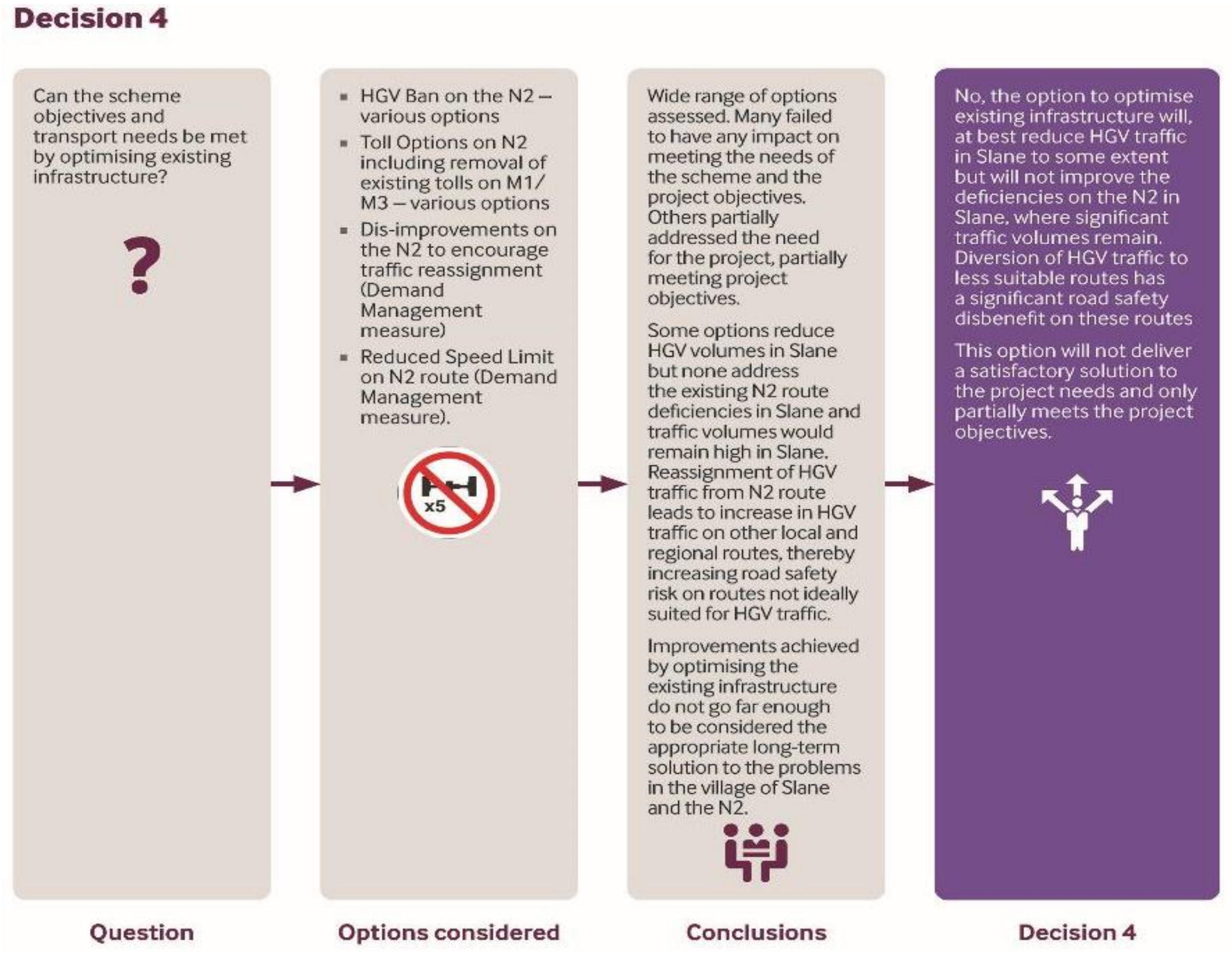


Figure 3.22: NIFTI Decision 4 – Optimising Existing Infrastructure

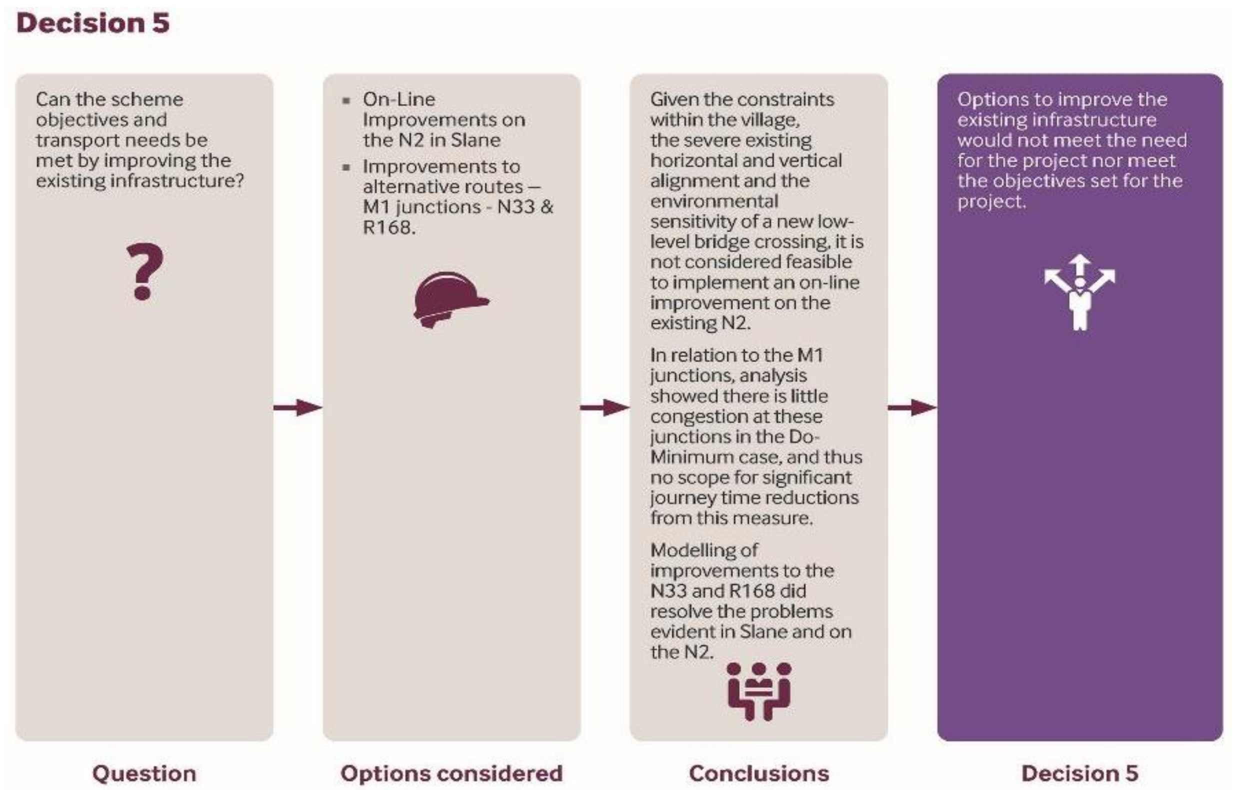


Figure 3.23: NIFTI Decision 5 – Improving Existing Infrastructure

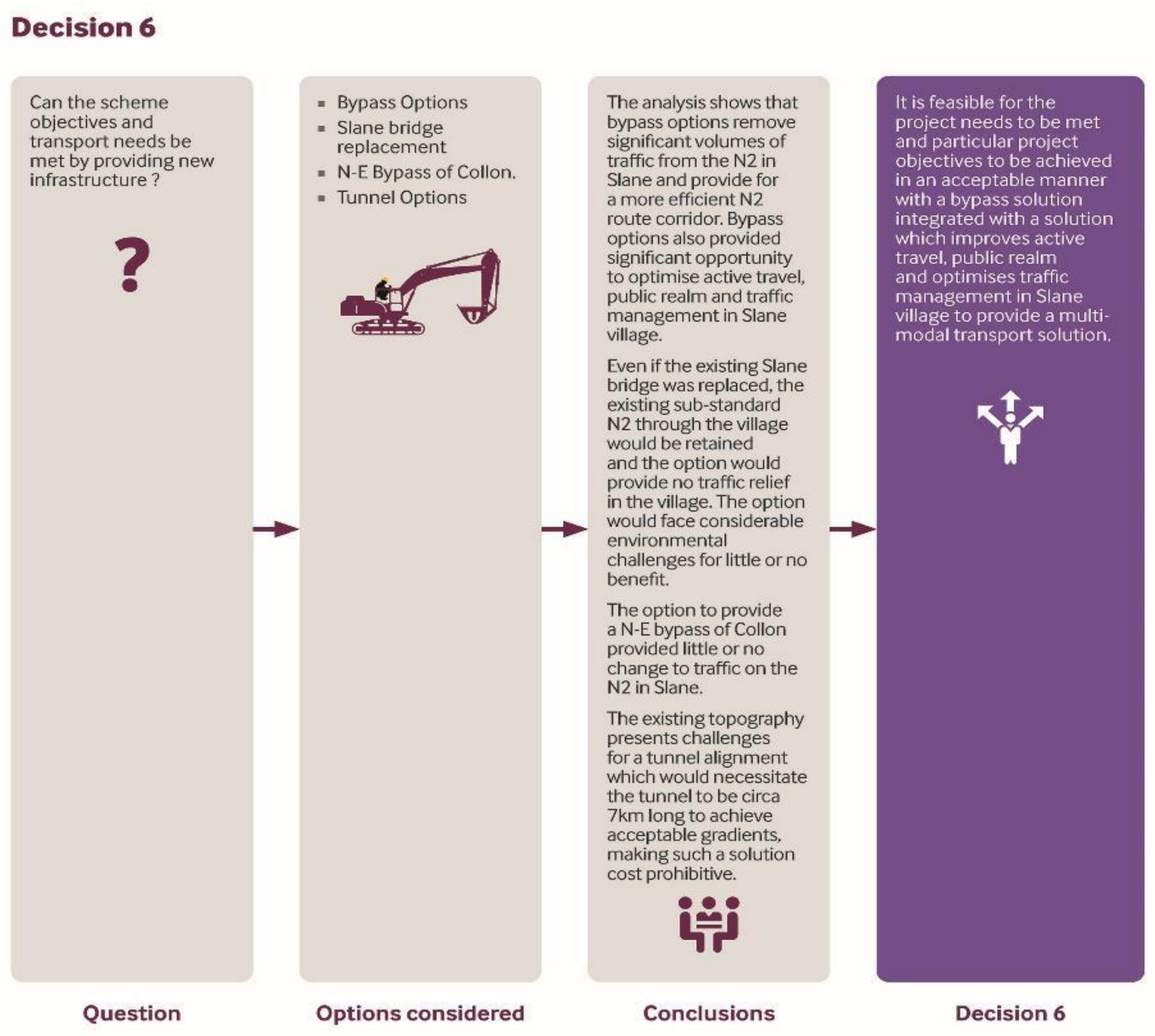


Figure 3.24: NIFTI Decision 6 – Provision of New Infrastructure

3.7.3 Conclusion on the NIFTI Hierarchy

The preceding assessment does not proport to be an option assessment or business case in itself. To ensure value for money, future investment in the transport system will continue to be subject to rigorous appraisal and the requirements of the Public Spending Code and sectoral guidance set out in the Common Appraisal Framework for Transport Projects and Programmes (DoT (2016)). The in-depth analysis of options is reported in the Option Selection Report and Preliminary Business Case (RPS for MCC, 2020). The assessments in these reports set out the detailed work carried out to appraise the options and to test the assessment outcomes against the Proposed Scheme objectives in order to confirm the emerging preferred option for the Proposed Scheme.

Section 3.7.2.2 above has described the alignment of the Proposed Scheme with the principles set out in NIFTI. The assessment concludes that the Proposed Scheme is aligned with the investment priority to *Enhance Regional and Rural Connectivity*. The Proposed Scheme also aligns with the priorities to *Decarbonise* and to enhance the *Mobility of People and Goods in Urban Areas*, primarily through the provision of enhanced active travel measures in Slane village, which are only feasible after a bypass has been constructed. There is alignment with the priority to *Protect and Renew* through the achievement of road safety improvements on the existing N2 in Slane.

Section 3.7.2.2 has considered the option selection process already undertaken to demonstrate the alignment of the process with the hierarchies of choice set out in NIFTI. The assessment shows that a wide range of options and alternatives were considered in the option selection process which can be demonstrated to be aligned with the hierarchies in NIFTI. The outcome from the processes carried out and choices made is a Proposed Scheme which provides sustainable multi-modal improvements to transport nationally, regionally and locally. The development of the project aligns well with the priorities and hierarchies of choice set out in NIFTI.

3.8 Chapter References

DHPLG (2018) National Planning Framework 2040.

DoT (2021) National Investment Framework for Transport in Ireland.

DoT (2016) Common Appraisal Framework for Transport Projects and Programmes V4. [Updated 2021].

DoT (2015) Strategic Investment Framework for Land Transport.

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TII (*Various dates*) Project Management Guidelines [Updated December 2020].

TII (2019) Project Manager's Manual for Major National Road Projects.

TII (2016) Project Appraisal Guidelines for National Roads Unit 7.0 – Multi Criteria Analysis.