Wicklow County Council

N11/M11 Junction 4 to Junction 14 Improvement Scheme

Option Selection Report
Appendix D7 – Noise and vibration

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Contents

Tables

1 Noise and vibration

1.1 Introduction

This report details the environmental assessment of the Stage 2 Project Appraisal Matrix for the N11/M11 Scheme with respect to the noise and vibration constraints identified in **Section 6** (Noise and vibration) of **Volume B.**

For the corridor assessment, the overall scheme has been split into two sections, i.e. the Northern Section and the Southern Section, and the corridor options assessed are those discussed in **Chapter 8** of **Volume A.**

There are three zones associated with each corridor option referred to in the corridor assessment:

- The potential road "footprint" which is the potential landtake required to construct or improve the road;
- The road "corridor" which is a 200m wide corridor centred around the alignment centre line for all off-line corridors. For the on-line Corridor Options 1 (North), 1 (South) and 5 (South), the width is variable, but is typically narrower than the width of the off-line corridors. The "footprint" sits inside the "corridor" boundary; and
- The "assessment study area" which includes a 300m assessment zone from the edge of the "footprint" line on both sides. There are four bands within this 300m assessment zone associated with each corridor option. These are referred to in the Potential Impact Rating (PIR) assessment criteria and are detailed in **Section 1.3.1**.

A transport assessment forms part of this Stage 2 Project Appraisal Matrix. This assessment is included in **Section 1.5**. The transport scenarios that were assessed are as follows:

- Transport Scenario 5A - Parallel Links + Junction Rationalisation;
- Transport Scenario 5B - N11/M11 Additional Lane(s) + Junction Improvements; and
- Transport Scenario 4 – Bus Service Enhancements.

Section 1.2 outlines the methodology that was used to carry out the assessment, and **Section 1.3** outlines the assessment criteria which were used. The Stage 2 assessment is presented in **Section 1.4** (Corridors) and **Section 1.5** (Transport Scenarios) and references are listed in **Section 1.6**.

1.2 Methodology

The noise impact assessment has been conducted in accordance with the following relevant documents and guidance:

- Section 5.0 of the Transport Infrastructure Ireland (TII), formerly National Roads Authority (NRA) 2004 Guidelines for the Treatment of Noise and Vibration in National Road Schemes (TII Noise Guidelines 2004)[1];
- Section 2 of the 2014 Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes (TII Noise Guidelines 2014)[2];
- TII Project Management Guidelines 2019[3];
- TII Project Manager's Manual, 2019[4]; and the
- TII Project Appraisal Guidelines for National Roads (PAG) Unit 7.0 – Multi Criteria Analysis (hereafter referred to as the TII PAG), October 2016[5].

The assessment of potential noise impacts and the ranking of corridor options is based upon property counts, operational traffic noise levels, the likely requirement for mitigation measures and the potential magnitude of change in traffic noise levels with or without the proposed development in place.

From a noise point of view, ranking of the corridor options is therefore dependent on traffic volumes along each corridor. As a transport assessment forms part of this Stage 2 Project Appraisal, traffic volumes associated with each corridor option vary depending on the transport scenario chosen. In this instance, noise impacts and associated ranking for both the corridor options and the transport scenarios are interchangeable.

The following has been conducted to assess each of the corridor options and transport scenarios under consideration:

- The Potential Impact Rating (PIR) for each corridor has been calculated using property counts within distance bands extending to 300m from either side of the footprint line of each corridor option. This methodology is described in **Section 1.3.1.**

[1]Transport Infrastructure Ireland, Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004. Available from: https://www.tii.ie/technical-services/environment/planning/Guidelines_for_the_Treatment_of_Noise_and_Vibration_in_National_Road_Schemes.pdf

[2] Transport Infrastructure Ireland, Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes, 2014. Available from: https://www.tii.ie/technical-services/environment/planning/Good_Practice_Guidance_for_the_Treatment_of_Noise_during_the_Planning_of_National_Road_Schemes.pdf

[3] Transport Infrastructure Ireland, Project Management Guidelines PE-PMG-02041, 2019. Available from: https://www.tiipublications.ie/library/PE-PMG-02041-02.pdf

[4] Transport Infrastructure Ireland, Project Management Manual PE-PMG-02042, 2019. Available from: https://www.tiipublications.ie/library/PE-PMG-02042-01.pdf

[5] Transport Infrastructure Ireland, Project Appraisal Guidelines for National Road Schemes Unit 7.0 – Multi Criteria Analysis, October 2016. Available from: https://www.tiipublications.ie/library/PE-PAG-02031-01.pdf

- Traffic noise levels associated with each corridor option have been assessed at the nearest noise sensitive locations within a 300m wide buffer taking account of traffic flows associated with each transport scenario. This methodology is described in **Section 1.3.2.**
- Traffic noise impacts associated with each transport scenario and corridor option have been used to rank these options.

1.3 Assessment criteria

The assessment of potential noise impacts and ranking of corridor options is based on the following assessment criteria:

- Potential Impact Rating (PIR);
- Likely Requirements for Noise Mitigation, and;
- Potential Changes in Noise Levels.

1.3.1 Potential Impact Rating (PIR)

An assessment of Potential Impact Rating (PIR) based upon the number of noise sensitive receptors within specified distance bands from each of the corridor options was undertaken.

The number of properties potentially sensitive to noise and/or vibration within the assessment study area of each of the proposed corridor options has been identified. For the purpose of this study, property counts include existing residential properties, hospitals and medical buildings, educational buildings and religious buildings which were undertaken using OS mapping data[6]. The counts also take account of noise sensitive buildings which have been granted planning by Wicklow County Council (WCC) and Dún Laoghaire-Rathdown County Council (DLRCC) which were sourced from Geohive[7].

Property counts have been undertaken for four bands either side of the footprint line of each corridor option, i.e. 0 to 50m, 50 to 100m, 100 to 200m and 200 to 300m. The footprints represent the potential area required for a road including earthworks and ancillaries. For the 0-50m band, all properties extending 50m from the footprint line are counted to ensure that an indicative road footprint is represented. This assumption for the purposes of this assessment, therefore, excludes all properties that may be acquired or demolished within the footprint, as these properties will no longer be receptors left in place.

A weighting value for each distance band has been applied with a weighting factor of 4 for the closest distance band (0 to 50m) down to 1 for the furthest distance band (200 to 300m).

[6] Ordnance Survey Ireland. Licence Number 2020/35/CCMA/Wicklow County Council, OSI Digital Terrain Data (Prime 2) [Received from Wicklow County Council: 20 September 2019]
[7] Department of House, Planning and Local Government, National Planning Applications. Available from: https://data.gov.ie/dataset/national-planning-applications [Accessed: 16 December 2020]

For the PIR assessment, the calculated weighted value for each distance band is summed to obtain a total PIR value. The corridor option with the lowest PIR has the lowest nominal potential impact.

1.3.2 Calculation of traffic noise impacts

1.3.2.1 Calculation of noise footprint

The operational noise footprint for a given corridor option is dependent on a range of factors including traffic volumes, traffic speed, road surface type and the vertical alignment. For this assessment, traffic flows in terms of the Annual Average Daily Traffic (AADT) flows, percentage Heavy Good Vehicles (HGVs), and horizontal and vertical alignments have been provided by the design team.

As noted in **Section 1.2**, the operational traffic volumes along each corridor are dependent on the transport scenario chosen for the project.

In order to sufficiently assess and compare these scenarios, traffic flow data for each of the corridor options and transport scenarios have been provided by the design team and used in the assessment.

The following three conditions must be satisfied under the TII 2004[1] and 2014[2] Guidelines in order for noise mitigation to be provided:

- The combined expected maximum traffic noise level, i.e. the relevant noise level, from the proposed road development together with other traffic in the vicinity is greater than the design goal of 60dB L_{den};
- The relevant noise level is at least 1dB more than the expected traffic noise level without the proposed road development in place; and
- The contribution to the increase in the relevant noise level from the proposed road development is at least 1dB.

In order to analyse the potential noise impacts and likely requirement for noise mitigation associated with each combination of corridor and transport scenario options, the following methodology was undertaken:

- A 3D alignment for each corridor option was used to develop a 3D noise model of the corridor option provided by the design team;
- 3D contour mapping was obtained from LIDAR[8] grids up to 30m spacing.

[8]Transport Infrastructure Ireland, 2m Grid Spacing LIDAR Mapping based on survey in 2010-2011. Available from: https://dcenr.maps.arcgis.com/apps/webappviewer/index.html?id=b7c4b0e763964070ad69bf8c1572c9f5 & 30m Grid Spacing LIDAR InfraWorks 360 Model Builder Software

This was merged with a detailed topographical survey at Kilmacanoge[9] and project detailed topographical survey[10] as the information was available at the time of assessment;

- AADT traffic flows and percentage HGVs for individual sections of each corridor option for either Transport Scenario 5A or 5B were provided by the project traffic consultants for the Design Year of 2042;
- A standard hot rolled asphalt road surface was assumed for all corridor options;
- A traffic speed of 100km/h was used for the N11/M11 road sections. A traffic speed of 60km/h was used for parallel roads in the Northern Section of the study area and 80km/h was used for the declassified N11 in the Southern Section of the study area;
- Using guidance from the TII's 2014 Guidelines[2], calculated traffic noise levels at properties extending to a minimum distance of 300m of the road alignment were established using predictive noise modelling;
- Noise levels were calculated at the same assessment locations for the Reference Case scenario for the year 2042 to determine the likely change in noise levels;
- An assessment of the potential number of properties likely to be exposed to traffic noise levels at or above 60dB L_{den} and meet the three TII criteria for noise mitigation was undertaken, and;
- An assessment of the likely change in traffic noise levels has been conducted to assess the overall positive and negative impacts associated with the operation of each corridor option and each transport scenario.

Proprietary noise calculation software was used for the purposes of this study. The selected software, DGMR 7810 *Predictor*[11], calculates traffic noise levels in accordance with the Calculation of Road Traffic Noise (CRTN)[12] and TII 2004 Noise Guidelines[1]. The CRTN method of predicting noise from a road scheme consists of the following five elements:

- Divide the road scheme into segments so that the variation of noise within this segment is small;
- Calculate the basic noise level at a reference distance of 10 metres from the nearside carriageway edge for each segment;

[9] Kilmacanoge Topographical Survey, 2017. Received from Kildare National Roads Design Office
[10]N11/M11 Junction 4 to Junction 14 Improvement Scheme Topographical Survey, November 2020.
[11]This is the same software as was used for the Stage 1 Preliminary Options Assessment but with a different parent company.
[12]Department of Transport - UK. (1988) Calculation of Road Traffic Noise (CRTN). Available from: http://bailey.persona-pi.com/Public-Inquiries/M4-Newport/C%20-%20Core%20Documents/14.%20Noise%20and%20Vibration/14.2.1%20-%20Department%20of%20Transport%20and%20Welsh%20Office%20Calculation%20of%20Road%20Traffic%20Noise.%201988.pdf

- Assess for each segment the noise level at specified receiver location point (i.e. noise sensitive building) taking into account distance attenuation and screening of the source line;
- Correct the noise level at the receiver location point to take account of site layout features, and the size of source segment; and
- Combine the contributions from all segments to give the predicted noise level at the receiver locations for the whole road scheme.

The calculations are based on Method A prescribed in the TII Noise Guidelines[1] using hourly traffic data, determined from the diurnal traffic profiles provided in Appendix 1 of the TII 2004 noise Guidelines[1]. The CRTN methodology is used to produce $L_{A10(hour)}$ values which are then converted to $L_{Aeq(1\ hour)}$ values using the formula from Method A[1]. The output of the noise model using this method is calculated road traffic noise in terms of the L_{den} parameter. This is the noise parameter used in Ireland to describe and assess traffic noise.

1.3.2.2 Assessment of Change in Traffic Noise Levels

In the absence of any Irish guidelines or standards relating to assessing the effects associated with changes in road traffic noise levels, reference is made to the UK's Design Manual for Roads and Bridges (DMRB) LA 111 Noise and vibration Revision 01 (2020)[13]. This document provides suggested magnitude rating tables relating to changes in noise levels associated with road traffic noise.

The magnitude of impacts is assessed by comparing the Reference Case noise level against the Do-Something scenario. The calculated road traffic noise levels used in this study relate to the Design Year of 2042, hence in line with the DMRB guidance, the following magnitude of change is applied for the long-term period (Design Year) as reproduced in **Table 1.1**.

Table 1.1: Classification of magnitude of traffic noise impacts in long term (DMRB 2020)[13]

Long-term Magnitude	Long term noise change, dB
Major	Greater than or equal to 10.0
Moderate	5.0 to 9.9
Minor	3 to 4.9
Negligible	Less than 3.0

For each of the corridor options, the calculated change in traffic noise level has been determined and ranked in accordance with **Table 1.1**.

The change can be related to either positive changes (decrease in noise levels) or negative changes (increase in noise levels).

[13] Design Manual for Roads and Bridges LA 111Noise and vibration, 2020. Available from: UK's Design Manual for Roads and Bridges (DMRB) LA 111 Noise and Vibration Rev 01 (2020).

1.3.3 Operational vibration impacts

In terms of vibration, road traffic along normal well maintained surfaces, in line with this proposed development, generates very low levels that are normally not perceptible to building occupants. For the purposes of this assessment, therefore, it is assumed that all options will have a comparable low vibration impact during their operational stage and vibration is not assessed further.

1.3.4 Construction noise and vibration impacts

The potential noise and vibration impacts associated with the construction phase of each option will be of short-term duration (less than 7 years). Whilst there will be varying impacts associated with each, the construction phase for all will be undertaken using standard road construction techniques (with the exception of Corridor Option 6 (South)) and will be controlled through the use of construction noise and vibration limits.

For the Northern Section, construction noise and vibration impacts will result from road works along the on-line corridor and construction of new elements (service and parallel roads, road reconfigurations etc. and the realigned Junction 7 (Bray South). Noise and vibration impacts associated with either Corridor Option 1A (North) or 1B (North) will be similar at affected noise sensitive properties and will be controlled through relevant criteria. No further consideration has therefore been given to the construction phase to differentiate either option.

For the Southern Section, construction noise and vibration impacts will vary depending on the construction methodologies required for each corridor option.

Corridor Options 1 (South) and 5 (South) will predominately involve road works along the on-line corridor including road / junction reconfigurations. Due to the proximity of noise sensitive locations along the on-line corridor, construction noise impacts will be experienced at a high number of properties. Vibration impacts will be limited to surface breaking activities, where required. The magnitude of vibration has the potential to be perceptible to building occupants, but orders of magnitude below those associated with cosmetic or structural damage to buildings. There will likely be a requirement for weekend, evening and night-time works to facilitate traffic management which has the potential to result in higher noise impacts to noise sensitive buildings.

Corridor Option 2 (South) will require the same road works as Corridor Options 1 (South) and 5 (South) for the on-line sections of this corridor. For the off-line section of this corridor option, the use of rock extraction through blasting or other means will be required for cut sections. This activity will result in high noise levels at noise sensitive properties in proximity to the works and potentially perceptible vibration impacts depending on the methods of excavation used. Where blasting is required, the blast will be designed below limit values set to avoid any cosmetic or structural damage to buildings and structures. The construction of embankments for fill sections will also be required, however noise and vibration impacts associated with this activity are less significant. The density of noise sensitive locations in proximity to the off-line section is lower compared to those in proximity to the on-line section and hence will affect a lower number

of properties. Construction works associated with the off-line section will largely be undertaken during daytime and weekend (Saturday) periods.

Corridor Option 6 (South) will require the same road works as Corridor Options 1 (South) and 5 (South) for the on-line sections of this corridor. For the tunnel section, a tunnel boring machine (TBM) will be used. Airborne noise impacts associated with this construction activity will occur in proximity to the portal where the TBM will be launched and serviced from. Above the tunnel section, groundborne noise and vibration impacts associated with the progression of the TBM will potentially be experienced at sensitive buildings above, depending on the tunnel depth and intervening ground conditions. Vibration impacts are limited to those associated with human perception rather than any form of cosmetic or structural damage to buildings. The duration of impacts associated with this activity will be temporary at any one location, depending on the progression rate of the TBM. These impacts will be controlled through strict limit values. In the event of night-time tunnel works, there is potential for significant night-time impacts which may necessitate temporary rehousing, in line with best practice.

In summary, whilst varying construction noise and vibration impacts will occur depending on the corridor option, construction will be undertaken using best practice control measures and will be required to be designed to be constructed within relevant limit values. The impacts will also be temporary to short term in duration. In this instance, no further consideration has therefore been given to the construction phase to differentiate either option in the Southern Section.

1.4 Stage 2 Project Appraisal Matrix – corridor assessment

1.4.1 Northern Section

1.4.1.1 Potential Impact Rating (PIR)

An assessment of potential noise impact based upon the number of noise sensitive receptors within specified distance bands from each of the corridor options under consideration is set out below. In the Northern Section, there are two options, Corridor Option 1A (North) and Corridor Option 1B (North). Both these options follow the on-line red corridor option in the Northern Section. The only difference between these two corridor options relates to the design and layout of a reconfigured Junction 7 (Bray South). Corridor Option 1A (North) includes a reconfigured Junction 7 (Bray South) to the east of the N11 with a new link road connecting to the Bray South Circular Road (SCR) and Option 1B (North) includes a reconfigured Junction 7 (Bray South) to the west of the N11.

In terms of the PIR in the Northern Section, therefore, the only difference in affected properties relates to the study area in the vicinity of Junction 7 (Bray South).

Table 1.2 summarises the PIR values calculated for the northern corridor options 1A (North) and 1B (North) using the weighting values for each distance band

discussed above and taking account of existing properties and permitted developments/ properties within the 300m band.

Table 1.2: PIR assessment table Northern Section

Corridor Option	PIR 0-50m Band	PIR 50-100m Band	PIR 100-200m Band	PIR 200-300m Band	Total PIR
	(No Properties x weighting)				
Corridor Option 1A (North)	(541 x 4) 2,164	(476 x 3) 1,428	(1,027 x 2) 2,054	(1,040 x 1) 1,040	6,686
Corridor Option 1B (North)	(547 x 4) 2,188	(472 x 3) 1,416	(1,025 x 2) 2,050	(1,038 x 1) 1,038	6,692

There is no significant difference in the PIR values between either corridor option. Corridor Option 1B (North) has a slightly higher PIR value of 6,692 compared to Corridor Option 1A (North), 6,686. The main difference in the ranking relates to the 0 – 50m band where an additional 6 properties are counted within Corridor Option 1B (North) compared to Corridor Option 1A (North). Properties within the closer distance band attract a higher rating due to the potential noise impact closer to the road.

Based on the PIR in isolation, Corridor Option 1A (North) has a marginally lower noise impact compared to Corridor Option 1B (North).

1.4.1.2 Likely requirement for noise mitigation

The northern options, Corridor Option 1A (North) and Corridor Option 1B (North), follow the on-line red corridor option with two alternative designs to reconfigure Junction 7 (Bray South). Whilst the footprint of both options differs only in this section of the corridor, traffic volumes along the full extent of the corridor vary depending on the arrangement of Junction 7 (Bray South) and the transport scenario chosen. Corridor Options 1A (North) and 1B (North) are compatible with either Transport Scenario 5A and 5B. To fully evaluate the differences between these scenarios, the full extent of Corridor Option 1A (North) and Corridor Option 1B (North) has been modelled with traffic associated with both Transport Scenario 5A and Transport Scenario 5B. A total of 638 properties have been modelled along the full extent of the Northern Section study area.

The methodology described in **Section 1.3.2** has been used to calculate traffic noise levels associated with each scenario and to determine the indicative number of properties likely to exceed 60dB L_{den} in addition to those likely to require noise mitigation in line with the TII criteria outlined in **Section 1.3.2**. The results are presented in **Table 1.3**.

Table 1.3: Indicative noise mitigation requirements for full extent of Northern Section

Corridor Option North	**Corridor Option 1A (North)**		**Corridor Option 1B (North)**	
	Transport Scenario 5A	**Transport Scenario 5B**	**Transport Scenario 5A**	**Transport Scenario 5B**
Indicative No of Properties above 60dB L_{den}	606	615	617	614
No of Properties Potentially Requiring Noise Mitigation	28	24	32	52

For the Northern Section, the results of the modelling assessment have determined that the indicative number of properties exposed to road traffic noise levels above 60dB L_{den} are broadly similar for both corridor options with both transport scenarios. Corridor Option 1A (North) coupled with Transport Scenario 5A results in a marginally lower number of properties when compared to the other combinations.

The highest number of properties potentially requiring noise mitigation is associated with Corridor Option 1B (North) coupled with Transport Scenario 5B, followed by Corridor Option 1B (North) coupled with Transport Scenario 5A. For the majority of noise sensitive locations along both corridors, the prevailing traffic noise level is at or above 60dB L_{den} during the Reference Case scenario. In this instance, the likely requirement for noise mitigation is based on the likely increase in traffic noise levels above the Reference Case scenario by at least 1dB L_{den}. It should be noted that the differences between the Reference Case and Do-Something scenarios for both corridor options with both transport scenarios is no greater than 2.5dB for any combination, with the majority of increases above the Reference Case scenario being limited to between 0.5 and 1.5dB $L_{den.}$ On the basis of the above, whilst Corridor Option 1B (North) coupled with Transport Scenario 5B results in the highest potential increase above the Reference Case scenario, the overall difference between each corridor and transport scenario is within a small tolerance (+/-1dB) which overall is a negligible difference between each corridor option and the associated transport scenarios.

In the immediate vicinity of Junction 7 (Bray South), an analysis of the closest affected properties has been extracted and reviewed to determine the specific impact of both Corridor Option 1A (North) and Corridor Option 1B (North) on the immediate environment taking account of the traffic volumes associated with both transport scenarios. This study area relates to 54 of the closest noise sensitive properties in this study area. The results are summarised in **Table 1.4**.

Table 1.4: Indicative noise mitigation requirements for Junction 7 (Bray South) immediate study area

Corridor Option North	**Corridor Option 1A (North)**		**Corridor Option 1B (North)**	
	Transport Scenario 5A	**Transport Scenario 5B**	**Transport Scenario 5A**	**Transport Scenario 5B**
Indicative No of Properties above 60dB L_{den}	54	54	54	54
No of Properties Potentially Requiring Noise Mitigation	9	9	9	14

For the study area in the vicinity of Junction 7 (Bray South), the results of the modelling assessment have determined that the indicative number of properties exposed to road traffic noise levels above 60dB L_{den} are the same for both corridor options with both transport scenarios.

The highest number of properties potentially requiring noise mitigation is associated with Corridor Option 1B (North) coupled with Transport Scenario 5B. These receptors are located to the immediate east and west of Junction 7 (Bray South) for Corridor Option 1B (North). This option is therefore less preferred compared to the other options.

1.4.1.3 Potential change in traffic noise level

Table 1.5 presents the number of properties calculated to experience changes in noise levels for the full extent of Corridor Option 1A and 1B (North) based on the DMRB magnitude of change in **Table 1.1**. As noted above, the changes in traffic noise level against the Reference Case scenario is less than +/-2.5dB L_{den} for all scenarios, hence all changes are defined as *'Negligible'* i.e. there are no minor, moderate or major changes in noise levels. To differentiate between the options, **Table 1.5** presents the number of properties calculated to experience a neutral or negligible positive change in noise levels (0 to -3dB) and those calculated to experience a negligible negative change in noise levels (<0 to +3dB).

Table 1.5: Change in Noise Levels – Northern Section – Full extent

Corridor Option North	**Corridor Option 1A (North)**		**Corridor Option 1B (North)**	
	Transport Scenario 5A	**Transport Scenario 5B**	**Transport Scenario 5A**	**Transport Scenario 5B**
Neutral or Negligible Positive (0 to -3dB)	106	49	61	49
Negligible Negative (>0 to +2.9dB)	532	589	577	589

The assessment has determined that Corridor Option 1A (North) coupled with Transport Scenario 5A results in a neutral or negligible positive impact at a greater number of properties compared to the other options. This is followed by Corridor Option 1B (North) coupled with Transport Scenario 5A. Corridor Option 1A (North) and 1B (North) coupled with Transport Scenario 5B results in a marginally higher number of properties likely to experience an increase in noise levels, albeit the increase being noted to be negligible, i.e. of the order of 1 to 2dB.

Table 1.6 presents the extracted analysis for properties in the immediate study area of Junction 7 (Bray South) for Corridor Option 1A (North) and Corridor Option 1B (North) based on the DMRB magnitude of change in **Table 1.1.**

Table 1.6: Change in noise levels – Northern Section – Junction 7 (Bray South) immediate study area

Corridor Option North	**Corridor Option 1A (North)**		**Corridor Option 1B (North)**	
	Transport Scenario 5A	**Transport Scenario 5B**	**Transport Scenario 5A**	**Transport Scenario 5B**
Neutral or Negligible Positive (0 to -3dB)	17	10	3	1
Negligible Negative (>0 to +2.9dB)	37	44	51	53

The assessment has determined that Corridor Option 1A (North) coupled with Transport Scenario 5A results in a neutral or negligible positive impact at a greater number of properties compared to the other options. This is followed by Corridor Option 1A (North) coupled with Transport Scenario 5B.

Corridor Option 1B (North) coupled with Transport Scenario 5A and 5B results in a higher number of properties likely to experience an increase in noise levels, albeit the increase being noted to be negligible, i.e. of the order of 1 to 2dB.

1.4.1.4 Overall ranking – Northern Section

Based on the quantitative and qualitative analysis undertaken for the Northern Section, Corridor Option 1A (North) and Corridor Option 1B (North) have been assessed against the following scoring system based on the TII PAG scoring system as follows:

7 – Major or highly positive;

6 – Moderately positive;

5 – Minor or slightly positive;

4 – Not significant or neutral;

3 – Minor or slightly negative;

2 – Moderately negative; and

1 – Major or highly negative.

The assessment has indicated that both corridor options coupled with either transport scenario will result in a negligible noise level change compared to the Reference Case scenario either in a positive or negative sense.

Taking account of the assessments set out above, the impact rating score and associated qualitative assessment for each corridor option within the Northern Section of the study area are summarised in **Table 1.7**. The assessment results are based on the full extent of each corridor which incorporates properties in the immediate vicinity of Junction 7 (Bray South).

Table 1.7: Corridor option assessment – Northern Section

Assessment Criteria	**Corridor Option 1A (North)**		**Corridor Option 1B(North)**	
	Transport Scenario 5A	**Transport Scenario 5B**	**Transport Scenario 5A**	**Transport Scenario 5B**
PIR	6686		6692	
No of Properties likely above 60dB L_{den}	606	615	617	614
No of Properties Likely to Require Noise Mitigation	28	24	32	52
Number of properties likely to experience a Neutral or Negligible Positive (0 to -3dB)	106	49	61	49
Number of properties likely to experience a Negligible Negative (>0 to +2.9dB	532	589	577	589

Assessment Criteria	Corridor Option 1A (North)		Corridor Option 1B(North)	
	Transport Scenario 5A	Transport Scenario 5B	Transport Scenario 5A	Transport Scenario 5B
Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative	Minor or Slightly Negative	Minor or Slightly Negative
Score / Impact Level	3	3	3	3
Preference	Preferred		Intermediate	

Taking account of the assessment criteria discussed above, Corridor Option 1A (North) and Corridor Option 1B (North) with either transport scenario is determined to result in a *minor or slightly negative* impact level in terms of noise. This is determined on the basis that the overall change in the noise environment, when compared to the Reference Case scenario, will be negligible.

Opportunities exist along both corridor options to incorporate noise mitigation measures as part of the improvement works to reduce traffic noise levels overall along the corridor which have the potential to result in positive impacts to existing properties.

Whilst both are determined to be of *minor or slightly negative* impact, on balance, Corridor Option 1A (North) has been ranked as preferred over Corridor Option 1B (North) due to the smaller number of properties likely to require noise mitigation and the potential for a negligible positive impact to be experienced at a greater number of properties compared to Corridor Option 1B (North).

Corridor Option 1B (North) is ranked on balance as intermediate as the difference between both corridor options is small.

1.4.2 Southern Section

1.4.2.1 Potential Impact Rating (PIR)

An assessment of potential noise impact based upon the number of noise sensitive receptors within specified distance bands from each of the corridor options under consideration is set out below. In the Southern Section, there are four Corridor Options: 1 (South), 2 (South), 5 (South) and 6 (South). Corridor Options 1 (South) and 5 (South) follow the on-line N11 corridor for the full extent of the Southern Section. For the noise assessment, both Corridor Option 1 (South) and 5 (South) are assessed in tandem as the traffic volumes are the same for both. Corridor Option 2 (South) follows the on-line corridor option with an off-line segment to the west of the N11 between Junction 9 (Glenview) and Junction 12 (Newtownmountkennedy /Roundwood). Corridor Option 6 (South) follows the on-line corridor option with an off-line tunnel segment to the west of the Glen of the Downs between Junction 9 (Glenview) to the south of Junction 10 (Delgany /Drummin).

Table 1.8 summarises the PIR values calculated for the Southern Section Corridor Options 1 (South), 2 (South), 5 (South) and 6 (South) using the weighting values for each distance band discussed above and taking account of existing properties and permitted developments/ properties within the 300m band.

Table 1.8: PIR assessment table Southern Section

Corridor Option	PIR 0-50m Band	PIR 50-100m Band	PIR 100-200m Band	PIR 200-300m Band	Total PIR
	(No Properties x weighting)				
Corridor Option 1 (South)	(176 x 4) 704	(125 x 3) 375	(242 x 2) 484	(195 x 1) 195	1758
Corridor Option 5 (South)	(176x 4) 704	(125 x 3) 375	(242 x 2) 484	(196 x 1) 196	1759
Corridor Option 2 (South)	(90 x 4) 360	(106 x 3) 318	(151 x 2) 302	(149 x 1) 149	1129
Corridor Option 6 (South)	(166 x 4) 664	(121 x 3) 363	(202 x 2) 404	(163 x 1) 163	1594

The highest PIR value is associated with Corridor Options 1 (South) and 5 (South) (1,758 and 1,759 respectively). These corridors both follow the existing N11 and are therefore fully on-line options.

An on-line option will typically result in the highest PIR value due to the high number of existing properties located in proximity to the road.

Corridor Option 6 (South) has the next highest PIR (1,594). For this corridor option, properties located above the tunnel footprint have not been counted as once operational, they will not experience any traffic noise for this section of the road.

Corridor Option 2 (South) has the lowest overall PIR (1,129) compared to the other corridor options.

On the basis of the PIR analysis in isolation, Corridor Options 1 (South) and 5 (South) have the highest potential noise impact due to the number and distribution of noise sensitive properties. On the basis of the above, Corridor Option 2 (South) would affect the lowest number of properties.

1.4.2.2 Likely requirement for noise mitigation

Similar to the Northern Section, traffic volumes along any of the corridor options varies depending on the transport scenario chosen. To fully evaluate the differences between these scenarios, each corridor option has been modelled with traffic associated with both Transport Scenario 5A and Transport Scenario 5B. A total of 966 noise sensitive properties have been modelled along the full extent of the Southern Section. Each corridor option model includes the same properties in order to compare potential noise impacts against the same properties.

The methodology described in **Section 1.3.2** has been used to calculate traffic noise levels associated with each scenario and to determine the indicative number of properties likely to exceed 60dB L_{den} in addition to those likely to require noise mitigation in line with the TII criteria outlined in **Section 1.3.2**. The results are presented in **Table 1.9**.

Table 1.9: Indicative noise mitigation requirements for Southern Section

Corridor Option South	**Corridor Option 1 & 5 (South)**		**Corridor Option 2 (South)**		**Corridor Option 6 (South)**	
	TS 5A	**TS 5B**	**TS 5A**	**TS 5B**	**TS 5A**	**TS 5B**
Indicative No of Properties above 60dB L_{den}	473	468	339	320	452	454
No of Properties Potentially Requiring Noise Mitigation	38	34	57	58	39	39

For the Southern Section, the results of the modelling assessment have determined that the indicative number of properties exposed to road traffic noise levels above 60dB L_{den} are broadly similar for Corridor Options 1 (South), 5 (South) and 6 (South) with both transport scenarios. Corridor Options 1 (South) and 5 (South) overall have the highest number of properties above 60dB L_{den} due to the proximity of properties to the existing road edge.

Corridor Option 2 (South) coupled with either transport scenario results in the lowest number of properties likely to be exposed to road traffic noise levels above 60dB L_{den} when compared to the other options.

The highest number of properties potentially requiring noise mitigation is associated with Corridor Option 2 (South) coupled with either transport scenario, this is associated with newly impacted properties along the off-line corridor to the west of the existing N11. Corridor Options 1 (South), 5 (South) and 6 (South) have a similar number of properties potentially requiring noise mitigation (34 to 39).

Of these options, Corridor Option 1 (South) and 5 (South) coupled with Transport Scenario 5B have a marginally lower number of properties likely to require noise mitigation.

1.4.2.3 Potential change in traffic noise level

Table 1.10 presents the number of properties calculated to experience changes in noise levels for the full extent of the Southern Section based on the DMRB magnitude of change in **Table 1.1**. To differentiate between the options, **Table 1.10** presents the number of properties calculated to experience a neutral to major change in noise levels, both positive and negative, along each corridor option.

Table 1.10: Change in noise levels - Southern Section

No of properties likely to experience a noise change defined as:	**Corridor Option 1 & 5 (South)**		**Corridor Option 2 (South)**		**Corridor Option 6 (South)**	
	TS 5A	**TS 5B**	**TS 5A**	**TS 5B**	**TS 5A**	**TS 5B**
Major Negative	0	0	19	19	0	0
Moderate Negative	0	0	37	37	0	0
Minor Negative	0	0	130	131	0	0
Major Positive	0	0	13	27	5	6
Moderate Positive	0	0	168	161	142	141
Minor Positive	0	0	61	62	50	51
Neutral – Negligible	966	966	538	529	769	768

The assessment has determined that along Corridor Options 1 (South) and 5 (South) with either transport scenario, there are no properties calculated to experience a magnitude of change greater or less than 3dB. The change in noise environment along this corridor option is within +/-3dB compared to the Reference Case scenario and hence is negligible when compared against the DMRB long term significance criteria.

Corridor Option 2 (South) is determined to result in the highest number of properties likely to experience a minor to major negative noise impact with either transport scenario compared to the other corridor options. This is due to the alignment of the off-line section of the corridor passing through an environment not currently exposed to any significant road traffic noise.

Whilst this corridor option will result in negative noise impacts to new properties along its off-line corridor, operational noise levels along the new off-line section will be required to be mitigated to or below 60dB L_{den}. This corridor option provides the greatest reduction in noise levels (positive impact) to properties along the existing N11 compared to the other corridor options.

There is no calculated minor to major negative changes in noise levels associated with Corridor Option 6 (South) for either transport scenario. This option will, however, result in a minor to major positive impact to properties along the existing N11 where traffic is diverted off-line. The number of properties determined to experience a positive impact is lower than those compared to Corridor Option 2 (South).

Overall, Corridor Option 6 (South) provides the greatest overall benefit across the study area compared to the other corridor options through the reduction in noise levels at existing properties and with no significant negative noise level increases. This corridor option will also result in a significant reduction in noise levels across the Glen of the Downs amenity area in the vicinity of the tunnel section.

1.4.2.4 Overall ranking – Southern Section

Based on the quantitative and qualitative analysis undertaken for the Southern Section, Corridor Options 1 (South), 2 (South), 5 (South) and 6 (South) have been assessed against the following TII PAG[5] scoring system.

Taking account of the assessments set out above, the impact rating score and associated qualitative assessment for each corridor option within the Southern Section of the study area are summarised in **Table 1.11**.

Table 1.11: Corridor option assessment – Southern Section

Assessment Criteria	**Corridor Option 1 & 5 (South)**		**Corridor Option 2 (South)**		**Corridor Option 6 (South)**	
	TS 5A	**TS 5B**	**TS 5A**	**TS 5B**	**TS 5A**	**TS 5B**
PIR	1758	1758	1129	1129	1594	1594
No. of Properties likely above 60dB Lden	473	468	339	320	452	454
No of Properties Likely to Require Noise Mitigation	38	34	57	58	39	39

Assessment Criteria	Corridor Option 1 & 5 (South)		Corridor Option 2 (South)		Corridor Option 6 (South)	
	TS 5A	TS 5B	TS 5A	TS 5B	TS 5A	TS 5B
No of Properties Likely to experience a Moderate to Major Negative Impact	0	0	56	56	0	0
No of Properties Likely to experience a Moderate to Major Positive Impact	0	0	181	188	147	147
No of Properties Likely to experience a Neutral – Negligible	966	966	538	529	769	768
Qualitative Assessment	Minor or Slightly Negative	Minor or Slightly Negative	Minor or Slightly Negative	Minor or Slightly Negative	Minor or Slightly Negative	Minor or Slightly Negative
Score / Impact Level	3	3	3	3	3	3
Preference	Intermediate		Intermediate		Preferred	

Taking account of the assessment criteria discussed above, Corridor Option 6 (South) with either transport scenario is determined to result in a *minor or slightly negative* impact level in terms of noise. This is determined on the basis that a positive impact will be experienced at properties along sections of the existing N11 where traffic is diverted off the existing road whilst a neutral to negligible positive or negative impact will be experienced at properties along the remaining corridor. There are no minor to major negative impacts determined as a result of this corridor option. There are overall a high number of properties remaining above 60dB L_{den} along this corridor in the absence of noise mitigation. Opportunities exist along this corridor to incorporate noise mitigation measures as part of the upgrade works to reduce traffic noise levels overall along the corridor which have the potential to result in positive impacts to existing properties. On the basis of all assessment criteria, this corridor option is determined to be preferred over Corridor Options 1 (South), 5 (South) and 6 (South).

Taking account of all assessment criteria, Corridor Option 2 (South) is determined to result in a *minor or slightly negative* impact level in terms of noise. This is determined on the basis that this corridor option has the lowest number of properties exposed to noise levels above 60dB L_{den} compared to the other options but has the highest number of properties likely requiring noise mitigation compared to the other corridor options. This corridor option results in the highest number of properties likely experiencing a positive noise impact compared to the other corridor options. On balance this option is ranked intermediate taking account of both the positive and negative potential impacts.

Taking account of all assessment criteria, Corridor Options 1 (South) and 5 (South) are determined to result in a *minor or slightly negative* impact level in terms of noise.

This is determined on the basis of the lowest number of properties likely to require noise mitigation and the negligible magnitude of negative change that will be experienced at properties overall within the study area. These options do not provide any significant positive impact to properties along the existing N11/M11 which are achieved with Corridor Options 2 (South) and 6 (South). Similar to Corridor Option 6 (South), opportunities exist along this corridor to incorporate noise mitigation measures as part of the upgrade works to reduce traffic noise levels overall along the corridor which have the potential to result in positive impacts to existing properties. On balance, these corridor options are ranked intermediate alongside Corridor Option 2 (South) due to the absence of any minor to major positive impacts but recognising the negligible positive or negative change in noise levels overall.

1.5 Stage 2 Project Appraisal Matrix – transport scenario assessment

The noise assessment of Transport Scenario 5A and 5B has been incorporated into the corridor assessments for the northern and southern sections discussed in **Sections 1.4.1** and **1.4.2.**

For the Northern Section, Transport Scenario 5A has been determined to be preferred over Transport Scenario 5B for Corridor Option 1A due to the overall negligible to positive noise impacts compared to Transport Scenario 5B, albeit marginal (Refer to **Table 1.7**). For Corridor Option 1B (North), Transport Scenario 5A is also preferred over Transport Scenario 5B based on the same rationale (Refer to **Table 1.7**). On balance, Transport Scenario 5A is preferred in the Northern Section. Transport Scenario 5B is determined to be intermediate due to the marginal differences between the transport scenarios in this section.

In the Southern Section, Transport Scenario 5A and 5B are determined to be of intermediate preference for all corridor options due to the marginal difference in potential noise impacts between both.

Table 1.12 summarises the ranking for each based on the assessment criteria discussed in **Section 1.4.1** and **Section 1.4.2**.

Table 1.12: Corridor option assessment

Assessment Criteria	Transport Scenario 5A	Transport Scenario 5B
Preference in Northern Section	Preferred	Intermediate
Preference in Southern Section	Intermediate	Intermediate
Preference	Preferred	Intermediate

1.5.1 Transport Scenario 4 assessment

Transport Scenario 4 is a supplementary measure to Transport Scenarios 5A and 5B. It is compatible with either 5A or 5B and represents a major investment in the bus services within the study area in addition to the bus services already included in the Transport Strategy for the Greater Dublin Area 2016 – 2035 (GDA Strategy) and the Bus Connects project. Details of Transport Scenario 4 are summarised below:

- Bus priority in the form of dedicated bus lanes for all new proposed bus services;
- Enhanced Bus Éireann Route 2 (Wexford – Dublin Airport);
- Upgrade of existing Bus Éireann Route 133 (Wicklow – Dublin Airport);
- New bus route connecting Greystones and Bray to Dublin city centre, with a connecting orbital route serving Cherrywood, Sandyford and Tallaght.; and
- New Local Service connecting towns along the N11/M11 Corridor (Enniscorthy, Gorey, Arklow, Wicklow, Newcastle, Kilcoole, Greystones, Bray & Dún Laoghaire).

Based on the N11/M11 Local Area Model, Transport Scenario 4 will enhance the people carrying capacity of the N11/M11 and in turn results in a modal change from private car to public transport by the order of 3 to 5% compared to the Reference Case scenario.

Given the potential for a reduction in private vehicle traffic along the N11/M11 corridor as a result of Transport Scenario 4, coupled with an increase in bus fleet, this scenario coupled with either Transport Scenario 5A or 5B is likely to result in a neutral to negligible positive impact, compared to the Reference Case scenario.

On the basis of the above, from a noise point of view, the inclusion of Transport Scenario 4 alongside Transport Scenario 5A or 5B is likely to result in a neutral or negligible positive impact compared to the Reference Case scenario.

1.6 References

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