Route Selection Report

N6 Galway City Transport Project

Volume 1B

Report - Part 2

March 2016

An Roinn Iompair Turasóireachta agus Spóirt

Bonneagar Iompair Éireann Transport Infrastructure Ireland

Comhairle Cathrach na Gaillimhe Galway City Council

Comhairle Chontae na Gaillimhe Galway County Council

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Galway County Council

N6 Galway City Transport Project

Route Selection Report

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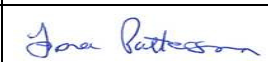
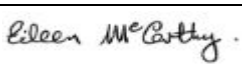
		Signature			
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7 Stage 2 Project Appraisal

7.1 Introduction

Following on from Stage 1 of the route selection process, a Stage 2 project appraisal of the refined route options (see **Section 7.1.1** below) was carried out using the multiple criteria outlined by the Department of Transport in *Guidelines on a Common Appraisal Framework for Transport Projects and Programme June 2009*. This multiple criteria comprises of Economy, Safety, Environment, Accessibility and Social Inclusion and Integration.

For the Economy criterion, Option Comparison Estimates of the refined route options were prepared and a cost benefit analysis was completed. Factors such as route option length, property acquisitions and significant structures impact on the overall costs, whilst factors such as traffic volumes, junction connectivity and delay contribute significantly to the estimation of the benefits of the scheme, and it is the relationship of the costs of the route option to the benefits of the route options that define the economic appraisal of the route option. A summary of the Economy Appraisal is included below in **Section 7.2**.

All six route options were assessed in terms of safety benefits. An independent Road Safety Audit was undertaken for each route option to outline the impacts on road safety of the route options. A summary of the Safety Appraisal is included below in **Section 7.3** and a copy of the Road Safety Audit Stage F Report (Part 1) is included in **Appendix A.7.3**.

Under the heading of Accessibility and Social Inclusion all of the route options were assessed in terms of how they seek to resolve the transportation issues in Galway and in turn to free capacity for further improvements to the public transport network, which in turn will remove traffic from the city streets. This will allow improvement of the streetscapes to enable workers/school children to commute by walking and cycling, thereby reducing the very high percentage of short commutes by providing a safe environment for such a change in behaviour. A summary of the Accessibility and Social Inclusion Appraisal is included below in **Section 7.4**.

All six route options were also assessed under the heading of Integration. All decisions must align with Government Policy to ensure that the project is in line with land use integration, geographical integration and other Government policies. Route options which provide resolution of the transportation issues in Galway must be compatible with the Government's objectives in National, Regional and Local policy documents. Transport integration aims to provide improved road linkages between key centres, improved connectivity between roads and other modes, improved public transport, and improved access to other transport infrastructure such as ports and airports. A summary of the Integration Appraisal is included below in **Section 7.5**.

Environment encompasses many disciplines, with the emphasis and importance of the different disciplines varying depending on the particular discipline. A ranking assessment methodology was adopted for each of the environmental specialist assessments within the Environment criterion. *Human Beings, Ecology, Landscape and Visual, and Material Assets – Non Agricultural* are significant disciplines under

the Environment criterion. The Environmental Appraisal is included below in **Section 7.6**.

A summary of the overall appraisal of the Stage 2 Route Options using the five criteria is included in the Project Appraisal in **Section 7.7** below. For the Stage 2 assessment, the options are assessed in three sections. The location of the breakline between Section 1 and Section 2 used for the Stage 1 assessment has been moved eastwards to the Galway City boundary. Section 1 extends from the R336 to the Galway City boundary and Section 2 extends from the Galway City boundary to the existing N6 in the east of the city. An additional break down at the N6 tie-in at Coolagh has been incorporated in order to compare the junction layouts at the N6 tie-in for the Stage 2 assessment. This section is referred to as Section 3. These junction layouts are shown on **Figures 7.2.2** to **7.2.5**.

7.1.1 Option Development

7.1.1.1 Outcomes of Public Consultation No. 2

Public Consultation No. 2 took place on 28 and 29 January 2015 and on 3 and 4 February 2015 at the Westwood Hotel, Galway and the Menlo Park Hotel, Galway respectively. An overview of this consultation is included in **Section 6.2** of this report with full details of the consultation and submissions received from the public included in **Appendix A.6.1**.

Following the public consultation, the display material was made available for inspection in the project office for four weeks. During this time, multiple consultation meetings were convened with concerned residents, key stakeholders, residents associations and various other interested parties. This consultation facilitated the dissemination of information and allowed members of the public to make informed submissions on the route selection process. The closing date for submissions on the route options was 6 March 2015. Approximately 1,000 submissions were received via email, post or in person.

The general consensus of the submissions was as follows:

1. Habitats have been given more importance than people – the impact of the route options on people's homes and on communities is too great;
2. We need a solution to the congestion but public transport can solve this congestion; and
3. 2006 GCOB scheme should be considered.

Each submission was catalogued and circulated to team members for consideration as part of the Stage 2 route option assessment. In addition, the route options were reviewed in detail to establish whether improvements could be made to the Stage 1 Route Options in order to address the concerns as noted in the submissions above.

7.1.1.2 Stage 2 Route Options

This section details the major amendments and alterations made to the route options between Stage 1 which are outlined in **Section 6.1** and Stage 2. Each amendment and alteration improves on previous designs and options in order to address concerns raised and issues identified through public consulation. The layout of the

Stage 2 Route Options is shown on **Figure 7.1.1** and the schematic of the route options is shown on **Figure 7.1.2**. The modifications to the six route options are outlined below and these modified route options were assessed according to Stage 2 of the route selection process outlined in the NRA PMGs 2010 by the full design team including the environmental specialist. Plan and profile drawings of these route options are presented in **Figures 7.3.1.0** to **7.3.6.13**. To distinguish from the State 1 Route Options the Stage 2 Route Options are denoted with a 2, e.g.Red2 Route Option, Oragne2 Route Option etc.

Red2 Route Option

1. Further traffic assessment identified capacity issues on the mainline from the N17 to the N6 at Briarhill. This required the addition of a lane in each direction of travel. The additional westbound lane terminates at the diverge ramp of City East Business Park grade separated junction. The additional eastbound lane commences at the merge ramp from the N17 grade separated junction. The lanes terminate prior to joining the existing N6.

Orange2 Route Option

1. The link road from the N59 at Bushypark Church to Bothar Stiofan in Knocknacarra was re-aligned to take account of residentially zoned lands. The junction with the N59 remains a signalised junction.
2. Further traffic assessment identified capacity issues on the mainline from the N17 to the N6 at Briarhill. This required the addition of a lane in each direction of travel. The additional westbound lane terminates at the diverge ramp of City East Business Park grade separated junction. The additional eastbound lane commences at the merge ramp from the N17 grade separated junction. The lanes terminate prior to joining the existing N6.

Yellow2 Route Option

1. The route option corridor from the R336 to Knocknacarra was modified in order to minimise impacts to residential properties and communities in the Bearna area.
2. The link road from the N59 at Glenlo Abbey to Bothar Stiofan in Knocknacarra was re-aligned in order to take account of residentially zoned lands and to minimise impacts to residential properties and communities. The realignment also necessitated provision of a signalised junction connection at the N59.
3. Further traffic assessment identified capacity issues on the mainline from the N17 to the N6 at Briarhill. This required the addition of a lane in each direction of travel. The additional westbound lane terminates at the diverge ramp of City East Business Park grade separated junction. The additional eastbound lane commences at the merge ramp from the N17 grade separated junction. The lanes terminate prior to joining the existing N6.

Blue2 Route Option

1. The layout of the Bearna Inner Relief road was modified on its western extents to match the previous Part 8 planning application for this section of the route option. At its eastern extents the layout was modified to minimise impacts to residential properties.

2. The junction layouts on the N84 and N17 were re-examined. Further traffic assessment and design work was undertaken in order to minimise the impacts to residential properties and communities in the Castlegar area from the N84 to the N17.

Pink2 Route Option

1. The layout of the Bearna Inner Relief road was modified on its western extents to match the previous Part 8 planning application for this section of the route option. At its eastern extents the layout was modified to minimise impacts to residential properties.
2. The route corridor from Bearna Village to Knocknacarra was modified in order to minimise impacts to residential properties and communities in the Bearna area.
3. The link road from the N59 at Glenlo Abbey to Bothar Stiofan in Knocknacarra was re-aligned in order to take account of residentially zoned lands and to minimise impacts to residential properties and communities in the Bushypark area. The realignment also necessitated provision of a signalised junction connection at the N59.
4. The N59 grade separated junction was re-examined and further design work undertaken in order to minimise the impacts to residential properties and communities in the Circular Road area.
5. The mainline alignment was modified in the vicinity of the National University of Ireland, Galway (NUIG) and Bushypark National School in order to minimise impacts to the recreational, commercial business and educational facilities in the area.
6. The junction layouts on the N84 and N17 were re-examined. Further traffic assessment and design work was undertaken in order to minimise the impacts to residential properties and communities in the Castlegar area from the N84 to the N17.
7. The junction layout at Coolagh/Briarhill was re-examined and further design work undertaken in order to minimise the impacts to residential properties and communities in the Coolagh area.

Green2 Route Option

1. The route corridor from the N17 to the N6 was modified in order to minimise impacts to residential properties and communities in the Coolagh / Briarhill area.
2. The split junction layout at Coolagh / Briarhill was re-examined and further design work undertaken in order to minimise the impacts to residential properties, educational facilities and communities in the Coolagh area.

7.1.1.3 Public Transport Alternatives

As discussed in **Section 5.2.3**, a 'Do-Something Public Transport' option does not meet the project objectives when implemented in isolation but it has been retained as a possible component of an overall solution for the transport issues in Galway.

The ITMP transport strategy, which is being undertaken by Galway City Council in conjunction with the NTA, (see **Section 1.3**) will identify a series of supporting

infrastructure, operational and policy measures to help optimise travel by sustainable modes in order to meet both the current and future travel needs of Galway. A review of the preferred route option will be undertaken in the context of the recommendations of the wider Galway transport strategy at Stage 3 of this project.

7.1.1.4 Review 2006 GCOB

During Public Consultation No. 2, discussions arose as to the reasons for discounting the 2006 GCOB scheme. As outlined in **Section 5.2.6** the 2006 GCOB scheme was outside the 'Option Development Zones' and therefore did not merit inclusion in the Stage 1 Route Options, as there were route options which were less damaging to the integrity of the Lough Corrib cSAC available. An assessment for the 2006 GCOB Route Option is included in **Appendix A.5.4**.

7.1.1.5 Environmental Workshop No. 4

Environmental Workshop No. 4 took place on 19 March 2015. The Stage 2 Route Options reviewed at this workshop are shown on **Figure 7.2.1.** The purpose of the workshop was to update the entire team on the outcome of the public consultation, to review each route option to establish that they represented the best balance achievable in terms of all constraints, and to focus the team towards the selection of an Emerging Preferred Route Corridor.

During this workshop, a switch from the Green2 Route Option to the Blue2 Route Option immediately east of the River Corrib crossing was evaluated to address the queries raised at the public consultation. This is referred to as the 'Green2 – Blue2 Switch Route Option'. It should be noted that this 'Switch' could also be used to connect the Green2 Route Option with the Yellow2 or Pink2 Route Option.

This 'Green2 - Blue2 Switch Route Option' shown on **Figure 7.1.3**, provided an alternative route option which included the Green2 Route Option from the R336 to and including, the River Corrib crossing point. It then connects with the Blue2 Route Option before entering into Lackagh Quarry and followed the path of the Blue2 Route Option to the N6. The connection between the Green2 and Blue2 Route Options at Menlough has a greater impact on Menlo Castle from an architectural and cultural heritage and landscape and visual perspective than either the Green2 or Blue2 Route Options considered alone. The direct impact on residential properties for this alternative route option is also greater than that of the Blue2 Route Option over the portion of the 'Switch' between the Green2 Route Option and Blue2 Route Option. The Green2 Route Option River Corrib crossing point is also worse than that of the Blue2 Route Option crossing in terms of ecology. The benefits of this route option include the avoidance of impacts to NUIG Recreational Facilities and reduction of direct impacts on the Dangan area west of the River Corrib, and the avoidance of Menlough Village to the east of the River Corrib. An assessment of this route option, 'Green2 – Blue2 Switch Route Option' is included in **Appendix A.7.1**.

The conclusion of the workshop was that there was further work required to close out some outstanding issues before final conclusion on the Emerging Preferred Route Corridor. This included some additional liaison with key stakeholders and additional traffic analysis.

7.2 Summary of Economy Appraisal

7.2.1 Introduction

In accordance with the NRA PMG, the Option Comparison Estimates of route options carried from Stage 1 to Stage 2 were reviewed. This review accounted for design alterations and amendments.

Section 7.2.2 summarises the Stage 2 engineering assessment of each route option. The purpose of this assessment is to fully understand the output from the cost estimates and the cost benefit analysis. Factors such as route option length and significant structures impact on the overall costs, whilst factors such as traffic volumes, junction connectivity and delay contribute significantly to the estimation of the benefits of the scheme, and it is the relationship of the costs of the route option to the benefits of the route options that define the economic appraisal of the route option.

As part of the Stage 2 Economy Appraisal, a Cost Benefit Analysis of each route option was undertaken in accordance with the NRA Project Appraisal Guidelines. This is appended to this report and a summary of this analysis is provided in **Section 7.2.4** below. A key aspect of the Economy Appraisal is the Traffic Modelling Report. The Traffic Modelling Report is included in **Appendix A.3.1** and the Cost Benefit Analysis Report is included in **Appendix A.7.2**.

7.2.2 Engineering Summary

As outlined in **Section 7.1.2** above, changes have been incorporated into the route options from Stage 1 of Route Selection, and these route options have progressed to Stage 2 assessment. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options.

An engineering assessment of each route option is carried out to establish the most preferred option from a purely engineering perspective. The same criteria and methodology that were identified in the Stage 1 engineering assessment have been used for this Stage 2 assessment (refer **Section 6.3.2**).

For the Stage 2 assessment, the options are assessed in three sections. The location of the breakline between Section 1 and Section 2 has been moved eastwards to the Galway City boundary. Section 1 extends from the R336 to the Galway City boundary and Section 2 extends from the Galway City boundary to the existing N6 in the east of the city. An additional break down at the N6 tie-in at Coolagh has been incorporated in order to compare the junction layouts at the N6 tie-in for the Stage 2 assessment. This section is referred to as Section 3 and this is assessed separately as the criteria under which the mainline are assessed are not as relevant to the junction assessment.

The engineering assessment criteria utilised for the mainline assessment are categorised under the following headings: Geometry, Cross-section, Length, Junction Strategy, Structures, Topography and Earthworks, Constructability, and Traffic. A summary table for each criterion is provided below in **Tables 7.2.2.1** to **7.2.2.15**.

Thereafter, the cumulative ranking of each of the criteria was quantified, and based on this, the engineering ranking was given as Preferred (P), Intermediate (I) or Least Preferred (LP).

7.2.2.1 Geometry

As outlined in **Section 6.3.3.1**, a number of indicators which contribute to geometric performance are assessed and the resultant ranking is tabulated below for each section.

Table 7.2.2.1 Geometric Assessment – Section 1

Route Option	Horizontal Alignment Ranking	Vertical Alignment Ranking	Assessment
Red2	I	I	I
Orange2	I	I	I
Yellow2	LP	I	LP
Blue2	LP	I	LP
Pink2	LP	I	LP
Green2	P	I	P

Note: P = Preferred, I = Intermediate, LP = Least Preferred

The Green2 Route Option is the most preferred route option in Section 1 in terms of geometry. The Blue2, Pink2 and Yellow2 Route Options are the least preferred route options in Section 1.

Table 7.2.2.2 Geometric Assessment – Section 2

Route Option	Horizontal Alignment Ranking	Vertical Alignment Ranking	Assessment
Red2	LP	LP	LP
Orange2	LP	I	I
Yellow2	I	I	I
Blue2	I	I	I
Pink2	I	I	I
Green2	P	I	P

Note: P = Preferred, I = Intermediate, LP = Least Preferred

The Green2 Route Option is the most preferred route option in Section 2. The Red2 Route Option is least preferred in terms of geometry.

7.2.2.2 Cross-Section

For the Stage 2 engineering assessment a single carriageway has been assumed from the western tie in at the R336 to the first at-grade junction immediately before the N59 grade separated junction on the Green2, Blue2, Orange2, Yellow2 and Pink2 Route Options. From this point east, a Type 2 dual carriageway cross-section has been assumed throughout on the Green2, Blue2, Orange2, Yellow2 and Pink2

Route Options. The cross-section of the Red2 Route Option varies and is detailed in **Appendix A.5.3.**

An incremental assessment will be carried out on the preferred route corridor at Phase 3 *Design* to establish the optimum cross-section throughout and to fully justify the transition from single to dual carriageway at the optimum location.

7.2.2.3 Length

The length parameter is a measure of each route option's length from its most western extent, where it connects to the R336 in the vicinity of Bearna, to the tie-in with the existing N6 Galway to Dublin road at Biairhill, Coolagh.

Table 7.2.2.3 Overall Length Assessment

Route	Length (m)
Red2	15073
Orange2	14862
Yellow2	17453
Blue2	16870
Pink2	16045
Green2	20161

Table 7.2.2.4 Length Assessment – Section 1

Route Option	Length (m)	Assessment
Red2	2290	P
Orange2	2297	P
Yellow2	4171	LP
Blue2	3571	I
Pink2	3151	I
Green2	3935	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

The Red2 and Orange2 Route Options in Section 1 offer the shortest travel distances and are the preferred route options in terms of length. The Yellow2 Route Option has longest travel distance and is consequently the least preferred.

Table 7.2.2.5 Length Assessment – Section 2

Route Option	Length (m)	Assessment
Red2	12783	I
Orange2	12565	P
Yellow2	13283	I
Blue2	13299	I
Pink2	12894	I
Green2	16226	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred

In Section 2, the Orange2 Route Option offers the shortest travel distance and consequently is the preferred route option, while the Green2 Route Option gives the furthest travel distance and is therefore least preferred.

7.2.2.4 Junction Strategy

The assessment methodology in respect of junction assessment is as set out for the Stage 1 assessment, refer to **Section 6.3.3.4**. A summary of the assessment for each section is provided below.

Table 7.2.2.6 Junction Assessment – Section 1

Route Option	Number of At-Grade Signalised Junctions or Roundabouts	Number of At-Grade Priority/Left In Left Out Direct Access Junctions	Number of Grade Separated Junctions	Assessment
Red2	1	0	0	P
Orange2	1	0	0	P
Yellow2	5	0	0	LP
Blue2	4	1	0	LP
Pink2	4	1	0	LP
Green2	2	0	0	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

For Section 1, the Red2 and Orange2 Route Options are the most favourable, and are the preferred route options in terms of junction connectivity from a delay context. The Yellow2 Route Option is the least preferred.

Table 7.2.2.7 Junction Assessment – Section 2

Route Option	Number of At-Grade Signalised Junctions or Roundabouts	Number of At-Grade Priority/Left In Left Out Direct Access Junctions	At-Grade Assessment	Number of Fully Grade Separated Junctions	Grade Separated Assessment	Junction Configuration	Connectivity to National Routes	Assessment
Red2	4	10	LP	4.75	P	I	I	I
Orange2	2	1	I	4	I	LP	LP	LP
Yellow2	2	1	I	3	LP	I	I	LP
Blue2	1	0	P	3.5	I	P	I	I
Pink2	2	0	I	3.5	I	I	I	I
Green2	2	0	I	4	I	P	P	P

Note: P = Preferred, I = Intermediate, LP = Least Preferred

For Section 2, the Green2 Route Option is the most favourable, and is the preferred option in terms of junction connectivity from a delay context. The Yellow2 and Orange2 Route Options are the least preferred options.

7.2.2.5 Structures

The assessment methodology in respect of structures assessment is as set out for the Stage 1 assessment, refer to **Section 6.3.3.5**. A summary of the assessment for each section is provided below.

Table 7.2.2.8 Structures Assessment – Section 1

Route Option	River/Stream Bridge	Mainline on Overbridge	Mainline in Underpass	Rank Average
Red2	1	0	3	I
Orange2	1	0	3	I
Yellow2	1	1	0	P
Blue2	1	0	2	I
Pink2	1	1	0	P
Green2	1	4	0	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred

For Section 1, the Yellow2 and Pink2 Route Options score most favourably in terms of structures and are the preferred route options. The Green2 Route Option is least preferable in terms of structures.

Table 7.2.2.9 Structures Assessment – Section 2

Route Option	River/Stream Bridge	Mainline on Overbridge	Mainline in Underpass	Total Number of Bridges	Number of Bridges Rank Average	Major Structure Extents Assessment`*	Overall Assessment
Red2	7	3	8	18	I	LP	LP
Orange2	3	0	12	15	P	LP	LP
Yellow2	4	12	5	21	LP	P	P
Blue2	3	16	4	23	LP	I	I
Pink2	3	14	7	24	LP	I	I
Green2	4	12	3	19	I	I	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

**Major structures include River Corrib bridge, viaduct and tunnel extents*

For Section 2 under the structures assessment, the Yellow2 Route Option is the preferred route option. The Red2 and Orange2 Route Options are the least preferred options.

7.2.2.6 Topography and Earthworks

A preliminary assessment of the earthworks quantities has been carried out along the mainline for each of the route options. Following the Stage 1 assessment, the vertical profile was reduced in some locations to try to limit the visual impact on residential communities. An initial assessment of the balance of the earthworks has been carried out. This is the difference between the cut and fill volumes along the route options. The route option with the smallest difference is the most balanced and is therefore the most preferred route option from the point of view of engineering and earthworks. A full balancing exercise of the earthworks quantities will be carried out at the detailed design phase to minimise the requirement for import or disposal of fill material. A summary of the initial volumes is provided below.

Table 7.2.2.10 Earthworks Balance – Section 1

Route Option	Total Cut (m3)	Total Fill (m3)	Volume Balance (m3)	Assessment
Red2	366,276	-12,662	353,613	LP
Orange2	348,366	-8,101	340,266	LP
Yellow2	55,173	-127,449	-72,276	P
Blue2	152,314	-70,065	82,249	P
Pink2	9,374	-186,004	-176,630	I
Green2	46,093	-342,386	-296,293	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred

For Section 1, the Yellow2 and Blue2 Route Options are the preferred route options. The Red2, Orange2 and Green2 Route Options are the least preferred route options in terms of earthworks balance.

Table 7.2.2.11 Earthworks Balance – Section 2

Route Option	Total Cut (m3)	Total Fill (m3)	Volume Balance (m3)	Assessment
Red2	1,756,176	-430,771	1,325,404	LP
Orange2	2,342,308	-16,645	2,325,663	LP
Yellow2	1,132,572	-1,545,379	-412,807	I
Blue2	1,620,813	-2,161,695	-540,882	I
Pink2	1,612,232	-1,787,761	-175,528	P
Green2	1,294,373	-1,714,944	-420,571	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

For Section 2, the Pink2 Route Option is the preferred route option. The Red2 and Orange2 Route Options are the least preferred route options in terms of earthworks balance.

7.2.2.7 Constructability

The assessment methodology in respect of constructability assessment is as set out for the Stage 1 assessment, refer to **Section 6.3.3.7**. It is based on the fact that the route option with the greatest length of on-line construction, with either rehabilitation of the existing N6 or rehabilitation of existing roads, will be the most difficult to construct.

As the route options are almost entirely off-line in Section 1, they were ranked here according to the nature of the areas they pass through and the number of road crossings involved in this section. In Section 2, the complexity of constructing long structures, particularly tunnels, is also taken into account.

Table 7.2.2.12 Constructability Assessment – Section 1

Route Option	Assessment
Red2	P
Orange2	P
Yellow2	I
Blue2	LP
Pink2	LP
Green2	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

For Section 1, the Red2 and Orange2 Route Options are the preferred route options. The Blue2 and Pink2 Route Options are the least preferred route option in terms of constructability.

Table 7.2.2.13 Constructability Assessment – Section 2

Route Option	Assessment
Red2	LP
Orange2	LP
Yellow2	I
Blue2	P
Pink2	P
Green2	P

Note: P = Preferred, I = Intermediate, LP = Least Preferred

For Section 2, the Blue2, Pink2 and Green2 Route Options are the preferred route options. The Red2 Route Option is the least preferred route option in terms of constructability.

7.2.2.8 Traffic

Detailed traffic models of all of the Stage 2 Route Options have been prepared. A comparison of the various options has been carried out as part of the Stage 2 assessment.

In addition to the validated 2012 Base Year network, the future year networks developed are:

2019 Opening Year Do-Minimum;

2019 Opening Year Do-Something(s):

- Orange2 Route Option;
- Green2 Route Option;
- Yellow2 Route Option;
- Blue2 Route Option;
- Pink2 Route Option;
- Red2 Route Option; and
- PT Alternative.

2034 Design Year Do-Minimum;

2034 Design Year Do-Something(s):

- Orange2 Route Option;
- Green2 Route Option;
- Yellow2 Route Option;
- Blue2 Route Option;
- Pink2 Route Option;
- Red Route Option; and
- PT Alternative.

A summary of the performance of each route option, based on the following analysis, is provided below:

- Network Performance Indicators;
- Journey Times;
- Traffic Patterns; and
- Mode Share.

The analysis presented in this section is for the morning peak hour and has been run through the demand model to take account of changes in transport costs, such as vehicle operating costs, values of time and congestion levels.

Network Performance Indicators

Network performance indicators for the 2034 Design Year are outlined in the tables below, extracted from the morning peak hour highway assignments.

In 2034 Do-Minimum the total network delay in the morning peak hour shoots up by 70% relative to the Base Year, far more than the increase in trips, indicating capacity issues on the network.

All route options reduce the network delay relative to the Do-Minimum and provide a faster average speed, however, the Red2 and Orange2 Route Options are the only

two that bring total network delay back down to Base Year levels for the morning peak hour.

All route options provide an improvement compared to the Do-Minimum when measured in terms of these road network performance indicators. However, the PT (Public Transport) Alterative performs worse than the Do-Minimum.

Table 7.2.2.14 Network Performance Indicators 2034 Design Year

Option	**Total Vehicle Distance (pcu.kms)**	**Total Network Travel Time (pcu.hrs)**	**Total Network Delay** (pcu.hrs)	**Average Vehicle Speed (kph)**
2012 Base	195815	6429	1749	30.5
2034 Do-Min	223107	8297	2969	26.9
2034 Orange2	249324	6966	1765	35.8
2034 Green2	254348	7188	1965	35.4
2034 Yellow2	246144	7192	1946	34.2
2034 Blue2	245170	7055	1882	34.7
2034 Pink2	244898	7029	1863	34.8
2034 Red2	248107	6901	1751	36.0
2034 PT Alternative	221743	8452	3151	26.2

Table 7.2.2.15 Network Performance Indicators 2034 Design Year – Indexed against the Base

Option	**Total Vehicle Distance (pcu.kms)**	**Total Network Travel Time** (pcu.hrs)	**Total Network Delay (pcu.hrs)**	**Average Vehicle Speed (kph)**	**Rank**
2012 Base	100	100	100	100	-
2034 Do-Min	114	129	170	88	-
2034 Orange2	127	108	101	117	2
2034 Green2	130	112	112	116	6
2034 Yellow2	126	112	111	112	5
2034 Blue2	125	110	108	114	4
2034 Pink2	125	109	107	114	3
2034 Red2	127	107	100	118	1
2034 PT Alternative	113	131	180	86	7

Journey Times

Journey time analysis has been undertaken for three key routes in Galway City, in order to compare the performance of each transport option. These routes were identified in Phase 1 as key routes i.e. primary transport corridors, and journey times on these key routes are a key performance indicator on which all transport options are tested.

The table below presents the journey time analysis for the three key routes.

The journey time analysis shows that the Red2 Route Option performs best at reducing journey times on the three key routes, saving an average of 9 minutes (33% reduction) on the inbound key routes and 5 minutes (26% reduction) on the outbound key routes. The biggest journey time savings for the Red2 Route Option are on the N6 (Route 1), this is logical as the N6 is upgraded under the Red2 Route Option; however the relief that this brings to the other two key routes is also significant.

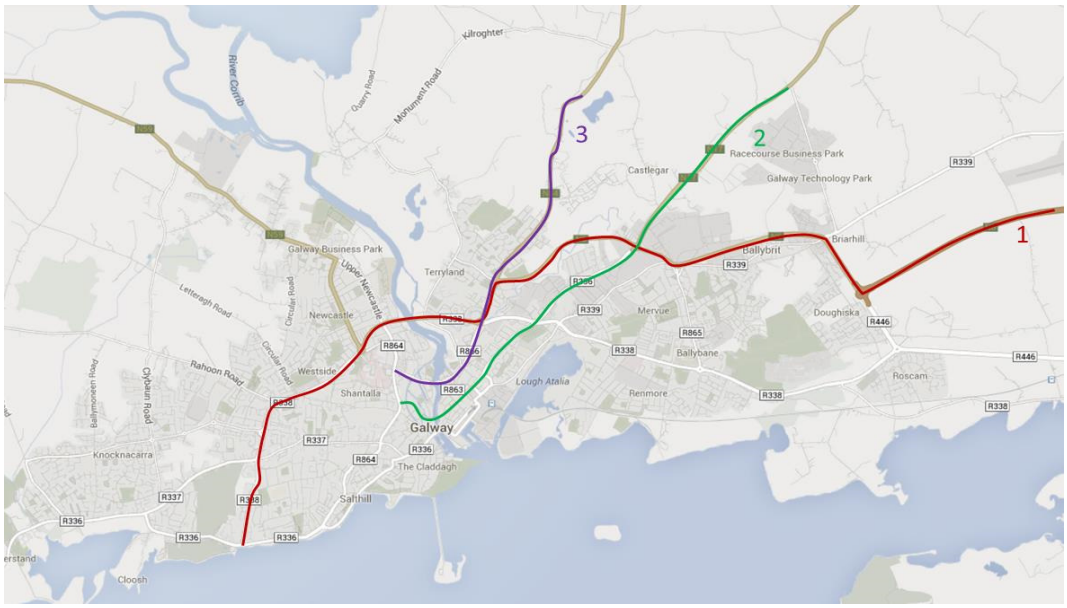
The Orange2 Route Option performs second best, saving an average of 6 minutes (22%) on the inbound key routes and 4 minutes (21% reduction) on the outbound key routes. This is closely followed by the Green2 Route Option, which in turn is closely followed the Blue2, Yellow2 and Pink2 Route Options.

The PT Alternative provides a dis-improvement in car journey times on two of the three key routes inbound compared to the Do-Minimum, and a minor change on the outbound key routes.

Table 7.2.2.16 Journey Times 2034 Design Year

		2034 Morning Peak Hour Journey Times (minutes)							
		Do-Minimum	Orange Route	Green Route	Yellow Route	Blue Route	Pink Route	Red Route	PT Alternative
Inbound	Route 1 IN	33	22	25	28	27	26	16	34
	Roue 2 IN	26	23	23	23	24	24	22	28
	Route 3 IN	21	17	16	16	16	15	16	19
	Average	**27**	**21**	**21**	**22**	**22**	**22**	**18**	**27**
Outbound	Route 1 OUT	28	19	23	22	25	23	17	27
	Roue 2 OUT	19	18	18	19	18	18	18	19
	Route 3 OUT	10	9	9	9	10	10	9	9
	Average	**19**	**15**	**17**	**17**	**17**	**17**	**14**	**18**

Image 7.2.2.1 Journey Time Key Routes



Traffic Patterns

As noted in **Section 3.2.5.6** the GIM predicts changes to travel patterns based on the population and job forecasts and the changes in travel costs (for example changes in congestion). The strongest change is a re-distribution of trips as people change their destination (e.g. where they work or shop) based on the changes in travel costs over a number of years.

In the 2034 Do-Minimum, the overall growth in car trips to/from/through Galway City is 20%. However, the re-distribution impacts result in the growth in car trips crossing the River Corrib of just 11%, because the capacity constraints to cross the river suppress some of the cross-river trips.

In the 2034 Do-Something(s), the overall growth in car trips remains at 20%, but the growth in car trips crossing the River Corrib increases to 37% on average across the Route Options, because the increased capacity to cross the river relieves the suppressed demand.

Mode Share

The other change in travel patterns predicted by the GIM is a change in travel mode based on the changes in travel costs.

The tables below present the mode share between private vehicle and public transport for the 2012 Base and 2034 Design Year, extracted from the model for the morning peak hour for the Do-Something options.

As noted in **Section 3.2.5.6**, the mode share analysis shows that there is a low public transport mode share of just 5.0% in the Base Year.As can be seen below, the impact of the Do-Something options on mode share is minimal.

Table 7.2.2.17 Mode Share 2034 Design Year

	Morning Peak Hour Person Trips			
Option	Car	PT	%Car	%PT
2012 Base	27,478	1,452	95.0%	5.0%
2034 Do-Minimum	32,898	1,697	95.1%	4.9%
2034 Orange2	32,956	1,639	95.3%	4.7%
2034 Green2	32,960	1,635	95.3%	4.7%
2034 Yellow2	32,928	1,667	95.2%	4.8%
2034 Blue2	32,943	1,651	95.2%	4.8%
2034 Pink2	32,959	1,636	95.3%	4.7%
2034 Red2	32,955	1,639	95.3%	4.7%
2034 PT Alternative	32,614	1,992	94.2%	5.8%

The overall integration of the public transport strategy for Galway will be re-examined as part of a wider integrated transport strategy identifying the needs of pedestrians, cyclists, public transport users and motorists. This strategy will examine the multi-modal transport needs of Galway in the context of the preferred route option for this study in Phase 3: *Design*.

Do-Something AADT tables

The forecast AADT flows on the road network extracted from the models for the 'Do-Something' options are presented below and the AADT point locations are shown on **Figures 7.2.8.1** to **7.2.8.6** included in the volume of figures.

Table 7.2.2.18 Red2 Route AADT 2034 Design Year

			DM - 2034		DS - RED - 2034	
	AADT Point	Location	AADT	% HGV	AADT	% HGV
DM links	1	N6 South of Galway Airport	21,900	2.9%	49,900	2.1%
	2	R446 West of Oranmore Business Park	20,200	4.9%	15,500	5.9%
	3	R446 South of N6 Roundabout	14,400	3.3%	17,300	4.2%
	4	N6 South of Briarhill	31,100	2.8%	10,000	4.1%
	5	N6 Near Ballybrit Business park	37,000	4.5%	67,100	2.9%
	6	N6 between N17 and R865	32,000	3.0%	53,900	2.5%
	7	N6 Between N84 and N17	33,800	2.8%	72,200	2.3%
	8	N6 East of Quincentenary Bridge	29,900	4.7%	27,300	4.4%
	9	N6 - On Quincentenary Bridge	34,800	3.3%	59,800	2.3%
	10	R338 at Westside Playing fields	11,500	2.5%	39,900	1.7%
	11	Western Distributor Rd between Clybaun Rd and R338	12,800	0.8%	30,400	0.8%
	12	Western Distributor Rd between Clybaun Rd and Ballymoneen Rd	10,600	0.7%	15,900	0.8%
	13	R337 Kingston Road. Kingston	7,100	1.4%	7,300	0.4%
	14	R336. Salthill Road Upper. Galway Golf Course.	18,400	0.7%	15,900	0.4%
	15	R336. Barna Road. Barna Woods	16,600	0.9%	9,700	0.4%
	16	R336. Barna Road. Barna. Creagan bus stop	13,400	1.0%	15,200	0.9%
	17	R336. Barna Road. West of Barna. Garrynagry	11,400	1.2%	13,300	1.0%
	18	L1321. At Loughinch. South East of Bearna Golf Club	1,100	0.1%	800	0.2%
	19	Boleybeg Road. Between Cappagh Road and Ballymoneen Road	2,000	0.8%	1,800	0.9%
	20	Rahoon Road. Between Clybaun Rd and Bothar Stiofain	5,000	0.4%	5,800	0.5%
	21	N59. Thomas Hynes road. Between Hazel Park and Cherry Park	4,300	1.7%	7,300	2.2%
	22	N59. Upper Newcastle Road. Between R338 and Corrib Village	15,900	1.4%	17,100	1.1%
	23	N59. Barnacranny. Between chesnut Ln and Circular Rd	18,400	1.3%	19,600	1.3%
	24	N84. South of Ballindooly. Ballindooly Lough	10,600	2.1%	12,800	1.7%
	25	N84. North of Ballindooly	17,300	1.3%	17,300	1.3%
	26	N17. Tuam Road. NorthEast of Parkmore Road	19,300	1.6%	16,400	2.2%
	27	R338. Dublin Road. West of Junction with Coast Road.	13,500	4.5%	8,800	2.6%
	28	R338. Dublin road. Between Renmore Rd and M. Collins road	18,600	3.3%	17,500	1.6%
	29	R336. Tuam Road. Mervue Business Park	14,500	2.6%	9,200	2.3%
	30	Wolfe Tone Bridge	20,800	2.6%	14,600	2.2%
	31	O'Briens Bridge	9,100	1.9%	6,800	2.3%
	32	Salmon Weir Bridge	16,700	1.7%	11,600	2.0%
	33	N17. Tuam Road. NorthEast of School Road	14,900	2.0%	14,300	3.2%
	89	Eglington Street	7,800	2.6%	4,400	2.9%
	90	R336 South of Eyre Square	13,600	2.5%	12,400	1.7%
DS links	80	Expressway - RED - Briarhill Junction			49,900	2.1%
	81	Expressway - RED - South of Ballybrit Business Park			63,500	3.1%
	82	Expressway - RED - Between N17 and R865			53,900	2.5%
	83	Expressway -RED - Between N17 and N84			72,200	2.3%
	84	Expressway -RED - Between N84 and R8338			43,900	2.3%
	85	Expressway - RED - New Corrib Crossing (Local Road)			12,400	2.2%
	86	Expressway - RED -R338 at Westside Playing fields			39,900	1.7%
	87	Expressway - RED -Western Distributor Rd between Clybaun Rd and R338			30,400	0.8%
	88	Expressway - RED -Western Distributor Rd between Clybaun Rd and Ballymoneen Rd			15,900	0.8%

Table 7.2.2.19 Blue2 Route AADT 2034 Design Year

			DM - 2034		DS - BLUE - 2034	
	AADT Point	Location	AADT	% HGV	AADT	% HGV
DM links	1	N6 South of Galway Airport	21,900	2.9%	33,900	2.0%
	2	R446 West of Oranmore Business Park	20,200	4.9%	22,900	4.8%
	3	R446 South of N6 Roundabout	14,400	3.3%	23,600	3.1%
	4	N6 South of Briarhill	31,100	2.8%	28,500	3.5%
	5	N6 Near Ballybrit Business park	37,000	4.5%	27,400	4.7%
	6	N6 between N17 and R865	32,000	3.0%	24,100	3.3%
	7	N6 Between N84 and N17	33,800	2.8%	20,800	3.4%
	8	N6 East of Quincentenary Bridge	29,900	4.7%	31,600	4.0%
	9	N6 - On Quincentenary Bridge	34,800	3.3%	29,400	2.7%
	10	R338 at Westside Playing fields	11,500	2.5%	5,800	2.0%
	11	Western Distributor Rd between Clybaun Rd and R338	12,800	0.8%	9,900	0.2%
	12	Western Distributor Rd between Clybaun Rd and Ballymoneen Rd	10,600	0.7%	5,700	0.2%
	13	R337 Kingston Road. Kingston	7,100	1.4%	5,000	1.2%
	14	R336. Salthill Road Upper. Galway Golf Course.	18,400	0.7%	17,300	0.5%
	15	R336. Barna Road. Barna Woods	16,600	0.9%	9,500	0.8%
	16	R336. Barna Road. Barna. Creagan bus stop	13,400	1.0%	6,200	1.0%
	17	R336. Barna Road. West of Barna. Garrynagry	11,400	1.2%	13,400	1.0%
	18	L1321. At Loughinch. South East of Bearna Golf Club	1,100	0.1%	300	0.3%
	19	Boleybeg Road. Between Cappagh Road and Ballymoneen Road	2,000	0.8%	1,500	1.1%
	20	Rahoon Road. Between Clybaun Rd and Bothar Stiofain	5,000	0.4%	4,300	0.4%
	21	N59. Thomas Hynes road. Between Hazel Park and Cherry Park	4,300	1.7%	3,000	0.8%
	22	N59. Upper Newcastle Road. Between R338 and Corrib Village	15,900	1.4%	15,400	0.9%
	23	N59. Barnacranny. Between chesnut Ln and Circular Rd	18,400	1.3%	19,800	0.7%
	24	N84. South of Ballindooly. Ballindooly Lough	10,600	2.1%	17,200	1.5%
	25	N84. North of Ballindooly	17,300	1.3%	18,200	1.4%
	26	N17. Tuam Road. NorthEast of Parkmore Road	19,300	1.6%	20,600	1.9%
	27	R338. Dublin Road. West of Junction with Coast Road.	13,500	4.5%	9,600	3.5%
	28	R338. Dublin road. Between Renmore Rd and M. Collins road	18,600	3.3%	18,700	2.0%
	29	R336. Tuam Road. Mervue Business Park	14,500	2.6%	13,200	2.5%
	30	Wolfe Tone Bridge	20,800	2.6%	17,300	2.3%
	31	O'Briens Bridge	9,100	1.9%	7,800	2.1%
	32	Salmon Weir Bridge	16,700	1.7%	14,900	2.0%
	33	N17. Tuam Road. NorthEast of School Road	14,900	2.0%	18,300	2.1%
	89	Eglington Street	7,800	2.6%	6,400	3.0%
	90	R336 South of Eyre Square	13,600	2.5%	12,800	1.6%
DS links	60	Expressway - BLUE - Briarhill Junction	-		33,900	2.0%
	61	Expressway - BLUE - Parkmore	-		30,500	1.3%
	62	Expressway - BLUE - Between N17 and N84	-		50,700	1.6%
	63	Expressway - BLUE - New Corrib Crossing	-		34,600	2.0%
	64	Expressway - BLUE - N59 Link Road	-		12,000	2.0%
	65	Expressway - BLUE - Rahoon Link Road	-		19,100	2.0%
	66	Expressway - BLUE - Between Ballymoneen and Cappagh Road	-		10,500	0.8%
	67	Expressway - BLUE - @ Ballard	-		10,500	0.8%
	68	Expressway - BLUE - Junction with new Bearna Link Road	-		10,500	0.8%
	69	New Bearna Link Road - BLUE - North of R336	-		12,100	0.7%

Table 7.2.2.20 Green2 Route AADT 2034 Design Year

			DM - 2034		DS - GREEN - 2034	
	AADT Point	Location	AADT	% HGV	AADT	% HGV
DM links	1	N6 South of Galway Airport	21,900	3%	47,000	2.0%
	2	R446 West of Oranmore Business Park	20,200	5%	12,200	6.9%
	3	R446 South of N6 Roundabout	14,400	3%	12,400	4.1%
	4	N6 South of Briarhill	31,100	3%	25,100	3.5%
	5	N6 Near Ballybrit Business park	37,000	4%	25,900	5.8%
	6	N6 between N17 and R865	32,000	3%	23,900	3.8%
	7	N6 Between N84 and N17	33,800	3%	20,900	4.5%
	8	N6 East of Quincentenary Bridge	29,900	5%	30,600	4.7%
	9	N6 - On Quincentenary Bridge	34,800	3%	31,100	2.9%
	10	R338 at Westside Playing fields	11,500	2%	7,600	2.2%
	11	Western Distributor Rd between Clybaun Rd and R338	12,800	1%	11,200	0.2%
	12	Western Distributor Rd between Clybaun Rd and Ballymoneen Rd	10,600	1%	5,600	0.1%
	13	R337 Kingston Road. Kingston	7,100	1%	4,400	1.1%
	14	R336. Salthill Road Upper. Galway Golf Course.	18,400	1%	16,900	0.6%
	15	R336. Barna Road. Barna Woods	16,600	1%	6,500	0.6%
	16	R336. Barna Road. Barna. Creagan bus stop	13,400	1%	5,200	0.5%
	17	R336. Barna Road. West of Barna. Garrynagry	11,400	1%	14,500	1.0%
	18	L1321. At Loughinch. South East of Bearna Golf Club	1,100	0%	2,000	0.8%
	19	Boleybeg Road. Between Cappagh Road and Ballymoneen Road	2,000	1%	300	0.6%
	20	Rahoon Road. Between Clybaun Rd and Bothar Stiofain	5,000	0%	12,800	1.7%
	21	N59. Thomas Hynes road. Between Hazel Park and Cherry Park	4,300	2%	3,200	1.4%
	22	N59. Upper Newcastle Road. Between R338 and Corrib Village	15,900	1%	15,800	1.1%
	23	N59. Barnacranny. Between chesnut Ln and Circular Rd	18,400	1%	21,500	1.1%
	24	N84. South of Ballindooly. Ballindooly Lough	10,600	2%	21,800	1.3%
	25	N84. North of Ballindooly	17,300	1%	18,700	1.4%
	26	N17. Tuam Road. NorthEast of Parkmore Road	19,300	2%	19,800	1.8%
	27	R338. Dublin Road. West of Junction with Coast Road.	13,500	5%	11,000	3.6%
	28	R338. Dublin road. Between Renmore Rd and M. Collins road	18,600	3%	18,400	2.1%
	29	R336. Tuam Road. Mervue Business Park	14,500	3%	13,600	1.8%
	30	Wolfe Tone Bridge	20,800	3%	17,600	2.2%
	31	O'Briens Bridge	9,100	2%	7,800	2.0%
	32	Salmon Weir Bridge	16,700	2%	15,200	2.0%
	33	N17. Tuam Road. NorthEast of School Road	14,900	2%	20,700	2.2%
	89	Eglington Street	7,800	3%	6,600	3.0%
	90	R336 South of Eyre Square	13,600	3%	13,500	1.4%
DS links	43	Expressway - GREEN - Briarhill Junction	-		36,600	1.4%
	44	Expressway - GREEN - Parkmore	-		36,600	1.4%
	45	Expressway - GREEN - Between N17 and N84	-		49,800	1.3%
	46	Realligned N84 - GREEN - South of Expressway Junction	-		21,800	1.3%
	47	Expressway - GREEN - New Corrib Crossing	-		32,000	1.8%
	48	Expressway - GREEN - Between Rahoon Rd and Letteragh Rd	-		32,400	1.2%
	49	Expressway - GREEN - Between Ballymoneen and Cappagh Road	-		18,000	0.8%
	50	Expressway - GREEN - @ Forramoyle	-		11,100	1.0%

Table 7.2.2.21 Yellow2 Route AADT 2034 Design Year

			DM - 2034		DS - YELLOW - 2034	
	AADT Point	Location	AADT	% HGV	AADT	% HGV
DM links	1	N6 South of Galway Airport	21,900	3%	37,000	2.2%
	2	R446 West of Oranmore Business Park	20,200	5%	21,400	5.0%
	3	R446 South of N6 Roundabout	14,400	3%	19,900	3.1%
	4	N6 South of Briarhill	31,100	3%	9,600	4.0%
	5	N6 Near Ballybrit Business park	37,000	4%	51,200	2.8%
	6	N6 between N17 and R865	32,000	3%	32,900	1.9%
	7	N6 Between N84 and N17	33,800	3%	29,000	2.2%
	8	N6 East of Quincentenary Bridge	29,900	5%	30,100	3.8%
	9	N6 - On Quincentenary Bridge	34,800	3%	25,800	3.3%
	10	R338 at Westside Playing fields	11,500	2%	5,800	2.7%
	11	Western Distributor Rd between Clybaun Rd and R338	12,800	1%	10,000	0.2%
	12	Western Distributor Rd between Clybaun Rd and Ballymoneen Rd	10,600	1%	5,700	0.2%
	13	R337 Kingston Road. Kingston	7,100	1%	4,300	0.9%
	14	R336. Salthill Road Upper. Galway Golf Course.	18,400	1%	16,400	0.5%
	15	R336. Barna Road. Barna Woods	16,600	1%	7,200	0.5%
	16	R336. Barna Road. Barna. Creagan bus stop	13,400	1%	5,800	0.5%
	17	R336. Barna Road. West of Barna. Garrynagry	11,400	1%	14,700	0.9%
	18	L1321. At Loughinch. South East of Bearna Golf Club	1,100	0%	1,700	0.4%
	19	Boleybeg Road. Between Cappagh Road and Ballymoneen Road	2,000	1%	400	2.8%
	20	Rahoon Road. Between Clybaun Rd and Bothar Stiofain	5,000	0%	6,300	0.4%
	21	N59. Thomas Hynes road. Between Hazel Park and Cherry Park	4,300	2%	3,300	1.0%
	22	N59. Upper Newcastle Road. Between R338 and Corrib Village	15,900	1%	15,600	0.9%
	23	N59. Barnacranny. Between chesnut Ln and Circular Rd	18,400	1%	19,600	0.7%
	24	N84. South of Ballindooly. Ballindooly Lough	10,600	2%	12,400	1.7%
	25	N84. North of Ballindooly	17,300	1%	16,700	1.3%
	26	N17. Tuam Road. NorthEast of Parkmore Road	19,300	2%	18,500	2.3%
	27	R338. Dublin Road. West of Junction with Coast Road.	13,500	5%	11,400	3.9%
	28	R338. Dublin road. Between Renmore Rd and M. Collins road	18,600	3%	18,400	2.6%
	29	R336. Tuam Road. Mervue Business Park	14,500	3%	14,500	2.5%
	30	Wolfe Tone Bridge	20,800	3%	17,200	2.2%
	31	O'Briens Bridge	9,100	2%	7,900	2.2%
	32	Salmon Weir Bridge	16,700	2%	14,400	2.1%
	33	N17. Tuam Road. NorthEast of School Road	14,900	2%	16,600	3.4%
	89	Eglington Street	7,800	3%	6,900	2.8%
	90	R336 South of Eyre Square	13,600	3%	11,700	1.6%
DS links	51	Expressway - YELLOW - Briarhill Junction	-		37,000	2.2%
	52	Expressway - YELLOW - South of Ballybrit Business Park	-		49,200	2.9%
	53	Expressway - YELLOW - Between N17 and R865	-		32,900	1.9%
	54	Expressway - YELLOW- Between N17 and N84	-		23,900	1.8%
	55	Expressway - YELLOW - New Corrib Crossing	-		39,500	1.6%
	56	Expressway - YELLOW - N59 Link Road	-		11,400	2.1%
	57	Expressway - YELLOW - Rahoon Link Road	-		18,700	1.6%
	58	Expressway - YELLOW - Between Ballymoneen and Cappagh Road	-		15,200	0.8%
	59	Expressway - YELLOW - @ Forramoyle	-		10,800	1.0%

Table 7.2.2.22 Orange2 Route AADT 2034 Design Year

			DM - 2034		DS - Orange - 2034	
	AADT Point	Location	AADT	% HGV	AADT	% HGV
DM links	1	N6 South of Galway Airport	21,900	3%	46,200	1.9%
	2	R446 West of Oranmore Business Park	20,200	5%	18,500	5.7%
	3	R446 South of N6 Roundabout	14,400	3%	20,300	3.9%
	4	N6 South of Briarhill	31,100	3%	10,500	4.3%
	5	N6 Near Ballybrit Business park	37,000	4%	68,000	2.8%
	6	N6 between N17 and R865	32,000	3%	54,300	2.3%
	7	N6 Between N84 and N17	33,800	3%	29,300	3.4%
	8	N6 East of Quincentenary Bridge	29,900	5%	35,500	4.1%
	9	N6 - On Quincentenary Bridge	34,800	3%	27,100	3.1%
	10	R338 at Westside Playing fields	11,500	2%	4,900	1.9%
	11	Western Distributor Rd between Clybaun Rd and R338	12,800	1%	10,000	0.2%
	12	Western Distributor Rd between Clybaun Rd and Ballymoneen Rd	10,600	1%	5,600	0.1%
	13	R337 Kingston Road. Kingston	7,100	1%	4,800	1.1%
	14	R336. Salthill Road Upper. Galway Golf Course.	18,400	1%	16,900	0.5%
	15	R336. Barna Road. Barna Woods	16,600	1%	9,000	0.7%
	16	R336. Barna Road. Barna. Creagan bus stop	13,400	1%	15,600	0.9%
	17	R336. Barna Road. West of Barna. Garrynagry	11,400	1%	13,800	1.0%
	18	L1321. At Loughinch. South East of Bearna Golf Club	1,100	0%	200	0.2%
	19	Boleybeg Road. Between Cappagh Road and Ballymoneen Road	2,000	1%	1,500	1.0%
	20	Rahoon Road. Between Clybaun Rd and Bothar Stiofain	5,000	0%	5,400	0.6%
	21	N59. Thomas Hynes road. Between Hazel Park and Cherry Park	4,300	2%	2,900	1.2%
	22	N59. Upper Newcastle Road. Between R338 and Corrib Village	15,900	1%	15,100	0.9%
	23	N59. Barnacranny. Between chesnut Ln and Circular Rd	18,400	1%	18,400	0.6%
	24	N84. South of Ballindooly. Ballindooly Lough	10,600	2%	14,000	1.7%
	25	N84. North of Ballindooly	17,300	1%	17,000	1.4%
	26	N17. Tuam Road. NorthEast of Parkmore Road	19,300	2%	17,100	2.4%
	27	R338. Dublin Road. West of Junction with Coast Road.	13,500	5%	9,000	3.1%
	28	R338. Dublin road. Between Renmore Rd and M. Collins road	18,600	3%	18,500	1.7%
	29	R336. Tuam Road. Mervue Business Park	14,500	3%	11,000	2.4%
	30	Wolfe Tone Bridge	20,800	3%	16,600	2.2%
	31	O'Briens Bridge	9,100	2%	7,800	2.2%
	32	Salmon Weir Bridge	16,700	2%	15,000	1.9%
	33	N17. Tuam Road. NorthEast of School Road	14,900	2%	14,000	3.5%
	89	Eglington Street	7,800	3%	5,300	3.3%
	90	R336 South of Eyre Square	13,600	3%	13,200	1.6%
DS links	34	Expressway - ORANGE - Briarhill Junction	-		46,200	1.9%
	35	Expressway - ORANGE - South of Ballybrit Business Park	-		62,400	2.9%
	36	Expressway - ORANGE - Between N17 and R865	-		54,300	2.3%
	37	Expressway - ORANGE - Between N17 and N84	-		71,200	2.2%
	38	Expressway - ORANGE - New Corrib Crossing	-		35,700	1.9%
	39	Expressway - ORANGE - N59 Link Road	-		8,300	2.0%
	40	Expressway - ORANGE - Rahoon Link Road	-		19,100	2.2%
	41	Expressway - ORANGE - Between Ballymoneen and Cappagh Road	-		12,700	0.8%
	42	Expressway - ORANGE - At Junction with R336	-		11,300	0.8%

Table 7.2.2.23 Pink2 Route AADT 2034 Design Year

			DM - 2034		DS - PINK - 2034	
	AADT Point	Location	AADT	% HGV	AADT	% HGV
DM links	1	N6 South of Galway Airport	21,900	2.9%	31,800	2.3%
	2	R446 West of Oranmore Business Park	20,200	4.9%	25,900	4.0%
	3	R446 South of N6 Roundabout	14,400	3.3%	31,100	2.8%
	4	N6 South of Briarhill	31,100	2.8%	30,700	3.2%
	5	N6 Near Ballybrit Business park	37,000	4.5%	29,800	4.2%
	6	N6 between N17 and R865	32,000	3.0%	26,000	2.6%
	7	N6 Between N84 and N17	33,800	2.8%	21,500	3.0%
	8	N6 East of Quincentenary Bridge	29,900	4.7%	32,400	3.9%
	9	N6 - On Quincentenary Bridge	34,800	3.3%	28,900	2.7%
	10	R338 at Westside Playing fields	11,500	2.5%	5,500	2.0%
	11	Western Distributor Rd between Clybaun Rd and R338	12,800	0.8%	9,900	0.2%
	12	Western Distributor Rd between Clybaun Rd and Ballymoneen Rd	10,600	0.7%	5,800	0.2%
	13	R337 Kingston Road. Kingston	7,100	1.4%	5,000	1.4%
	14	R336. Salthill Road Upper. Galway Golf Course.	18,400	0.7%	17,300	0.5%
	15	R336. Barna Road. Barna Woods	16,600	0.9%	9,600	0.8%
	16	R336. Barna Road. Barna. Creagan bus stop	13,400	1.0%	6,800	0.9%
	17	R336. Barna Road. West of Barna. Garrynagry	11,400	1.2%	13,400	1.0%
	18	L1321. At Loughinch. South East of Bearna Golf Club	1,100	0.1%	1,200	0.4%
	19	Boleybeg Road. Between Cappagh Road and Ballymoneen Road	2,000	0.8%	500	2.2%
	20	Rahoon Road. Between Clybaun Rd and Bothar Stiofain	5,000	0.4%	4,000	0.5%
	21	N59. Thomas Hynes road. Between Hazel Park and Cherry Park	4,300	1.7%	3,000	1.0%
	22	N59. Upper Newcastle Road. Between R338 and Corrib Village	15,900	1.4%	15,300	0.8%
	23	N59. Barnacranny. Between chesnut Ln and Circular Rd	18,400	1.3%	19,600	0.7%
	24	N84. South of Ballindooly. Ballindooly Lough	10,600	2.1%	18,100	1.5%
	25	N84. North of Ballindooly	17,300	1.3%	18,500	1.4%
	26	N17. Tuam Road. NorthEast of Parkmore Road	19,300	1.6%	20,300	2.0%
	27	R338. Dublin Road. West of Junction with Coast Road.	13,500	4.5%	9,800	3.3%
	28	R338. Dublin road. Between Renmore Rd and M. Collins road	18,600	3.3%	18,400	1.9%
	29	R336. Tuam Road. Mervue Business Park	14,500	2.6%	13,500	2.3%
	30	Wolfe Tone Bridge	20,800	2.6%	17,300	2.2%
	31	O'Briens Bridge	9,100	1.9%	7,800	2.2%
	32	Salmon Weir Bridge	16,700	1.7%	15,000	2.1%
	33	N17. Tuam Road. NorthEast of School Road	14,900	2.0%	17,700	2.0%
	89	Eglington Street	7,800	2.6%	6,500	3.0%
	90	R336 South of Eyre Square	13,600	2.5%	13,000	1.6%
DS links	70	Expressway - PINK - Briarhill Junction	-		31,800	2.3%
	71	Expressway - PINK - Parkmore	-		28,300	1.6%
	72	Expressway - PINK - Between N17 and N84	-		51,400	1.7%
	73	Expressway - PINK - New Corrib Crossing	-		35,500	2.0%
	74	Expressway - PINK - N59 Link Road	-		11,700	2.0%
	75	Expressway - PINK - Rahoon Link Road	-		19,400	2.1%
	76	Expressway - PINK - Between Ballymoneen and Cappagh Road	-		11,200	0.8%
	77	Expressway - PINK - @ Ballard	-		11,200	0.8%
	78	Expressway - PINK - Junction with new Bearna Link Road	-		10,300	0.8%
	79	New Bearna Link Road - PINK - North of R336	-		11,500	0.8%

For Section 1, the impact of the various options on the through traffic on the R336 through Bearna village was assessed. In particular the AADT for the 2034 year traffic at Creagán Bus Stop was assessed and compared to the Do-Minimum scenario for 2034. The route option that reduces the level of traffic through Bearna Village most effectively has been deemed the preferred route option and the option with the highest level of traffic retained through the village has been ranked least preferable.

Table 7.2.2.24 Traffic Assessment – Section 1

Route Option	Assessment
Red2	LP
Orange2	LP
Yellow2	I
Blue2	P
Pink2	P
Green2	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

In Section 1, the Blue2 and Pink2 Route Options provide the greatest relief to Bearna village, and are most preferred. The Red2/Orange2 Route Option offers the least benefit to Bearna Village and is therefore the least preferred in Section 1.

For Section 2, a number of performance indicators have been assessed under the heading of traffic. One of the key project objectives was to provide congestion relief to the city of Galway. To assess the effect of the options relative to one another, an assessment of the volume to capacity ratios (V/C) for a number of existing junctions was carried out. Similar to Section 1, this was carried out using the 2034 year traffic models.

A number of key junctions which are spread throughout the city were identified for the assessment. These are listed in alphabetic order as follows: Bodkin Junction, Briarhill Junction, Browne Junction, Cemetery Cross, Deane Roundabout, Headford Road/Dyke Road/St Brendan's Avenue Junction, Kirwan Roundabout, Moneenageisha Junction, Tuam Road Junction and UCHG main entrance on Newcastle Road. The greatest improvement in V/C ratio for the junctions has been ranked as the most preferred, and the least improvement is the least preferred.

In addition another performance indicator assessed is the overall reduction in traffic over the existing four city centre bridges, namely Quincentenary Bridge, Salmon Weir Bridge, O'Brien's Bridge and Wolfe Tone Bridge. The reduction in traffic was also considered in key pedestrian zones, namely Eglinton Street and the south side of Eyre Square. These figures were compared to the Do-Minimum scenario for 2034 refer to **Chapter 3**. This would also indicate whether an option has a positive or negative impact on the volumes of traffic within the city centre crossing the River Corrib. The highest relief provided by a route option is the most preferred, and the route option providing the lowest level of relief is the least preferred.

The overall attractiveness of each route option was also considered. This was carried out by assessing the AADT figures on the River Corrib crossing point of each route option. The greater the AADT figures, the greater the draw to that route option. A summary of the overall assessments is provided in the table below.

Table 7.2.2.25 Traffic Assessment – Section 2

Route Option	Relief to Key City Centre Junctions	Relief to City Centre Bridge Crossings	Attractiveness of Option	Overall Assessment
Red2	P	P	P	P
Orange2	LP	I	I	I
Yellow2	LP	I	I	I
Blue2	I	I	I	I
Pink2	I	I	I	I
Green2	I	LP	LP	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred

The most preferred route option for Section 2 in terms of traffic is the Red2 Route Option. This provides the highest level of congestion relief to the city centre and also draws the highest level of traffic onto the route and away from the existing infrastructure. The Green2 Route Option is the least preferred in terms of traffic.

7.2.2.9 Overall Engineering Assessment

The above assessment criteria under each of the sub-headings for engineering have been summarised below for Sections 1 and 2 respectively. An average ranking score for each of the route options has been determined based on the criteria rankings and is also shown below.

Table 7.2.2.26 Engineering Summary – Section 1

Route Option	Geometry	Length	Junctions	Structures	Earthworks	Constructability	Traffic	Overall Assessment
Red2	I	P	P	I	LP	P	LP	P
Orange2	I	P	P	I	LP	P	LP	P
Yellow2	LP	LP	LP	P	P	I	I	I
Blue2	LP	I	LP	I	P	LP	P	LP
Pink2	LP	I	LP	P	I	LP	P	LP
Green2	P	I	I	LP	LP	I	I	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

Table 7.2.2.27 Engineering Summary – Section 2

Route Option	Geometry	Length	Junctions	Structures	Earthworks	Constructability	Traffic	Overall Assessment
Red2	LP	I	I	LP	LP	LP	P	LP
Orange2	I	P	LP	LP	LP	LP	I	LP
Yellow2	I	I	LP	P	I	I	I	I
Blue2	I	I	I	I	I	P	I	I
Pink2	I	I	I	I	P	P	I	P
Green2	P	LP	P	I	I	P	LP	P

Note: P = Preferred, I = Intermediate, LP = Least Preferred

From an engineering perspective, the most preferred route option in Section 1 is the Red2 and Orange2 Route Options. The Yellow2 Route Option in Section 1, to the west of the Galway City boundary, is the least preferred of the route options from an engineering perspective.

From an engineering perspective, the most preferred route options in Section 2 are the Green2 and Pink2 Route Options. The Red2 and Orange2 Route Options are least preferred from an engineering perspective.

7.2.2.10 Section 3 Assessment

The junction layouts for each of the route options at the N6 tie-in are shown on **Figures 7.2.2** to **7.2.5**. The Red2, Orange2, Blue2 and Yellow2 Route Option junctions all comprise a grade separated junction with signals at the ends of the ramps. These signalised junctions connect to the existing road network, either Parkmore Road/Monivea Road or the existing N6, via a short section of dual carriageway. These signalised junctions and sections of dual carriageway are extremely heavily trafficked.

The Pink2 Route Option Junction is a free-flow grade separated junction at the confluence of the proposed Pink2 Route Option, the existing N6 and the M6/N6. This junction provides much higher capacity than the Red2, Orange2, Blue2 and Yellow2 Route Option Junctions.

The Green2 Route Option Junction is located further east along the N6/M6 link with connectivity to the existing N6 provided along the existing N6.

From an engineering perspective, the Red2, Orange2, Blue2 and Yellow2 Route Option Junctions are less preferable due to the capacity constraints.

The Green2 Route Option is disparate from the existing road network and therefore has spare capacity. It does not interconnect with the existing N6 movements as successfully as the Pink2 Route Option due to the fact that it is located approximately 1.2km east of the existing N6 between Briarhill Junction and Coolagh Roundabout. The Pink2 Route Option provides all of the connectivity with the existing N6 and the existing motorway, with full provision for all movements.

The movements are free flow slip lanes and therefore are not subject to delay due to signals.

The preferred junction arrangement at the N6 tie-in is the Pink2 Route Option as the convergence of all movements at this single junction occurs in an area where the existing N6 already dominates the landscape, which in turn reduces the impacts to the receiving environment at Coolagh Village. It also provides a clear terminus to the western end of the M6.

7.2.2.11 Overview of Key Features

Following on from the engineering assessment, an overview summary of the features which are quantified in each route option is provided below.

Table 7.2.2.28 Red2 Route Option

Item	Quantity / Unit
Residential Demolitions	94
Commercial Demolitions	19
Widening and addition of bus lanes on Western Distributor Road	2km
Grade Separated Junction Western Distributor Road	1
Cut and Cover tunnel Western Distributor Road to N59	1.3km
N59 Grade Separated Junction	1
Corrib River Bridge	0.14km
Terryland Shopping Centre Grade Separated Junction	1
Terryland Viaduct	1.2km
N84 Grade Separated Junction	1
N17 Grade Separated Junction	1
Cut and Parallel Road between N17 Grade Separated Junction and City East Business Park Grade Separated Junction	1km
City East Business Park Grade Separated Junction	1
Widening - City East Business Park to Briarhill Grade Separated Junction	1.3km
Cut and Cover Tunnel in area of Briarhill to accommodate Construction	0.5km
Briarhill Grade Separated Junction	1

Table 7.2.2.29 Orange2 Route Option

Item	Quantity / Unit
Residential Demolitions	53
Commercial Demolitions	9
N59 Grade Separated Junction	1
Bored Tunnel	3.5km
N84 Tri Level Grade Separated Junction	1
N17 Grade Separated Junction	1
Cut and Parallel Road between N17 Grade Separated Junction and City East Business Park Grade Separated Junction	1km
City East Business Park Grade Separated Junction	1
Widening - City East Business Park to Briarhill Grade Separated Junction	1.3km
Cut and Cover Tunnel in area of Briarhill to accommodate Construction	0.5km
Briarhill Grade Separated Junction	1

Table 7.2.2.30 Yellow2 Route Option

Item	Quantity / Unit
Residential Demolitions	106
Commercial Demolitions	11
N59 Grade Separated Junction	1
NUIG Viaduct	0.55km
River Corrib Crossing	0.25km
cSAC Viaduct	0.8km
N84 Grade Separated Junction	1
N17 Grade Separated Junction	1
Cut and Parallel Road between N17 Grade Separated Junction and City East Business Park Grade Separated Junction	1km
City East Business Park Grade Separated Junction	1
Widening City East Business Park to Briarhill Grade Separated Junction	1.3km
Cut and Cover Tunnel in area of Briarhill to accommodate Construction	0.5km
Briarhill Grade Separated Junction	1

Table 7.2.2.31 Blue2 Route Option

Item	Quantity / Unit
Residential Demolitions	54
Commercial Demolitions	6
N59 Grade Separated Junction	1
NUIG Viaduct	0.55km
River Corrib Crossing	0.25km
cSAC Viaduct	0.4km
cSAC Roadheader Tunnel	0.5km
N84 Grade Separated Junction	1
N17 Grade Separated Junction	1
Cut and Cover Tunnel Galway Racecourse	0.85km
Cut and Cover Tunnel Briarhill	0.4km
Grade Separated Junction Briarhill	1

Table 7.2.2.32 Pink2 Route Option

Item	Quantity / Unit
Residential Demolitions	46
Commercial Demolitions	6
N59 Grade Separated Junction	1
NUIG Viaduct	0.55km
River Corrib Crossing	0.25km
cSAC Viaduct	0.4km
cSAC Roadheader Tunnel	0.5km
N84 Grade Separated Junction	1
N17 Grade Separated Junction	1
Cut and Cover Tunnel Galway Racecourse Business Park	0.85km
Cut and Cover Tunnel Briarhill (car garage and crossing R339)	0.25km
Grade Separated Junction Briarhill	1

Table 7.2.2.33 Green2 Route Option

Item	Quantity / Unit
Residential Demolitions	76
Commercial Demolitions	10
N59 Grade Separated Junction	1
River Corrib Crossing	0.55km
Menlough Area Viaduct	0.2km
Ballindooley Viaduct	0.45km
N84 Grade Separated Junction	1
Roadstone Quarry Viaduct	0.25km
N17 Grade Separated Junction	1
Cut and Cover Tunnel Galway Racecourse Business Park	0.85km
N6 Grade Separated Junction	1

An indication of the mainline length from the R336 west of the city to the N6 east of the city for each route option is given below.

Table 7.2.2.34 Mainline Length

Route Option	West of River Corrib (km)	East of River Corrib (km)	Total Length (km)
Red2	7+900	7+200	15+100
Orange2	7+900	7+000	14+900
Yellow2	9+400	7+800	17+200
Blue2*	7+800	7+900	15+700
Pink2*	7+800	7+900	15+700
Green2	9+500	10+600	20+100

**Length of Blue2 and Pink2 Options is measured from the Bearna Inner Relief Road*

7.2.3 Option Cost Estimates

Section 6.6 of this report outlines the methodology used to calculate the Option Cost Estimates for each route option in Stage 1. The same methodology was used for the Stage 2 Option Cost Estimates.

All options examined within Stage 1 were brought forward for Stage 2 assessment. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options. The options reviewed and examined as part of the Stage 2 Economy Appraisal were therefore, as follows:

- Red2 Route Option;
- Orange2 Route Option;
- Yellow2 Route Option;

- Blue2 Route Option;
- Pink2 Route Option; and
- Green2 Route Option.

Detailed descriptions of each route option are provided in **Section 6.1. Table 7.2.2.18** to **Table 7.2.2.23** above summarise the key features of each route option. Details of the amendments and alterations made to the route options between Stage 1 and Stage 2 are provided in **Section 7.2.**

The Stage 2 Option Cost Estimates are detailed below.

Table 7.2.2.35 Stage 2 Option Comparison Estimates

Route Option	Total (millions) Incl. VAT
Red2	€714
Orange2	€859
Yellow2	€436
Blue2	€509
Pink2	€499
Green2	€509

The Stage 2 Option Cost Estimates were agreed with the NRA Cost Estimation Unit.

7.2.4 Cost Benefit Analysis

A Cost Benefit Analysis was undertaken for each route option in accordance with the NRA Project Appraisal Guidelines and is included in **Appendix A.7.2** of this report.

The Cost Benefit Analysis report sets out the economic assessment undertaken as part of the route selection stage of the N6 Galway City Transport Project. At route selection stage, the benefits and costs of the proposed scheme are assessed using agreed traffic growth scenarios. The "Do-Minimum" scenario (i.e. not to progress with the scheme) is compared with a number of "Do-Something" scenarios (i.e. the scheme options) which determines whether benefits resulting from each scheme option will outweigh the costs of construction and future maintenance.

All general parameters such as value of time, value of time growth rates, discount rates, fuel cost changes, fuel consumption, vehicle operating costs fuel / non-fuel, trip purpose distribution, tax rates, change in tax rates, vehicle occupancy rates, vehicle proportions and collision rates were taken from the NRA Project Appraisal Guidelines. Fuel efficiency was taken from UK WebTAG guidance as no guidance is currently available in Ireland. Fleet fuel type proportions were available from the Department of Environment.

Costs were represented in 2009 prices and values exclusive of VAT are used in the CBA appraisal.

For major transport schemes, residual value is a measure of the net present value of the infrastructure over a specified period beyond the 30-year appraisal period. No residual value period has been included in the appraisal results at route selection stage, therefore the standard 30-year appraisal period has been applied for all scheme options.

Table 7.2.2.36 summarises the ranking of the benefit cost ratios for each of the Stage 2 Options. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options.

Table 7.2.2.36 Cost Benefit Analysis RankingTable

Route Option	Overall Ranking
Red2	**I**
Orange2	**LP**
Yellow2	**P**
Blue2	**P**
Pink2	**P**
Green2	**P**

Note: P = Preferred, I = Intermediate, LP = Least Preferred

The Stage 2 engineering assessment of each route option has been detailed above in order to fully understand the output from the cost estimates and the cost benefit analysis. As noted earlier, factors such as route option length and significant structures impact on the overall costs, whilst factors such as traffic volumes, junction connectivity and delay contribute significantly to the estimation of the benefits of the scheme, and it is the relationship of the costs of the route option to the benefits of the route options that define the economic appraisal of the route option. Therefore, the summary table of the ranking of the cost benefit analysis is carried forward as the conclusion of the appraisal of the Stage 2 Route Options under the Economy criterion as it is representative of the accumulation of the contributing factors to the economic appraisal.

7.3 Summary of Safety Appraisal

An independent road safety audit was undertaken for each route option in accordance with *NRA HD 19 (Road Safety Audit)*. This audit compares the route options in terms of road safety. A number of criteria were used to assess the route options such as route length, collision risk, travel time, access control, extents of structures, geometry, attractiveness, consistency and vulnerable road user provision. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options. Based on these criteria, the Pink2 Route Option was preferred with the Blue2 and Green2 Route Options also demonstrating high safety benefits. The Yellow2 and Orange2 Route Options were less preferable and the Red2 Route Option is least preferred.

In terms of an economic assessment of the safety benefits, all route options will deliver safety benefits as all options are forecast to deliver significant safety benefits to the network as a result of transferring high levels of traffic on to newer, safer roads. The on-line and partial on-line options such as the Red2, Yellow2 and Orange2 Route Options have the highest level of traffic transferred on to newer, safer roads. These route options will demonstrate a higher economic value of safety

benefits than the Blue2, Pink2 and Green2 Route Options when the transfer of traffic is considered in isolation. However, this transfer of traffic to new network also facilitates reallocation of road space on the existing network which is not assessed as part of the economic assessment of the safety benefits at this stage of the design.

Therefore, the route options are ranked equal from a safety perspective at this time as all route options have the potential to deliver significant safety benefits as a result of transferring high levels of traffic on to newer, safer roads.

The Stage F Road Safety Audit is appended to this report in **Appendix A.7.3** Road Safety Audit Stage F Report (Part 1) and **Appendix A.8.2** Road Safety Audit Stage F Report (Part 2).

7.4 Summary of Accessibility and Social Inclusion Appraisal

Accessibility and Social Inclusion seeks to improve facilities for those without a car and to reduce access severance. The guidelines indicate that transport appraisals should assess the impacts of a road on vulnerable groups and deprived geographic areas.

The Do-Nothing and Do-Minimum options will allow traffic to continue to increase on the existing network and will stifle the possibility of any improvements to the public transport options as capacity will be restricted. Therefore, these options will not offer any possibility of improving the modal shift to public transport and do not facilitate those without access to a private vehicle.

All of the route options seek to resolve the transportation issues in Galway which will free capacity for further improvements to the public transport network, which in turn will remove traffic from the city streets. This will allow improvement of the streetscapes to enable workers/school children to commute by walking and cycling, thereby reducing the very high percentage of short commutes by providing a safe environment for such a change in behaviour.

Therefore all of the route options will facilitate the provision of improved public transport to a much greater extent of Galway by alleviating congestion and freeing capacity, all of which are not provided by the Do-Nothing and Do-Minimum.

7.5 Summary of Integration Appraisal

All decisions must align with Government policy to ensure that the project is in line with land use integration, geographical integration and other Government policies. Options which provide resolution of the transportation issues in Galway must be compatible with the Government's objectives in the National, Regional and Local policy documents.

Transport integration aims to provide improved road linkages between key centres, improved connectivity between roads and other modes, improved public transport, and improved access to other transport infrastructure such as ports and airports. All of the route options have the potential to improve public transport by providing faster and more reliable routes, both at the higher level to connect Galway City with the other major cities and locally by relieving capacity for the further provision of

local bus services. This is in line with National Spatial Strategy 2002 which outlines the need for improvement of Ireland's transport networks in order to improve regional accessibility and development. This in turn will support balanced regional development by revitalising these areas of the West.

The National Development Plan also supports development of all regions in Ireland within a co-ordinated, coherent and mutually beneficial framework with balanced regional development central to the investment strategy of the Plan. This is reinforced in the Regional Planning Guidelines.

Galway County Development Plan and City Development Plan seek to provide better connections to the trans-national network, relieve areas of congestion, provide multi-modal choice of travel and improve safety levels on all public roads, all of which bring markets closer together and serve to close the regional periphery gap.

Therefore all of the route options will improve integration in Galway by alleviating congestion and freeing capacity, all of which are not provided by the 'Do-Nothing' and 'Do-Minimum'.

7.6 Summary of Environmental Appraisal

7.6.1 Ecology

7.6.1.1 Introduction

This section details the Stage 2 assessment of the route options with respect to the ecological constraints identified in **Section 4.3 Ecology** of this report. The route options, as described in **Section 7.1** with the ecological constraints, are presented in **Figures 7.6.1.1** to **7.6.1.18**. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options.

Section 7.6.1.2 outlines the methodology that was used to carry out the study and **Section 7.6.1.3** details the options assessment. A summary is presented in **Section 7.6.1.4** and references are listed in **Section 7.6.1.5**.

A report assessing theses route options against the requirements of Article 6(3) of the Habitats Directive 92/43/EEC is included in **Appendix A.7.4.**

7.6.1.2 Methodology

The assessment of each route option, with respect to the ecological environment, was based on the alignments described in **Section 7.1** and presented on **Figures 7.6.1.1** to **7.6.1.18**.

Each route option was assessed with regard to the potential impacts likely to occur in relation to the identified key ecological receptors, as outlined below, where they were either confirmed or likely to occur within the overall scheme study area, and were deemed to be potentially at risk of impact from individual route options (discounting receptors where the risk of significant impacts is unlikely considering where the delivery of standard mitigation and best practice during construction is unequivocal and success is highly likely):

- Designated areas for nature conservation (Lough Corrib cSAC/SPA/pNHA, Galway Bay Complex cSAC/pNHA, Inner Galway Bay SPA, and Moycullen Bogs NHA) and their Qualifying Interests (QIs) or Special Conservation Interests (SCIs) in the case of European sites;[1]
- Ecological Sites (see **Chapter 4 Section 4.3**);
- Known or likely breeding places and, in some cases, broad habitat requirements, of Habitats Directive Annex II/IV species (e.g. Otter[2], Lesser horseshoe bat[3], Freshwater pearl mussel, Marsh fritillary butterfly);
- Known or likely breeding and roost sites of certain Birds Directive Annex I species (e.g. Hen harrier, Peregrine falcon);
- Known or likely breeding and roost sites of certain red-listed Birds of Conservation Concern species (e.g. Barn owl, Red grouse) and other raptors;

[1] Each route option was assessed against the requirements of Article 6(3) of the EU Habitats Directive 92/43/EEC. This assessment is provided in Appendix A.7.4.
[2] Otter habitat as defined in the *Threat Response Plan: Otter (2009-2011)* document (NPWS, 2009)
[3] In the case of this species, known non-breeding sites were also included.

- Known important or sensitive wintering bird sites; and
- Known locations of Flora (Protection) Order, 1999 species (*e.g.* Slender Cottongrass *Eriophorum gracile*, Small-white Orchid *Pseudorchis albida*, Chives *Allium schoenoprasum*).

These ecological receptors were chosen based on the following criteria: habitats or species protected at a national or European level, of a high conservation value/concern at these levels, and, were considered particularly vulnerable to significant negative impacts from road development. Where potentially significant, the likelihood for impacts to occur to other sensitive ecological receptors is also discussed in **Section 7.6.1.3** below.

The terminology used when describing impact significance is per *Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)* (Environmental Protection Agency, 2003).

In accordance with the *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (National Roads Authority, 2009), the levels of impact assigned to particular route options make the assumption that general mitigation measures will be implemented (i.e. where delivery is unequivocal and success is highly likely).

In ranking the route options, the highest weighting was given to potential impacts on European protected sites, particularly in relation to the Annex I habitats and Annex II species which are listed as Qualifying Interests (QIs) of affected European sites. In assessing the potential impacts on Lough Corrib cSAC, the habitat classifications described are based on the results of the habitat surveys carried out in 2013 and 2014. A high weighting was also given to potential impacts on nationally-designated sites (e.g. Moycullen Bogs NHA).

Route options are ranked with respect to their impacts on the ecological environment as follows: Preferred (P), Intermediate (I), and Least Preferred (LP). These terms are used to comparatively assess route options in either Section 1, Section 2 or Section 3 and should not be interpreted to compare the significance of impacts between those sections – i.e. by virtue of the fact that route options in Section 2 cross a European site whereas in Section 1 they do not, the LP route option(s) in Section 2 is likely to have a much greater impact on the ecological environment than the LP route option(s) in Sections 1 or 3.

The habitat areas calculated within the Lough Corrib cSAC boundary are based upon the intersection of the proposed route option alignments provided and the digital designated area boundaries downloaded from the NPWS website (revision 15/01/2015, downloaded in March 2015), and on an interpretation of the legal boundary, from the official Department of Arts, Heritage and the Gaeltacht boundary maps for Lough Corrib cSAC: Sheets (082a and 082c)[4].

The nomenclature used below when referring to Annex I habitat types follows that of the *Interpretation Manual of European Union Habitats EUR28* (CEC, 2013) or, where shortened forms of the Annex I habitat titles are used, *The Status of EU Protected Habitats and Species in Ireland 2013* (NPWS, 2013).

[4] The current versions of the digital designated area boundaries that can be downloaded from the NPWS website do not always accurately represent the legally defined boundaries, as shown on the official Department of Arts, Heritage and the Gaeltacht boundary maps, as they relate to features on the ground such as field boundaries, road margins etc. This is on account of the scale difference between the 6-inch maps used to originally define the European site boundaries and current larger scale vector mapping/orthophotography.

7.6.1.3 Route Option Assessment

Locations of the various ecological constraints discussed below, relative to the route options, are shown on **Figures 7.6.1.1** to **7.6.1.18**.

Section 1

Based on the findings of the desk review and field surveys, none of the route options in Section 1 are likely to result in any significant adverse impacts to designated areas for nature conservation, rare or protected plant species, Red grouse, Barn owl, or other raptor species.

None of the route options in this Section directly impact any designated areas for nature conservation; the nearest designated areas are Galway Bay Complex cSAC/pNHA (*c*.140m south of the nearest route option, Yellow2) and Moycullen Bogs NHA (*c*.160m to the west of the nearest route option, Yellow2). As all route option are remote from Galway Bay Complex cSAC/pNHA and Inner Galway Bay SPA (and separated from the coastline by the existing R336), significant disturbance or displacement effects are unlikely with respect to QI species of the cSAC (e.g. Otter and the Common seal) or SCI bird species of the SPA (e.g. wintering coastal waders and tern species). With best practice methodologies applied during construction, none of the route options are likely to result in any significant indirect impacts to the designated areas, or adversely affect the integrity of any European sites, along the coastline as a result of a reduction in water quality in the River Corrib or the estuary/bay downstream.

There were records for Chives *Allium schoenoprasum* – a plant species protected under the Flora (Protection) Order, 1999 – from the An Léana Riabhach/Bearna Woods area. However, none of the known locations of this species are directly impacted by any of the route options.

There were no records of Red grouse from any of the survey sites impacted by the route options. The nearest records are from an area of heath and bog west of Lough Inch; *c*.700m from the closest route options (Green2 and Yellow2 Route Options).

There are also no Barn owl nest or roost sites in this section (the closest nest site is almost 6km to the east) and no other known raptor nest/roost sites are likely to be affected by route options in Section 1.

Therefore, since these ecological receptors are not likely to be affected by the route options in Section 1, they did not influence the ranking of the route options and are not discussed below under the individual route option assessments.

All route options will result in the severance of Marsh fritillary breeding sites/suitable breeding habitat from the main metapopulation (i.e. satellite or remote sites, on the fringes of the species distribution locally, are being fragmented from the main clusters of breeding sites). The effects of this are unlikely to be significant at a population level and therefore, the discussion below in relation to this species focuses on habitat loss impacts.

Red2 and Orange2 Route Options

Both of these route options follow the same path within Section 1 and are therefore discussed together below.

The Red2 and Orange2 Route Options impact on a small part (*c*.50m^2) of Annex I habitat, within a habitat block comprised of a mosaic of bracken, scrub, heath and exposed rock. Although this habitat block does support Dry heath [4030], the actual cover of this habitat was estimated to be less than 10% and therefore the area of Annex I habitat actually impacted may be much less. These route options would also result in the least amount of habitat loss, in terms of area, of local importance (higher value) habitats when compared with the other route options.

Similar to the other route options in Section 1, at their eastern ends, these route options are *c*.1km from two Lesser horseshoe bat roosts, two Whiskered bat roosts, and two Leisler's bat roosts. At this distance from roost sites, there is the potential for significant negative impacts to result from habitat loss, severance, and displacement associated with the construction and operation of a road development. When compared against the Green2 and Yellow2 Route Options, the potential impacts of these route options are likely to be of a lesser magnitude, along with the Blue2 and Pink2 Route Options, given their shorter length[6].

The Red2 and Orange2 Route Options only cross one watercourse[7]; fewer than any of the other route options. In terms of impacts to fisheries and Otter habitat, the potential for significant impacts is much reduced for the Red2 and Orange2 Route Options when compared with the other route options which cross multiple watercourses; with some requiring major realignment of the watercourse channels. No significant impacts are predicted in relation to wintering birds. Significant impacts to the local Marsh fritillary population, either through habitat loss or displacement, are also unlikely as areas of suitable habitat, and areas of confirmed breeding habitat, are avoided.

These route options have the lowest impact on terrestrial habitats, aquatic habitats and species, and avoid wintering bird sites, and avoid habitat areas that either support Marsh fritillary breeding populations or contains suitable habitat for the species. The Red2 and Orange2 Route Options are therefore the preferred route options from an ecological perspective in Section 1.

Yellow2 Route Option

The Yellow2 Route Option will result in the loss of *c*.2.71ha of Annex I habitat within the Ecological Sites (EC05, EC09, EC11, EC12, EC14, and EC18); predominantly Dry heath [4030] but also areas of Wet heath [4010] and Molinia meadow [6410]. Along with the Green2 Route Option, the Yellow2 Route Option would also result in a greater loss of local importance (higher value) habitats when compared with Red2, Orange2, Blue2 and Pink2 Route Options.

At its eastern end, the Yellow2 Route Option in this section is *c*.1km from two Lesser horseshoe bat roosts, two Whiskered bat roosts and two Leisler's roosts. At this distance from roost sites, there is the potential for significant negative impacts to result from habitat loss, severance, and displacement associated with the

[6] In Section 1, the lengths of the route options are as follows: Red/Orange 2,290m, Yellow 4,171m, Blue 3,571m, Pink 3,151m, and Green 3,935m.
[7] Based on a review of Ordnance Survey Ireland's 1:50,000 Discovery Series mapping and the Environmental Protection Agencies watercourses database (http://gis.epa.ie/Envision, accessed March 2015)

construction and operation of a road development. Potentially of a greater magnitude for this route option, along with Green2 Route Option, given their longer length and that they are further removed from the urban centre of Bearna Village.

The Yellow2 Route Option crosses the Trusky Stream, Liberty Stream, and the Bearna Stream; some of which may require realignments of sections of those streams. This may result in the loss of a significant linear length of potential fisheries and Otter habitat (e.g. *c.*170m of An Sruthán Dubh, a tributary of the Bearna Stream).

This route option will result in the loss of confirmed Marsh fritillary breeding habitat at three locations; Cnoc na Gréine, An Chloch Scoilte, and at Ballard. It will also result in the loss of areas of suitable habitat for the species and passes through the margins of an upland site which supports Red and Amber listed wintering birds[8], and wintering bird species listed as qualifying interests of Inner Galway Bay SPA (Ecological Site EC14 and winter bird survey site WB07).

The Yellow2 Route Option has the greatest impact on Annex I habitats. There is also the potential for significant impacts to aquatic habitats and species with multiple crossings of the Trusky Stream and Liberty Stream and the associated loss of fisheries and Otter habitat; albeit without the significant stream realignments that are associated with Blue2, Pink2 and Green2 Route Options. Given their greater length, the impacts on the local bat population are potentially more significant for the Green2 and Yellow2 Route Options when compared with the other route options. The Yellow2 Route Option will also result in the loss of confirmed Marsh fritillary breeding habitat at three locations; more than any of the other route options. The Yellow2 Route Option is therefore the least preferred route option from an ecological perspective in Section 1.

Blue2 Route Option

The Blue2 Route Option will result in the loss of *c.*0.35ha of Annex I habitat in Ecological Site EC18; two patches of Dry heath [4030]. This is a greater impact than Red2 or Orange2 Route Options but less than that associated with Pink2, Green2 and Yellow2 Route Options.

The Blue2 Route Option is *c.*1km from two Lesser horseshoe bat roosts, two Whiskered bat roosts, and two Leisler's bat roosts. At this distance from roost sites, there is the potential for significant negative impacts to result from habitat loss, severance, and displacement associated with the construction and operation of a road development. Although this route option is longer in length than the Red2 and Orange2 Route Options, that portion of the Blue2 Route Option which is removed from Bearna Village is similar to Red2 and Orange2 Route Options, and the potential for impacts in this regard are likely to be comparable – i.e. the potential for impacts is likely to be less than that associated with the longer Green2 and Yellow2 Route Options.

This route option crosses the main channel of the Trusky Stream at two locations, and will likely require significant realignments of the stream (*c.*400m), and also crosses the Bearna Stream. On the Trusky Stream, this will result in the loss of a significant linear length of potential fisheries and Otter habitat.

[8] From Birds of Conservation Concern in Ireland (Colhoun & Cummins, 2013)

This route option will result in the loss of an area of suitable Marsh fritillary habitat; although this area did not support breeding colonies in 2014. It also passes through the margins of an upland site which supports Red and Amber listed wintering birds (Ecological Site EC17 and winter bird survey site WB05).

After Red2 and Orange2, the Blue2 Route Option has the lowest impact on Annex I habitats and on Marsh fritillary habitat. The Blue2, Yellow2, Pink2, and Green2 Route Options all have potentially significant impacts on watercourses, however the lesser impacts that the Blue2 Route Option has on Annex I habitats and Marsh fritillary habitat when compared with those route options ranks it above them. The Blue2 Route Option is therefore the third ranked route option from an ecological perspective in Section 1.

Pink2 Route Option

The Pink2 Route Option will result in the loss of *c.*1.18ha of Annex I habitat in Ecological Site EC18; a mosaic of Dry heath [4030] and Wet heath [4010] habitats. This is a greater impact than the Red2, Orange2 or Blue2 Route Options but less than that associated with the Green2 and Yellow2 Route Options.

The Pink2 Route Option is *c.*1km from two Lesser horseshoe bat roosts, two Whiskered bat roosts, and two Leisler's bat roosts. At this distance from roost sites, there is the potential for significant negative impacts to result from habitat loss, severance, and displacement associated with the construction and operation of a road development. Although this route option is longer in length than the Red2 and Orange2 Route Options and slightly shorter than the Blue2 Route Options, the offline components of these route options are similar and therefore, the potential for impacts in this regard are likely to be comparable – i.e. the potential for impacts is likely to be less than that associated with the longer Green2 and Yellow2 Route Options.

This route option crosses the main channel of the Trusky Stream and Bearna Stream, and will likely require a significant realignment of the Trusky Stream channel (*c.*700m). This will result in the loss of a significant linear length of potential fisheries and Otter habitat.

This route option will result in the loss of confirmed Marsh fritillary breeding habitat at Ballard in addition to two small areas of suitable Marsh fritillary habitat; although these areas did not support breeding colonies in 2014. It avoids any areas known to support important populations of wintering birds of conservation concern or wintering bird species listed as qualifying interests of Inner Galway Bay SPA.

The Pink2 Route Option has a greater impact on Annex I habitats than the Red2, Orange2 and Blue2 Route Options but less than that associated with the Yellow2 and Green2 Route Options. It also has a greater impact on Marsh fritillary habitat than the Red2, Orange2 and Blue2 Route Options. It also has the potential for more significant impacts in relation to watercourses when compared to the Red2 and Orange2 Route Options. The Pink2 Route Option is therefore the fourth ranked route option from an ecological perspective in Section 1.

Green2 Route Option

The Green2 Route Option will result in the loss of *c.*1.57ha of Annex I habitat within the Ecological Sites (EC05, EC11, EC12, and EC14); predominantly Dry heath [4030] but also including a small area of Wet heath [4010]. Along with the

Yellow2 Route Option, the Green2 Route Option would also result in a greater loss of local importance (higher value) habitats when compared with the Red2, Orange2, Blue2 and Pink2 Route Options.

At its eastern end in Section 1, the Green2 Route Option is *c.*1km from a Lesser horseshoe bat roost, two Whiskered bat roosts, and two Leisler's bat roosts. At this distance from roost sites, there is the potential for significant negative impacts to result from habitat loss, severance, and displacement associated with the construction and operation of a road development. Potentially of a greater magnitude for this route option, along with the Yellow2 Route Option, given their longer length and that they are further removed from the urban centre of Bearna Village.

The Green2 Route Option crosses the Trusky Stream, Liberty Stream, and the Bearna Stream; impacts to the Trusky and Liberty Streams may require realignments of sections of those streams. This may result in the loss of a significant linear length of potential fisheries and Otter habitat.

This route option will result in the loss of suitable Marsh fritillary habitat; some of which occurs next to locations that supported breeding colonies in 2014. It also passes through the margins of an upland site which supports Red and Amber listed wintering birds[9], and wintering bird species listed as qualifying interests of Inner Galway Bay SPA (Ecological Site EC14 and winter bird survey site WB07[10]).

The Green2 Route Option has the greatest impact on Annex I habitat, after the Yellow2 Route Option. Like the Yellow2 Route Option, it also has multiple crossings of the Trusky Stream and Liberty Stream with the associated loss of fisheries and Otter habitat. Significant realignment of sections of the Liberty Stream are likely to be required. The loss of suitable habitat to support the Marsh fritillary population is greater for the Green2 Route Option than that associated with all other route options, bar the Yellow2 and Pink2 Route Options (both of which will impact on confirmed breeding sites). Also, given their greater length, the impacts on the local bat population are potentially more significant for the Yellow2 and Green2 Route Options when compared with the other route options. The Green2 Route Option is therefore the fifth ranked route option from an ecological perspective in Section 1.

Table 7.6.1.1 Section 1 – Summary of Ecology ranking of Route Options

Route Option	Ranking	
Red2	1	P
Orange2	1	P
Yellow2	6	LP
Blue2	3	I
Pink2	4	I
Green2	5	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred

[9] From Birds of Conservation Concern in Ireland (Colhoun & Cummins, 2013)
[10] The full results of the winter bird surveys are provided in the Ecological Constraints Report, an appendix to Chapter 4, Ecological Constraints

Section 2

Introduction

The Lough Corrib cSAC is the most significant ecological constraint within the scheme study area given that all of the route options being considered must cross it, and considering the high ecological valuation, and legal protection afforded to European sites and their qualifying interest habitats and species under the Habitats Directive. Therefore, in determining the order of preference of the route options in Section 2, the highest weighting was given to the potential for significant impacts to European sites.

An ecological assessment of the route options was carried out against the requirements of Article 6(3) of the Habitats Directive in order to aid the decision making process with respect to selecting an emerging preferred route option.

With regard to the screening for Appropriate Assessment test:

Is a given route option, either individually or in combination with other plans or projects, likely to have a significant effect on any European site(s) – *i.e.* in view of the sites' conservation objectives and in the absence of mitigation measures, is there a source-pathway-receptor relationship by which a given route option could potentially result in a significant effect on a European site in view of its conservation objectives?

With regard to the Appropriate Assessment test:

If a given route option has the potential to significantly affect a European site(s), would that result in an adverse effect on the integrity of the European site(s) concerned – *i.e.* where a source-pathway-receptor relationship exists and significant effects are likely, would it, despite the implementation of mitigation measures, affect the attributes and targets supporting the conservation condition of the Qualifying Interest habitats and/or species[11] and therefore affect the integrity of the European site concerned?

This ecological assessment is presented in **Appendix A.7.4**.

Where potential impacts relating to the Lough Corrib cSAC are such that a clear difference between route options could not be determined, other ecological constraints were then considered in the ranking process – see **Section 7.6.1.2**. For example, four of the route options ranked equal in terms of integrity on Lough Corrib cSAC, therefore other ecological constraints were then considered in the overall ecological ranking process.

Of the nine QI species listed for the Lough Corrib cSAC, only Otter, Atlantic salmon, Sea lamprey, Brook lamprey, and the Lesser horseshoe bat are known to be within the scheme study area boundary. Based on the bridge designs proposed for the River Corrib crossing (or tunnel in the case of the Orange2 Route Option), and assuming that general mitigation measures are implemented, none of the route options are likely to result in any significant impacts to water quality or to QI aquatic species, which would adversely affect the integrity of Lough Corrib cSAC,

[11] Qualifying Interest habitats and species are those habitats and species for which European sites have been selected and are the basis of cSAC and SPA designation. In the case of SPAs the reasons for designation of these sites are generally known as Special Conservation Interests rather than Qualifying Interests.

and therefore these ecological constraints do not weight highly in influencing the route options ranking. Otter and the Lesser horseshoe bat[12] are discussed below under each of the route options.

Neither Lough Corrib SPA, nor Inner Galway Bay SPA, are directly impacted by any of the route options. Assuming that general mitigation measures are implemented, none of the route options are likely to result in any significant indirect impacts in relation to Inner Galway Bay SPA as a result of effects to water quality in supporting estuarine and coastal habitats, and therefore are unlikely to adversely affect the integrity of this European site. Lough Corrib SPA is upstream of all route options and therefore not at risk from water quality effects. The only distinguishing feature between the route options, with regard to potential impacts to SCI bird species, is that the Orange2 Route Option does not have a bridge structure over the River Corrib valley – this is discussed in more detail under the Orange2 Route Option below.

Based on the findings of the desk review and field surveys, none of the route options in Section 2 are likely to result in any significant impacts to the local Red grouse population.

All of the route options will involve crossing multiple watercourses in Section 2; although fewer along the, mostly on-line, Red2 Route Option. However, assuming that general mitigation measures are implemented, none of the route options are likely to result in any significant impacts to fish species and therefore, the relative impacts between route options on this ecological receptor do not affect the ranking of route options discussed below.

Based on the findings of the field surveys, all of the route options will also have some impact on wintering birds, affecting winter bird survey sites which support Annex I bird species, SCI species of the nearby Lough Corrib SPA or Inner Galway Bay SPA, and bird species on the Red and Amber BoCCI lists. None of the surveyed sites either directly impacted by, or in close proximity to, the proposed route options support populations of wintering birds in International or Nationally important numbers. There is little to significantly differentiate between the route options in terms of their potential to impact on the local wintering bird population. However, route options that have a significant on-line component are likely to have the least impact given that the zone of influence of any habitat loss, disturbance or displacement effects is likely to be reduced in redesigning and widening an existing road, when compared with the other route options which travel across agricultural and upland habitats removed from the urban/suburban development surrounding Galway City. This is not to say that there are not urban sites, such as parklands and the area around the Claddagh, which are not important for wintering birds, but these sites are largely removed from the route options being considered and bird species using urban/suburban sites would be expected to be more tolerant to the introduction of new road infrastructure, and habituate to any associated increased disturbance, than those using agricultural or upland habitats.

[12] Although a QI species for Lough Corrib cSAC, the Lesser horseshoe bat is included as a QI for a roost at the northern end of Lough Corrib, *c*.30km away, and based on available information the roost at Menlough does not form part of the QI population of this species

Red2 Route Option

The Red2 Route Option crosses Lough Corrib cSAC at one location to the south of the existing Quincentenary Bridge over the River Corrib.

As the Lough Corrib cSAC boundary follows the existing river bank in this area, the footprint of this route option within the cSAC is limited to that associated with the construction of the proposed new bridge spanning the River Corrib (to the south of the existing Quincentenary Bridge) which would necessitate the installation of two supporting structures in the river channel (**Figure 7.6.1.3**). Given the absence of any QI habitat at this location, and the temporary nature of any construction works within the river channel, only indirect impacts associated with effects on water quality in the River Corrib and maintaining passage for the aquatic QI species – Otter, Atlantic salmon, Sea lamprey, and Brook lamprey – have the potential to be significant (and by association indirect effects downstream in the Galway Bay Complex cSAC/Inner Galway Bat SPA). However, with best practice construction methodologies applied, and assuming that both during construction and operation the bridge would not result in any impediment to fish passage along the River Corrib channel, it is considered unlikely that this route option would result in any significant impacts on the aquatic environment or to any species therein that would adversely affect the integrity of the European sites.

The Red2 Route Option has the least impact on Annex I habitats within the Ecological Sites; in total approximately 1.32ha in Ecological Sites EC41 and EC56. This is by virtue of the fact that the majority of this route option is either on-line or traverses existing urban/suburban areas of Galway City. The Annex I habitat affected are areas of Limestone pavement [*8240], Calcareous grassland [6210], and Lowland hay meadows [6510] adjacent to the margins of the existing N6 at Terryland and Castlegar (in total *c.*0.8ha), and fragmented areas of Limestone pavement in Ecological Site 56 around the existing N6 Junction at Doughiska (covering an area of *c.*1.23ha).

Along with the other route options (excepting Orange2 Route Option which tunnels underneath the River Corrib), Red2 Route Option will result in the loss of, or modification to, potential Otter habitat, and some level of disturbance/displacement impact, at watercourse crossings between Bearna and the River Corrib; including within Lough Corrib cSAC at the proposed River Corrib Bridge. These impacts have the potential to be significant at the local level if Otter holts/couches are present. However in the case of Lough Corrib cSAC, based on the findings of the Otter survey carried out, and considering the bridge design proposed (i.e. some habitat modification is likely but no permanent loss of suitable Otter habitat, or severance impacts is expected), the impacts are not likely to be significant and would not adversely affect the integrity of Lough Corrib cSAC.

The Red2 Route Option is the only route option which impacts on a Flora (Protection) Order plant species; there are two records for Chives *Allium schoenoprasum* from the Ballymoneen/Ballyburke area. Both records are approximate grid references (within 100m) in residential areas and given that this route option is on-line in this area, it may not impact on the species.

The majority of this route option is on-line where it passes through the foraging area of the Menlo Castle Lesser horseshoe bat roost; although it is one of three route options that is in close proximity to the mating/hibernation site at Cooper's Cave in the Terryland Stream Valley. As such, the Red2 Route Option is considered to be

one of the least damaging route options with regard to this species provided that the integrity of Cooper's Cave is maintained in the final design. On the same basis (i.e. that the majority of this route option is on-line) it is also likely to have the least impact on the local Barn owl population, breeding birds in general, and wintering birds.

Of the route options that impact on the Lough Corrib cSAC, Red2 Route Option is the most preferred and is one of the four route options that would not adversely affect the integrity of that site. It has the least impact on QI habitats along with Blue2 and Pink2 Route Options – none of these three route options impact on any Annex I habitat within the boundary of the cSAC. However, it is difficult to differentiate between these route options with respect to their relative impacts on Lough Corrib cSAC: neither the Red2 Route Option (which involves constructing two piers in the River Corrib) nor the Blue2 or Pink2 Route Options (which require the construction of three piers within non-Annex grassland inside the cSAC boundary) will result in direct impacts to QI habitats or species. These three route options, Red2, Blue2 and Pink2 Route Options are also unlikely to result in any significant impacts on water quality or significant severance, disturbance, or displacement effects that would affect QI habitats or species or adversely affect the integrity of Lough Corrib cSAC. However, the Red2 Route Option is more preferred than Blue2 or Pink2 Route Options as it has the lowest impact on Annex I habitats of all the route options in Section 2 and, considering that it is likely to have the least impact of all the route options on most ecological receptors.

The Red2 Route Option is therefore the second ranked route option from an ecological perspective in Section 2.

Orange2 Route Option

In tunnelling underneath the River Corrib cSAC, this route option avoids any direct impacts to qualifying interest habitats or species (**Figure 7.6.1.3**). Tunnelling in a karst substrate does carry a risk of both construction and operation impacts to the movement of groundwater and there is the potential for indirect effects to wetland habitats within Lough Corrib cSAC to the north, in the vicinity of the Coolagh Lakes. The risk of the tunnel affecting the existing hydrogeological regime is as low as reasonably practical by the application of modern tunnelling techniques and construction controls. Based upon these appropriate engineering tunnelling techniques and construction controls the tunnel is unlikely to result in any significant long-term effects on the conservation condition of the qualifying interest habitats within Lough Corrib cSAC, and is unlikely to adversely affect the integrity of the cSAC. Detailed geotechnical investigations would be required to fully quantify the associated risks if any. The use of a tunnel also avoids any impacts to Otter within the cSAC.

In relation to the SCI bird species of either Lough Corrib cSAC or Inner Galway Bay SPA and their use of the River Corrib corridor as a flight path, tunnelling under the River Corrib removes the risk of any bridge or road traffic collision risk.

The Orange2 Route Option will result in the loss of Annex I habitats from within the Ecological Sites EC20, EC25, EC41 and EC56; in total, approximately 3ha. West of the River Corrib, this consists of small patches of Wet heath/Dry heath [4010/4030]; east of the River Corrib, areas of Limestone pavement [*8240], Calcareous grassland [6210], and Lowland hay meadows [6510].

The majority of this route option is either on-line or underground within the foraging area of the Menlo Castle Lesser horseshoe bat roost. As such, it is considered to be one of the least damaging route options with regard to this species. This conclusion is based on the assumption that the integrity of Cooper's Cave in the Terryland River Valley is maintained, given that it is one of three route options that are in close proximity to this important Lesser horseshoe bat mating/hibernation site.

The Orange2 Route Option is within 2.5km of a Barn owl nest and roost site – a distance within which the introduction of a road is likely to have a significant negative impact on the species locally due to the increased risk of collisions with road traffic. However, the majority of the Orange2 Route Option is on-line within this zone and any potential impacts would be much less than that associated with the Green2, Blue2, Pink2, and Yellow2 Route Options; but may be greater than that associated with the Red2 Route Option.

The Orange2 Route Option is one of the four route options that would not adversely affect the integrity of Lough Corrib cSAC. In tunnelling underneath the River Corrib, it is the only route option that avoids direct impacts to Lough Corrib cSAC along with being unlikely to result in any associated significant indirect impacts on its QI habitats and species. With a large section of this route option below ground, this significantly reduces the potential for impacting on the Menlo Castle Lesser horseshoe bat population and the local Barn owl population when compared with the Green2, Blue2, Pink2 and Yellow2 Route Options.

The Orange2 Route Option is therefore the most preferred route option from an ecological perspective in Section 2.

Yellow2 Route Option

The Yellow2 Route Option crosses Lough Corrib cSAC at three locations: the proposed crossing point of the River Corrib; north-west of the Coolagh Lakes; and, along the Menlough Road (**Figure 7.6.1.4**).

The impact of the Yellow2 Route Option at the proposed River Corrib crossing is as described for the Blue2 Route Option above (i.e. the crossing points are the same).

It passes through the area north-west of the Coolagh Lakes and along Menlough Road, the viaduct structure passes over areas of Cladium fen [*7210], Limestone pavement [*8240], Calcareous grassland [6210], Residual alluvial forests [*91E0], and Hydrophilous tall herb habitat [6430] totalling approximately 1.27ha. Cladium fen, Limestone pavement and Calcareous grassland are QI habitats of Lough Corrib cSAC. Although not directly impacted by the viaduct structure – as all piers are located outside of Annex I habitat areas – some vegetation cutting/removal will likely be required to facilitate the construction works and on an ongoing basis to avoid any impact to the proposed road infrastructure during operation. Some effects to any remaining vegetation underneath the bridge structure would be expected as a result of shading. The proposed piers will be located in areas of (non-Annex) Semi-natural woodland, Calcareous grassland, Fen and scrub, and construction works to build the piers and install drainage will result in direct impacts to these habitats.

The Yellow2 Route Option will result in the loss of Annex I habitats from within the Ecological Sites (EC18, EC20, EC25, EC37, EC40, EC41, and EC56) and from

areas adjacent to the Lough Corrib cSAC boundary[13]; in total, approximately 2.81ha. West of the River Corrib, this consists of Wet heat/Dry heath areas [4010/4030]; east of the River Corrib, it is areas of Limestone pavement [*8240], Calcareous grassland [6210] and Residual alluvial forests [*91E0].

As discussed above in relation to the Red2 Route Option, the Yellow2 Route Option has the potential to result in significant impacts on the local Otter population at a local level, but is not likely to result in any significant impacts on the species.

This route option, along with the Blue2, Pink2 and Green2 Route Options, are potentially the most significant with respect to the local Lesser horseshoe bat population given the scale of habitat loss (*c.*32ha) and severance likely to be associated with these route options within their core foraging area, and in the immediate vicinity of the maternity roost at Menlo Castle (*c.*280m from the mainline of the proposed alignment, with smaller scale works proposed within 200m).

The Yellow2 Route Option, along with Blue2 and Pink2 Route Options, will also result in the greatest loss of suitable Marsh Fritillary habitat within Section 2. These areas are a small proportion of the available habitat resource within the scheme study area locally (four out of 137 suitable habitat patches recorded west of the River Corrib) and are also adjacent to the outer limit of Galway City, which acts as a barrier to any further population expansion to the south. Therefore, the loss of habitat associated with this route option is not likely to be significant in relation to the maintenance and potential expansion of the local metapopulation.

The Yellow2 Route Option, along with the Blue2, Pink2, and Green2 Route Options are likely to have the most significant impact on the local Barn owl population, due to the increased risk of collisions with road traffic, as these route options are all within 500m of a nest site.

Of the route options that impact directly on Lough Corrib cSAC, it has potentially the greatest impact on QI habitat habitat and would affect the integrity of this European site. As with the Green2 Route Option, the QI habitat is avoided but significant indirect effects are likely, particularly in relation to the areas of Cladium fen and supporting wetland habitats surrounding the Coolagh Lakes. The Yellow2 Route Option has the greatest impact on Annex I habitat outside of designated sites. The Yellow2 Route Option is also one of four route options that will have the greatest impact on the local Lesser horseshoe bat and Barn owl populations and, along with the Blue2 and Pink2 Route Options, will have the greatest impact on suitable Marsh fritillary habitat.

The Yellow2 Route Option is therefore the least preferred route option from an ecological perspective in Section 2.

Blue2 Route Option

The Blue2 Route Option crosses Lough Corrib cSAC at three locations: the proposed crossing point of the River Corrib; adjacent to the Menlough Road; and, to the west of Lackagh Quarry (**Figure 7.6.1.4**).

At the proposed River Corrib crossing, the Blue2 Route Option has a footprint of *c.*0.41ha, none is Annex I habitat. The three proposed piers will be located in an

[13] These areas were surveyed as part of Lough Corrib cSAC habitat survey and are not included within the boundaries of the Ecological Sites as shown on Figure 4.3.2

area of (non-Annex) Calcareous grassland on the north-east bank of the river. Construction works to build the piers and install drainage will result in direct impacts here. On the south-west river bank there are no piers located within the Lough Corrib cSAC boundary. The pier nearest to the cSAC boundary will be located in an area of wet and amenity grassland, scrub and broadleaved woodland adjacent to the existing NUIG Recreational Facilities. Some cutting/removal of vegetation will be required within the riparian zone (which is within the cSAC boundary) to facilitate the construction works, and on an ongoing basis to avoid any impact to the proposed road during operation, and some effects to any remaining vegetation underneath the bridge structure would be expected as a result of shading. However, the impact to this vegetation is not likely to be significant in the context of Lough Corrib cSAC and would not adversely affect the integrity of that site as they are not QI habitats of the cSAC.

Next to the Menlough Road, the viaduct structure passes over a small area of Hazel/Ash woodland in a corner of the Lough Corrib cSAC boundary (less than 85m^2. Although not directly impacted by the viaduct structure, some vegetation cutting/removal will likely be required to facilitate the construction works and on an ongoing basis to avoid any impact to the proposed road during operation.

To the west of Lackagh Quarry, the Blue2 Route Option tunnels underneath Lough Corrib cSAC; avoiding any direct impacts. In the vicinity of the proposed tunnel the QI Annex I habitats within the cSAC are Limestone pavement [*8240) and Calcareous grassland [*6210/6210]. None of these habitat types are groundwater dependent and are not likely to be affected in any way by a tunnel excavated underneath, in that regard. The fractured nature of karst limestone does pose some level of risk of subsidence at the surface as a result of tunnelling works. Given current tunnelling techniques available the magnitude of any such impact would be extremely low and it can be confidently predicted that any subsidence would not manifest itself at the surface as any perceptible change to the structure or functioning of these habitat types. The tunnel does also carry a risk of both construction and operation impacts to the movement of groundwater and there is the potential for indirect effects to wetland habitats within the Lough Corrib cSAC boundary to the south, in the vicinity of the Coolagh Lakes. The risk of the tunnel affecting the existing hydrogeological regime is as low as reasonably practical by the application of modern tunnelling techniques and construction controls. Based upon these appropriate engineering tunnelling techniques and construction controls the tunnel is unlikely to result in any significant long-term adverse effects on the conservation status of the qualifying interest habitats within Lough Corrib cSAC, or on the adversely affect the integrity of the cSAC. Detailed geotechnical investigations would be required to fully quantify the associated risks if any.

The Blue2 Route Option will result in the loss of Annex I habitats from within the Ecological Sites and from areas adjacent to the Lough Corrib cSAC boundary[14]; in total, approximately 2.82ha. West of the River Corrib, this consists of small patches of Wet heath/Dry heath [4010/4030]. To the east, areas of Limestone pavement [*8240], Molinia meadows [6410], Residual alluvial forests [*91E0], and a Turlough [*3180] are within the current design of the Blue2 Route Option. However in the case of Limestone pavement, most of these areas are underneath the viaduct structure that runs north-east from the Menlough Road, with the piers located outside of the Annex I habitat patches. The same applies in relation to the

[14] These areas were surveyed as part of the Lough Corrib cSAC habitat survey and are not included within the boundaries of the Ecological Sites as shown on Figure 4.3.2

Turlough feature. However, one structure is located in an area surrounded by Limestone pavement [*8240] and a turlough [*3180] and will need to be crossed to facilitate the construction works. Given that the area of Limestone pavement is not part of Lough Corrib cSAC, and that with careful construction methodology it should be possible to access the site of this supporting structure/pier without permanently damaging the structure of the Limestone pavement, this impact is unlikely to be significant.

As discussed above in relation to the Red2 Route Option, the Blue2 Route Option has the potential to result in significant impacts to the local Otter population (including at Ballindooley Lough, if Otter are present), at a local level, but is not likely to result in any significant impacts on the species.

This route option, along with the Pink2, Green2 and Yellow2 Route Options, are potentially the most damaging with respect to the local Lesser horseshoe bat population given the scale of habitat loss and severance likely to be associated with this route option within their core foraging area, and in the immediate vicinity of the maternity roost at Menlo Castle (this roost is *c.*280m from the mainline of the proposed alignment, with smaller-scale works proposed within 200m).

This route option, along with the Green2 and Pink2 Route Options, are in close proximity to a Peregrine falcon nest site and there is a high potential for significant associated disturbance and displacement impacts to occur during both construction and operation.

The Blue2 Route Option, along with Yellow2 and Pink2 Route Options, will also result in the greatest loss of suitable Marsh Fritillary habitat within Section 2. These areas are a small proportion of the available habitat resource within the scheme study area locally (four out of 137 suitable habitat patches recorded west of the River Corrib) and are also adjacent to the outer limit of Galway City, which acts as a barrier to any further population expansion to the south. Even though one of these areas was confirmed breeding habitat in 2014, the loss of habitat associated with this route option is not likely to be significant in relation to the maintenance, and potential expansion, of the local metapopulation.

The Blue2 Route Option, along with the Green2, Pink2, and Yellow2 Route Options are likely to have the most significant impact on the local Barn owl population, due to the increased risk of collisions with road traffic, as these route option are all within 500m of a nest site.

Of the route options that impact directly on Lough Corrib cSAC, the Blue2 Route Option is second in the order of preference, after the Red2 Route Option, and one of the four route options that would not adversely affect the integrity of that site. As discussed above, the difference between the Blue2 and Pink2 Route Options in terms of impacts to the cSAC is relatively minor – the Blue2 Route Option is likely to result in less habitat loss and disturbance within the cSAC boundary, as it has a smaller footprint at the proposed River Corrib crossing (*c.*0.4ha compared with *c.*0.56ha), and in contrast the Blue2 Route Option avoids the loss of a block of woodland habitat impacted by the Pink2 Route Option where it crosses the cSAC at the River Corrib. Nonetheless, considering this along with the greater impact on Annex I habitats of the Pink2 Route Option in Section 2, the Blue2 Route Option is more preferable than the Pink2 Route Option.

The Blue2 Route Option is therefore the third ranked route option from an ecological perspective in Section 2.

Pink2 Route Option

The Pink2 Route Option crosses the Lough Corrib cSAC at three locations: the proposed crossing point of the River Corrib; adjacent to the Menlough Road; and, to the west of Lackagh Quarry (**Figure 7.6.1.4**).

At the proposed River Corrib crossing, the Pink2 Route Option has a footprint of *c*.0.56ha, of which none is Annex I habitat. The three proposed piers will be located in an area of (non-Annex) Calcareous grassland and broadleaved woodland on the north-east bank of the river. Construction works to build the piers and install drainage will result in direct impacts here. On the south-west river bank there are no piers located within the Lough Corrib cSAC boundary. The pier nearest to the cSAC boundary on this side of the river will be located in an area of (non-Annex) Calcareous grassland and amenity grassland adjacent to the existing playing fields. Some cutting/removal of vegetation will be required within the riparian zone (which is within the cSAC boundary) to facilitate the construction works, and on an ongoing basis to avoid any impact to the proposed road during operation. Some effects to any remaining vegetation underneath the bridge structure would be expected as a result of shading.

Next to the Menlough Road, and in the area to the west of Lackagh Quarry the impacts are as described above under the Blue2 Route Option.

The Pink2 Route Option will result in the loss of Annex I habitats from within the Ecological Sites (EC18, EC20, EC25, EC36, EC39, and EC56) and from areas adjacent to the Lough Corrib cSAC boundary[15]; in total, approximately *c*.3.93ha. West of the River Corrib, this consists of small patches of Wet heath/Dry heath [4010/4030]. To the east, areas of Limestone pavement [*8240], Calcareous grassland [6210], Molinia meadows [6410], Alluvial woodland [91E0], and a Turlough [*3180] are within the current design for the Pink2 Route Option. However in the case of Limestone pavement, most of these areas are underneath the viaduct structure that runs north-east from the Menlough Road, with the piers located outside of the Annex I habitat patches. The same applies in relation to the Turlough feature. However, one structure is located in an area surrounded by Limestone pavement [*8240] and a turlough [*3180] and will need to be crossed to facilitate the construction works. Given that the area of Limestone pavement is not part of the cSAC, and that with careful construction methodology it should be possible to access the site of this supporting structure/pier without permanently damaging the structure of the Limestone pavement, this impact is unlikely to be significant. In terms of impacts to Annex I habitats outside of European sites, the Pink2 Route Option has a greater impact than the Blue2 Route Option where these sites cross Ecological Sites EC18 and EC56.

As discussed above in relation to the Red2 Route Option, the Pink2 Route Option has the potential to result in significant impacts to the local Otter population (including at Ballindooley Lough if Otter are present), at a local level, but is not likely to result in any significant impacts on the species.

This route option, along with the Blue2, Green2 and Yellow2 Route Options, is potentially the most significant with respect to the local Lesser horseshoe bat population given the scale of habitat loss and severance likely to be associated with these route option within their core foraging area, and in the immediate vicinity of

[15] These areas were surveyed as part of Lough Corrib cSAC habitat survey and are not included within the boundaries of the Ecological Sites as shown on Figure 4.3.2

the maternity roost at Menlo Castle (this roost is *c.*170m from the mainline of the proposed alignment).

The Pink2 Route Option, along with Yellow2 and Blue2 Route Options, will also result in the greatest loss of suitable Marsh Fritillary habitat within Section 2. These areas are a small proportion of the available habitat resource within the scheme study area locally (four out of 137 suitable habitat patches recorded west of the River Corrib) and are also adjacent to the outer limit of Galway City, which acts as a barrier to any further population expansion to the south. Even though one of these areas was confirmed breeding habitat in 2014, the loss of habitat associated with this route option is not likely to be significant in relation to the maintenance, and potential expansion, of the local metapopulation.

This route option, along with the Blue2 and Green2 Route Options, is in close proximity to a Peregrine falcon nest site and there is a high potential for associated disturbance and displacement impacts to occur during both construction and operation.

The Pink2 Route Option, along with the Blue2, Green2, and Yellow2 Route Options is likely to have the greatest impact on the local Barn owl population, due to the increased risk of collisions with road traffic, as these route option are all within 500m of a nest site.

Of the route options that impact directly on the Lough Corrib cSAC, the Pink2 Route Option is third in the order of ranking and one of the four route options that would not adversely affect the integrity of that site. As discussed above, in terms of impacts to Lough Corrib cSAC it is comparable with the Red2 and Blue2 Route Options. As the Pink2 Route Option has potentially a significantly greater impact on many other ecological receptors than the Red2 Route Option, and is likely to have a greater construction impact within the cSAC than the Blue2 Route Option, along with a greater impact overall on Annex I habitats within Section 2, it is the least preferred of these three. The Pink2 Route Option, along with the Blue2 and Yellow2 Route Options, will also result in the greatest loss of suitable Marsh fritillary habitat within Section 2.

The Pink2 Route Option is therefore the fourth ranked route option from an ecological perspective in Section 2.

Green2 Route Option

The Green2 Route Option crosses Lough Corrib cSAC at one location: the proposed crossing point of the River Corrib (**Figure 7.6.1.4**).

At this location, the Green2 Route Option has a footprint of *c.*1.81ha within the boundary of Lough Corrib cSAC, of which *c.*725m^2 is Alkaline fen [7220]. Alkaline fen is a QI habitat of Lough Corrib cSAC. The proposed bridge structure is elevated on piers as the proposed road passes through the cSAC and has been designed to avoid siting any of the supporting piers within the area of Alkaline fen. Although not directly impacted by the construction works, the construction of piers in associated wetland habitats in close proximity to Alkaline fen poses a risk of significant indirect impacts if the existing hydrogeological regime is affected, which could potentially affect the integrity of Lough Corrib cSAC. Species composition and species diversity in the fen area is likely to be affected as a result of shading and a reduction in direct precipitation associated with the bridge deck; an impact that would adversely affect the integrity of Lough Corrib cSAC.

Aside from the Annex I habitats, the other habitats present within the Lough Corrib cSAC boundary which lie within the footprint of the proposed road alignment are likely to be directly impacted during construction to install drainage and facilitate building the piers. These include mainly non-Annex I wetland habitats on the west bank, which would be particularly vulnerable to indirect impacts from construction works, (fen, wet grassland, and reed swamp) and, woodland, grassland, scrub, and reed swamp on the east bank.

The Green2 Route Option will result in the loss of Annex I habitats from within the Ecological Sites and from areas adjacent to the Lough Corrib cSAC boundary[16]; in total, approximately 2.45ha. West of the River Corrib, this consists of small patches of Wet heath/Dry heath [4010/4030]; east of the River Corrib, areas of Limestone pavement [*8240], Calcareous grassland [6210], Lowland hay meadows [6510], and a Turlough [*3180].

As discussed above in relation to the Red2 Route Option, the Green2 Route Option has the potential to result in significant impacts to the local Otter population (including at Ballindooley Lough if Otter are present), at a local level, but is not likely to result in any significant impacts on the species.

This route option, along with the Blue2, Pink2 and Yellow2 Route Options, is potentially the most damaging with respect to the local Lesser horseshoe bat population given the scale of habitat loss and severance likely to be associated with this route option within their foraging area, and in the immediate vicinity of the maternity roost at Menlo Castle (*c*.330m from the mainline of the proposed Green2 Route Option).

The Green2 Route Option will also result in the loss of suitable Marsh fritillary habitat within Section 2. These areas are a small proportion of the available habitat resource within the scheme study area locally (two out of 137 suitable habitat patches recorded west of the River Corrib) and are also adjacent to the outer limit of Galway City, which acts as a barrier to any further population expansion to the south. Even though one of these areas was confirmed breeding habitat in 2014, the loss of habitat associated with this route option is not likely to be significant in relation to the maintenance, and potential expansion, of the local metapopulation.

The Green2 Route Option lies immediately adjacent to the boundary of the Moycullen Bogs NHA, at the western margin of the site where an agricultural field grades into reed swamp surrounding a small dystrophic lake [3160]. Given the close proximity of the lake to this route option and its current design, there is the potential for indirect impact to water quality during construction, and potentially effects on the underlying hydrogeology.

This route option, along with the Blue2 and Pink2 Route Options, is in close proximity to a Peregrine falcon nest site and there is a high potential for associated disturbance and displacement impacts to occur during both construction and operation.

The Green2 Route Option, along with the Blue2, Pink2, and Yellow2 Route Options is likely to have the greatest impact on the local Barn owl population, due to the

[16] These areas were surveyed as part of Lough Corrib cSAC habitat survey and are not included within the boundaries of the Ecological Sites as shown on Figure 4.3.2

increased risk of collisions with road traffic, as these route option are all within 500m of a nest site.

Of the route options that impact directly on the Lough Corrib cSAC, the Green2 Route Option is fourth in the ranking. Only the Green2 and Yellow2 Route Options are likely to have a significant impact on QI habitat within the Lough Corrib cSAC – and as a result adversely affect the integrity of that site – but the impact of the Yellow2 Route Option is much greater. Although the QI habitat (in this case Alkaline fen) is avoided by the proposed road development, the potential impacts are associated with shading affecting the fen habitat underneath the bridge structure, the loss of associated, supporting wetland habitats within the cSAC boundary during construction, and the potential for indirect impact to the Alkaline fen in constructing the bridge piers and drainage. The Green2 Route Option is also one of four route options that will have the greatest impact on the local Lesser horseshoe bat and Barn owl populations.

The Green2 Route Option is therefore the fifth ranked route option from an ecological perspective in Section 2.

Table 7.6.1.2 Section 2 – Summary of Ecology ranking of Route Options

Route Option	Ranking	
Red2	2	P
Orange2	1	P
Yellow2	6	LP
Blue2	3	I
Pink2	4	I
Green2	5	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred

Section 3

This section assesses each of the four junction designs at the proposed N6 tie-in with respect to the ecological environment, based on the junction layouts described in **Section 7.1** and presented on **Figures 7.3.1** to **7.3.6**

None of the junction designs proposed will have a direct impact to any designated areas for nature conservation. Assuming that general mitigation measures are implemented, none of the route options are likely to result in any significant indirect effects in relation to Inner Galway Bay SPA as a result of effects to water quality in supporting estuarine and coastal habitats, and would therefore not adversely affect the integrity of that European site.

Based on the findings of the desk review and field surveys, none of the junction designs are likely to result in any significant impacts to plant species protected under the Flora (Protection) Order, 1999, Otter, Marsh fritillary, Red grouse, wintering birds, or fisheries habitat (i.e. there are no surface water features present[17]).

[17] Based on a review of Ordnance Survey Ireland's 1:50,000 Discovery Series mapping and the Environmental Protection Agencies watercourses database (http://gis.epa.ie/Envision, accessed March 2015)

Therefore, since these ecological receptors are not likely to be affected by the various junction options, they did not influence the ranking and are not discussed below under the individual junction assessments.

Red2, Orange2 and Yellow2 Route Option

The Red2, Orange2 and Yellow2 Route Options impact on *c*.1.23ha of Limestone pavement [*8240] in EC56; although the majority of this (*c*.1.16ha) is described as consisting of small fragmented areas of Annex I habitat.

The Red2, Orange2, and Yellow2 Route Option, whilst still off-line, are less removed from the existing road network than Green2 Route Option and where off-line, are significantly shorter, and are significantly further from a Barn owl roost site (*c*.2km away from the nearest off-line section). Therefore, the risk of significant impact to the local Barn owl population is likely to be less than that associated with Green2 Route Option but greater than that associated with Pink2 Route Option. This is the same as the potential for impacts to Barn owl associated with the Blue2 Route Options.

Based on the detector record and roost survey results the Blue2, Pink2, Red2, Orange2, and Yellow2 Route Options are likely to have similar impacts in relation to the local bat population.

Blue2 Route Option

The Blue2 Route Option impacts on *c*.1.23ha of Limestone pavement [*8240] in EC56; although the majority of this (*c*.1.16ha) is described as consisting of small fragmented areas of Annex I habitat.

The Blue2 Route Option, whilst still off-line, is less removed from the existing road network than the Green2 Route Option and where offline, is significantly shorter, and is significantly further from the roost site (*c*.2km away from the nearest offline section). Therefore, the risk of significant impact to the local Barn owl population is likely to be less than that associated with Green2 Route Option but greater than that associated with Pink2 Route Option. This is the same as the potential for impacts to Barn owl associated with the Red2, Orange2, and Yellow2 Route Option.

Based on the detector record and roost survey results the Blue2, Pink2, Red2, Orange2, and Yellow2 Route Options are likely to have similar impacts in relation to the local bat population.

Pink2 Route Option

The Pink2 Route Option impacts on *c*.0.03ha of Limestone pavement [*8240] and *c.*1.57ha of Calcareous grassland in EC56.

The Pink2 Route Option has the least potential to impact on the local Barn owl population as it is the furthest removed from the roost site, is the least removed from the existing road network and existing junction layout, and has the least amount of habitat loss within the 2.5km buffer from the roost.

Based on the detector record and roost survey results the Blue2, Pink2, Red2, Orange2, and Yellow2 Route Options are likely to have similar impacts in relation to the local bat population.

Green2 Route Option

The Green2 Route Option impacts on *c*.0.24ha of Limestone pavement [*8240] in Ecological Site (EC) EC56.

The fact that this route option is much closer to a Barn owl roost site than any of the other junction options, with a longer off-line section within the 2.5km buffer[18], and is significantly further removed from the existing road network, there is an increased risk of significant impact to the local Barn owl population associated with the Green2 Route Option, through habitat loss and mortality/collision risk with motorway traffic.

The Green2 Route Option severs a Brown long-eared bat roost from potentially suitable woodland foraging habitat to the north, beyond which there is another roost site for this species.

Table 7.6.1.3 Section 3 – Summary of Ecology ranking of Route Options

Route Option	Ranking	
Red2/Orange2/Yellow2	1	P
Blue2	1	P
Pink2	2	LP
Green2	2	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred

7.6.1.4 Summary

In identifying the preferred route option, a key factor in determining the order of preference was the potential for each of the route options to impact on Lough Corrib cSAC[19], given that it is the sole European designated site that all route options must cross within the scheme study area, and given the legal constraints that apply in relation to European protected sites under Article 6(3) of the EU Habitats Directive 92/43/EEC, under the transposition of that Directive into Irish law, and under how the Directive is interpreted by relevant case law.

Of the six route options considered in this report, two were found likely to result in adverse effects on the integrity of Lough Corrib cSAC (Green2 and Yellow2 Route Options). Four were therefore considerd equal with respect to their potential to adversely affect the integrity of European sites (Red2, Orange2, Pink2 and Blue2 Route Options).

In addition to considering the potential impacts on Lough Corrib cSAC in ranking the route options—both in terms of the Article 6(3) tests (see **Appendix A.7.4**) and any other ecological impacts within the cSAC boundary, not directly related to QI habitats/species and their conservation objectives—significant impacts to other ecological receptors were also considered in determining the order of preference.

The Orange2 Route Option is one of the four route options which would not adversely affect the integrity of this cSAC and is the preferred route option overall

[19] See detailed assessment of the route options with regard to European sites and the requirements of the EU Habitats Directive is provided in Appendix A.7.4

(Sections 1-3 combined) in terms of ecology as it avoids direct impacts on Lough Corrib cSAC. In addition, as a significant length of the Orange2 Route Option is either predominantly online or underground, it has a reduced impact on many of the other ecological receptors identified within the scheme study area.

The Red2 Route Option is second most preferred as, despite being one of the route options which would not adversely affect the integrity of this cSAC, there will be some degree of works within the cSAC boundary. However, compared with the Blue2 and Pink 2 Route Options the impact on Lough Corrib cSAC will be less. It also has the lowest impact on Annex I habitats across the scheme study area of all the route options and, by virtue of being predominantly online, is likely to have the least impact on most other ecological receptors

The Pink2 and Blue2 Route Options are next in order of ranking as although they would not adversely affect the integrity of Lough Corrib cSAC and avoid any impacts to Annex I habitats within the cSAC boundary, they will result in some degree of habitat loss within the designated site. However, the potential for such habitat loss is less than that associated with the Green2 and Yellow2 Route Options. Blue2 Route Option is more preferred than Pink2 Route Option due to its smaller footprint within Lough Corrib cSAC and lesser impact on Annex I habitat overall in this section. These route options, along with the Green2 and Yellow2 Route Options, are likely to result in the greatest impacts to the local Lesser horseshoe bat population, and the local Barn owl population.

The Green2 Route Option is next in the order of ranking, one of the two route options likely to adversely affect the integrity of Lough Corrib cSAC. It is preferred over the Yellow2 Route Option as the degree of impacts to QI habitats is less.

As the route option with the greatest potential for impacts to QI Annex I habitat within Lough Corrib cSAC, and therefore the greatest degree of adverse effect on site integrity, the Yellow2 Route Option is the least preferred route option.

There are two key ecological constraints in identifying the preferred junction with the existing N6 in the east: impacts to Annex I habitats and impacts to the local Barn owl population.

As the Green2 Route Option has the greatest potential to affect the local Barn owl population and the Pink2 Route Option impacts on the greatest areas of Annex I habitats, both these route options are considered to be the least preferred. The Blue2 and Red2, Orange2, and Yellow2 Route Option are therefore the preferred on the basis that the loss of Annex I habitat is less than that associated with the Pink2 Route Option but greater than Green2 Route Option, and the potential for impacting on Barn owl is less than that likely to be associated with the Green2 Route Option.

Table 7.6.1.4 below summaries the order of ranking for each of these route options in Section 1 and 2 and for the junction with the existing N6 in the east.

Table 7.6.1.4 Summary of Ecological ranking of Route Options

Route Option	Section 1	Section 2	Section 3
Red2	P	P	P
Orange2	P	P	P
Yellow2	LP	LP	P
Blue2	I	I	P
Pink2	I	I	LP
Green2	LP	LP	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred

7.6.1.5 References

CEC (Commission of the European Communities). (2013) *Interpretation manual of European Union Habitats EUR28*. European Commission, DG Environment.

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7.6.2 Soils and Geology

7.6.2.1 Introduction

This section details the Stage 2 assessment of the route options described in **Section 7.1** with respect to the soils and geology constraints identified and detailed in **Section 4.4 Soils and Geology** of this report. The route options as described in **Section 7.1** with the soils and geology constraints are presented in **Figures 7.6.2.1** to **7.6.2.12**. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options.

Section 7.6.2.2 outlines the methodology used to undertake the assessments and **Sections 7.6.2.3** details the assessments. A summary is presented in **Section 7.6.2.4** and references are listed in **Section 7.6.2.5**.

7.6.2.2 Methodology

The NRA Guidelines for the assessment and treatment of geology, hydrology and hydrogeology for National Road schemes forms the basis for the preparation of this section. The methodology for the assessment of soils and geology as described in **Section 6.5.2 Soils and Geology** of this report was also followed for this assessment.

The soils and geology constraints for the scheme study area have been compiled and are presented in **Section 4.4 Soils and Geology** of this report. The assessment of each route option, with respect to soils and geology, was based on the route options described in **Section 7.1** and presented on **Figures 7.6.2.1** to **7.6.2.12**. Each route corridor is assessed using the available published information from the sources listed in **Section 6.5.2 Soils and Geology** together with the additional sources of information included in **Section 7.6.2.5**.

7.6.2.3 Option Assessment

The following assessments take cognisance of modifications to the route options, where applicable post the Stage 1 assessment.The options are assessed in three sections. The location of the breakline between Section 1 and Section 2 has been moved eastwards to the Galway City boundary. Section 1 extends from the R336 to the Galway City boundary and Section 2 extends from the Galway City boundary to the existing N6 in the east of the city. An additional break down at the N6 tie-in at Coolagh has been incorporated in order to compare the junction layouts at the N6 tie-in for the Stage 2 assessment. This section is referred to as Section 3 and this is assessed separately as the criteria under which the mainline are assessed are not as relevant to the junction assessment.

Red2 Route Option

The Red2 Route Option has not changed significantly from that described in **Section 6.1.1**. Modifications to slip roads and access roads have been incorporated, as described in **Section 7.1**. The most significant change which impacts on soils and geology is the increase in the footprint of the cutting at Briarhill to accommodate additional traffic lanes. The level of impact at this location remains as 'High', unchanged from the assessment in **Section 6.5.2 Soils and Geology**.

Overview of Red2 Route Option

The principal cuttings and embankments for the Red2 Route Option are described in **Tables 7.6.2.1** and **7.6.2.2** and are shown on **Figures 7.6.2.11** and **7.6.2.12.**

Table 7.6.2.1 Principal cuttings along the Red2 Route Option

Section	Name	Location	Length (m)	Max cutting depth (m)	Level of impact
1	Red C1	Knockaunnacarra to Trusky East	640	5 - 10	Low
1	Red C3	Trusky East to Aille	1190	5 - 10	Medium[1]
2	Red C10	Rahoon to River Corrib	3420	10 - 15	High[2]
2	Red C12	Ballinfoyle	140	0 - 5	High[2]
2	Red C13	Glenanail	40	0 - 5	High[2]
2	Red C14	Glenanail to Ballybrit	1350	5 - 10	High[3]
2 / 3	Red C15	Ballybrit to N6	2858	10 - 15	High[4]

Note: In addition to the max cutting depth the location impact is influenced by:

1. *Length of cutting;*
2. *Prense of soft ground;*
3. *Length of cutting and presence of a number of Karst Features including K89; and*
4. *Length of cutting and presence of a number of Karst Features.*

Table 7.6.2.2 Principal embankments along the Red2 Route Option

Section	Name	Location	Length (m)	Max cutting depth (m)	Level of impact
1 / 2	Red E3	Aille to Cappagh	410	0 - 5	High[1]
2	Red E10	River Corrib	40	0 - 5	High[1]
2	Red E11	Terryland	570	10 - 15	High[1]
2	Red E12	Terryland to Ballinfoyle	380	5 - 10	High[1]
2	Red E14	Glenanail	100	0 - 5	High[1]

Note: In addition to the max embankment depth the location impact is influenced by:

1. *Presence of soft ground.*

The following features are associated with the principal cuttings and embankments and associated infrastructure provision for the Red2 Route Option.

This Red2 Route Option commences in a cutting in the Knocknacarra area which which is between 5 - 10m, with excavation of possible peat, glacial deposits and granite likely.

There is a proposed cut and cover tunnel and open cut commencing in the Rahoon area and finishing near the Upper Newcastle Road/N6 Junction. This would involve extensive deep excavations along the Seamus Quirke Road, Bishop O'Donnell Road, the Western Distributor Road and a large residential area at Rahoon. The tunnel would be approximately 1300m long. The overburden material would likely consist of glacial till and weathered rock and competent granite at depth. Soft, organic deposits are a possibility and were encountered during previous site investigation works in the area of the junction of Bishop O'Donnell Road and the Seamus Quirke Road (Peters et al., 2012).

A new bridge would be constructed downstream of the Quincentenary Bridge and would require new embankments to be constructed. The embankment on the east side of the river would be constructed over soft ground deposits. Investigation would be required to establish the thickness of the compressible depostits in the vicinity of the Terryland River. There would be a potential impact on the settlement profile and stability of the existing embankment which would need further assessment during the detailed design phase. Solutions such as lightweight fill, piled embankments or ground improvement could be used where adverse settlements are predicted.

The Red2 Route Option would be elevated on a viaduct over the former Bodkin Roundabout in Terryland and would travel across, adjacent to and along the route of the Terryland River before connecting to the existing N6. This structure would likely require rock socketed piles to carry the structural loads. There are extensive deposits of soft ground in this area and particular attention to the temporary works would be required in order to minimise the risk of instability in the working platform for the piling works.

There would be a high embankment over deep deposits of soft ground following on from the viaduct. This embankment would likely require piled foundations or extensive ground improvement to ensure that stability and settlement requirements would be achieved.

The Red2 Route Option runs over an area close to the Coopers Cave (K89) complex to the rear of Glenanail. The Red2 Route Option enters a cut in the vicinity of the cave complex travelling between the N17 and City East Business Park Junctions. The geology in this area would likely consist of glacial till over limestone

Following the cutting between the N17 and City East Business Park Junctions the route follows the existing ground profile before entering a deep cutting at Briarhill which would be approximately 2000m long and then connects to the existing N6. This cutting would likely be in glacial till and limestone and the depth of the cutting would be up to 15m. The extent of the cutting has been locally increased to accommodate additional traffic lanes from the route option assessed at Stage 1.

Further investigation would be required in order to determine the geological profile of the Red2 Route Option.

<u>Overview of Solid Geology, Subsoils and Soils along the Red2 Route Option</u>

Bedrock

The bedrock geology underlying this route option is shown on **Figures 7.6.2.3** and **7.6.2.4**. There are three principle forms of bedrock underlying this route option. From Knocknacarra to the N59 Browne Roundabout the bedrock consists of

undifferentiated granite and associated rocks. Between the N59 and the existing N6, the bedrock changes to the metagabbro and orthogneiss suite which extends across the River Corrib.

East of the River Corrib the bedrock changes from metasediments to Lower Carboniferous (Visean) Age Burren Limestone based on information from the construction of the Quincentenary Bridge. The boundary between the bedrock types is slightly different to what the GSI indicates on its bedrock mapping, again based on information from the construction of the Quincentenary Bridge. Limestone underlies the remainder of the route option to the existing N6 tie-in.

Subsoils

The following are subsoil features of the Red2 Route Option.

The subsoils underlying the Red2 Route Option are shown on **Figures 7.6.2.7** and **7.6.2.8**. The GSI mapping suggests that from Knocknacarra to Cappagh, the subsoils typically consist of glacial till or sandy gravely clay principally derived from the underlying bedrock. Large granite boulders would likely be encountered through this area.

The subsoils at Rahoon were investigated during ground investigation works undertaken for the project and are included in **Appendix A.4.5.** The subsoils consisted of glacial till of varying consistency overlying the granite bedrock. A more detailed description of the ground conditions in this area is provided in the referenced appendix.

Soft, compressible soils were encountered in the Westside area during the construction of the Seamus Quirke Road Quality Bus Corridor (Peters et al. 2012). Historical mapping shows the presence of a stream running approximately along the Seamus Quirke Road from the Old Seamus Quirke Road and extending along the existing N6 before entering the River Corrib south of the Quincentenary Bridge. There may be soft alluvial soils associated with this watercourse.

The subsoils in the Terryland River Valley consist of peat overlying calcareous silts overlying organic and inorganic lake muds. These soils are soft, highly compressible and prone to high rates of secondary compression. The geotechnical characteristics and challenges presented during the construction of the existing N6 are described by Flood and Eising (1987), Hunt (1991) and Naughton and Rodgers (2003). The soft soils in this area are bounded by glacial till derived from limestone on higher ground.

As the Red2 Route Option rises out of the Terryland River the subsoils consist of glacial till derived from the parent limestone rock. The depth to bedrock is variable and outcrops of limestone bedrock are evident for the remainder of the route option travelling eastwards.

Soils

The following are soil features of the Red2 Route Option.

The soils underlying the Red2 Route Option are shown on **Figures 7.6.2.5** and **7.6.2.6.** From Bearna to Cappagh, the soils are of a poorly drained clays with sporadic peaty deposits. The soils are of a poor to very poor quality from an agricultural perspective. The Red2 Route Option then enters the urban environment where Made Ground predominates.

The soils in the Terryland River Valley are peaty in nature and are of a very poor quality from an agricultural perspective.

This route option terminates in a greenfield site between Briarhill and Cloonagh.

Overview of ground conditions in karst limestone areas

The Red2 Route Option passes through limestone regions on the eastern side of the River Corrib. Both enclosed depressions (K75 and K88) and springs (K87 and K96) were identified adjacent to this route option in the vicinity of Coopers Cave (K89).

It is likely that this route option would encounter the limestone bedrock at the formation level of the route adjacent to the N17 Junction. Where the Red2 Route Option is in cutting or the formation level is close to rockhead level, additional investigations would be required to assess the potential geohazards from cavities in the rock.

At the eastern end of the option, a number of enclosed depressions (K172, K175 and K179) were confirmed. A number of springs were recorded on the GSI karst database (K161, K176, K178, K180 and K181) but unconfirmed/not found during the karst site survey.

Overview of the Historical Land use

The following are historical land use features of the Red2 Route Option.

Land use in the western extents of the Red2 Route Option was and is primarily agricultural and residential.

The density of housing has increased since 1995 in this area.

This route option runs adjacent to an old graveyard close to the junction of Bishop O'Donnell Road and the Seamus Quirke Road. The age of the cemetery is a mitigating factor against potential contaminants.

This route option runs along the Seamus Quirke Road. A number of industrial units were located along the road but have since been replaced or modified. The Farah Jeans factory which was located adjacent to this route option was extensively fire damaged in 1997.

Historical mapping shows a stream running along the existing Seamus Quirke Road from approximately the Old Seamus Quirke Road to the River Corrib close to the Quincentenary Bridge. The location of the stream would require further investigation.

The Red2 Route Option runs predominantly in an urban environment. The area along the Terryland River Valley has not been fully developed, partly due to the presence of soft ground. Historical mapping shows that this area was prone to flooding. This flooding was alleviated by flood protection works that commenced in the 19th century.

A series of quarries are shown on the OSI 25" mapping from where the Red2 Route Option passes Coopers Cave (K89) and the existing N6 at Ballybrit.

Further investigation would be required in order to rule out potential contamination from historical landuses and backfill material (if any) in historic quarries.

The impact of historical land on the Red2 Route Option use is assessed as low although further investigation at detailed design stage is required.

Overview of the Economic Geology

The Red2 Route Option passes through a predominantly urban landscape which is unlikely to be suitable for mining or quarrying activities. This route option does not impact on existing quarries or prospective expansion of quarries.

A series of historical pits/quarries are shown on the OSI 25" mapping from where the Red2 Route Option passes Coopers Cave (K89) and the existing N6 at Ballybrit. The backfill materials (if any) in the quarries would merits further investigation.

Overview of the Geological Heritage

The Geological Heritage constraints are shown on **Figures 7.6.2.1** and **7.6.2.2**. This route option does not impact on the identified sites

This route option would involve deep excavations in bedrock across the city and would expose a variety of bedrock types. These temporary exposures would provide greater information on the bedrock geology of Galway City which could be considered as a beneficial impact of this route option.

Impact assessment

The impact of the Red2 Route Option on attributes identified in the constraints study are summarised in **Table 7.6.2.3**..

Table 7.6.2.3 Assessment of the soil and geology impacts for the Red2 Route Option

Attribute	Attribute importance	Impact	Level of impact
Soils – route wide	Low	Loss of low fertility soil over limited section of route	Minor negative
Peat / soft soils at Rahoon	High	Ground improvement and / or excavation and replacement required. –soil likely to be excavated irrespectively.	Minor negative
Bedrock	Medium	Deep cuttings exposing the bedrock would increase the geological heritage	Minor positive
Karst – route wide	Medium	Karst features may require additional engineered solutions to ensure an acceptable risk level for design life of road.	Moderately negative
Karst Feature K89 Coopers Cave	High	The karst features has been listed on SEA Environmental Report of the Galway City Development Plan. The route may impact on the stability of the cave system. Further investigations would be required.	Moderately negative.
Historical landuse – route wide	Low	Historical landuses and backfill material (if any) in historic quarries require investigation in order to rule out potential contamination	Minor negative
Economic geology – route wide	Low	There is no impact on existing quarries or prospective expansion of quarries.	Negligible
Geological Heritage – route wide	Medium	The route option would provide greater exposure of bedrock underlying Galway.	Minor positive

Orange2 Route Option

The Orange2 Route Option has changed from that described in **Section 6.1.1**. The N59 link road has been realigned, resulting in a reduction in the depth of the cut at the N59 Junction. The most significant change however, which impacts on soils and geology is the increase in the footprint of the cutting at Briarhill in order to accommodate additional traffic lanes. The level of impact at this location remains as 'High', unchanged from the assessment in **Section 6.5.2 Soils and Geology**.

Overview of the Orange2 Route Option

The Orange2 Route Option includes a tunnel beneath the River Corrib. The principal cuttings and embankments are described in **Tables 7.6.2.4** and **7.6.2.5** below and are shown on **Figures 7.6.2.11** and **7.6.2.12**.

Table 7.6.2.4 Principal cuttings along the Orange2 Route Option

Section	Name	Location	Length (m)	Max cutting depth (m)	Level of impact
1	Orange C1	Knocknacarra to Trusky East	640	5 - 10	Low
1	Orange C3	Trusky East to Aille	1170	5 - 10	Medium[1]
2	Orange C5	Cappagh to Keeraun	1570	10 - 15	High[1]
2	Orange C12	Rahoon to Letteragh	1010	>15	High[1]
2	Orange C13	Ballinfoyle	750	10 - 15	Medium
2	Orange C14	Glenanail	40	0 - 5	High[2]
2	Orange C15	Glenanail to Ballybrit	1400	5 - 10	High[3]
2	Orange C16	Ballybrit to N6	2865	10 - 15	High[4]

Note: In addition to the max cutting depth the location impact is influenced by:

1. *Length of cutting;*
2. *Presence of soft ground;*
3. *Presence of a number of Karst Features including K89 and length of cutting; and*
4. *Presence of a number of Karst Features and length of cutting.*

Table 7.6.2.5 Principal embankments along the Orange2 Route Option

Section	Name	Location	Length (m)	Max cutting depth (m)	Level of impact
2	Orange E12	Ballinfoyle	290	0 - 5	High1
2	Orange E13	Glenanail	160	0 - 5	High1

Note: In addition to the max embankment depth the location impact is influenced by:

1. *Presence of soft ground.*

The following features are associated with the principal cuttings and embankments and associated infrastructure provision for the Orange2 Route Option.

This Orange2 Route Option commences in a cutting in the Bearna area which would be up to 8.5m deep with the excavation of peat, glacial deposits and granite likely. Further cuttings up to 8m deep would be required in the western extent of this route option approaching the proposed tunnel portal.

In areas where the option is close to grade in the western extent of the route option, it is possible that peat and other soft deposits may need to be excavated and replaced with materials to support the roadbed.

This route option enters a deep cutting in the Letteragh area to form a junction with the proposed N59 link road. The cutting would increase to a maximum depth of 30 – 35m to form the tunnel entrance. This depth of cutting is significantly deeper and more extensive than any existing road cutting in Ireland. This cutting would likely incorporate a series of benches to ensure that the stability of the face is satisfactory or alternative construction methodologies could be considered.

This route option enters a tunnel at Letteragh and emerges close to the junction of the N6 and N84. It is envisaged that this tunnel would be formed using a tunnel boring machine for a number of reasons, namely:

- The tunnel would travel under residential areas at Newcastle and Castlelawn Heights where settlement control may be more onerous than under greenfield sections;
- The tunnel would travel under mixed face conditions between the differing bedrock types. A tunnel boring machine (TBM) would be able to control tunnelling operations to a greater extent; and
- The tunnel would travel through karstic limestone under the River Corrib, consequently groundwater control measures would need to be given high consideration during the construction and design life of the tunnel.

Additional ground investigation would be required in order to develop tunnelling solutions. It is noted that the geological risks associated with tunnelling can only be partly mitigated by pre-works ground investigation. Modification to the works may be required depending on the results of probing and ground investigation during the works.

The Orange2 Route Option emerges from the tunnel in the Terryland Park area into an area of soft ground with outcrops of glacial till. A deep excavation supported by a retaining wall would likely be required. The impact of the cutting on the existing N6 would need to be carefully assessed during the design stage. Where the road is shown as a shallow cut it is likely that ground improvement may still be required in order to ensure post construction displacements would be tolerable.

There is an interchange proposed in the Terryland Park area over deep deposits of soft ground. The embankments associated with this interchange would likely require piled foundations or extensive ground improvement to ensure that stability and settlement requirements would be achieved.

The Orange2 Route Option runs over an area close to the Coopers Cave (K89) complex to the rear of Glenanail. There would be a potential impact on the Cave complex due to karstic features in their vicinity. The Orange2 Route Option enters a cut in the vicinity of the cave complex travelling between the N17 and City East Business Park Junctions. The geology in this area would likely consist of glacial till over limestone.

Following the cutting between the N17 and City East Business Park Junctions the route follows the existing ground profile before entering a deep cutting at Briarhill which is approximately 2,000m long and connects to the existing N6. This cutting would likely be in glacial till and limestone and the depth of the cutting would be up to 15m. The extent of the cutting has been locally increased to accommodate additional traffic lanes from the option assessed at Stage 1.

Further investigation would be required in order to determine the geological profile of the Orange2 Route Option.

Overview of Solid Geology, Subsoils and Soils along Orange2 Route Option

Bedrock

The bedrock geology underlying the route is shown on **Figures 7.6.2.3** and **7.6.2.4**. There are three principle forms of bedrock underlying the route. From the Bearna area as far as the Letteragh area, the bedrock consists of undifferentiated granite and associated rocks. A number of dykes have been mapped running transversely across this route option close to the proposed western tunnel portal in the Letteragh area.

The bedrock changes to the metagabbro and orthogneiss suite as the proposed tunnel approaches its proposed crossing of the River Corrib. The metagabbro and orthogneiss suite is shown on the GSI mapping extending to the River Corrib. The interface between the Devionan rocks and the Lower Carboniferous (Visean) Age Burren Limestone is unclear with the GSI showing the contact running along the river. Additional ground investigation would be required in order to determine the location of the contact. The tunnel would run in the limestone bedrock until the eastern portal at Terryland. Limestone underlies the remainder of this route option to the existing N6 tie-in.

Subsoils

The following are subsoil features of the Orange2 Route Option.

The subsoils underlying the route are shown on **Figures 7.6.2.7** and **7.6.2.8**. The GSI mapping suggests that from the Bearna area as far as the Letteragh area, the subsoils typically consist of glacial till or sandy gravely clay principally derived from the underlying bedrock. Large granite boulders would likely be encountered and rock outcropping is widespread.

The subsoils over the tunnel consist of Made Ground and Glacial Till derived from the granite bedock. Soft alluvial soils would be encountered in the River Corrib area before reverting to Made Ground and Glacial Till material derived from Limestone on the eastern side of the River Corrib.

The eastern tunnel portal at Terryland would be situated in glacial tills. The approach roads and N84 interchange would likely be affected by the soft, compressible deposits in the Terryland River Valley. The subsoils in the Terryland River Valley consist of peat overlying calcareous silts overlying organic and inorganic lake muds. These soils are soft, highly compressible and prone to high rates of secondary compression. The geotechnical characteristics and challenges presented during the construction of the existing N6 are described by Flood and Eising (1987), Hunt (1991) and Naughton and Rodgers (2003). The soft soils are bounded by glacial till derived from limestone on the higher ground.

As this route option rises out of the Terryland River Valley the subsoils consist of glacial till derived from the parent limestone rock. The depth to bedrock is variable and outcrops of Limestone bedrock are evident for the remainder of the route option travelling eastwards.

Soils

The following are soil features of the Orange2 Route Option.

The soils underlying the route are shown on **Figures 7.6.2.5** and **7.6.2.6.** From the Bearna area as far as the Letteragh area, the soils are poorly drained clays with sporadic peaty deposits with occasional well drained soils on slopes. The soils are of a moderate to very poor quality from an agricultural perspective.

The Orange2 Route Option enters the urban environment in the Letteragh area where Made Ground predominates. Where the proposed tunnel emerges into the Terryland River Valley the soils are peaty in nature and are of a very poor quality from an agricultural perspective.

This route option terminates in a greenfield site between Briarhill and Coolagh.

Overview of ground conditions in karst limestone areas

The proposed tunnel would encounter limestone bedrock at the interface with Devionan/Ordovician formations. Little is known at this stage about the nature and distribution of underground karst features in the area. It is probable that the limestone rock is karstified. The frequency and nature of the karst features is difficult to determine without extensive ground investigation and probing and this would be required during tunnelling operations.

The Orange2 Route Option passes through limestone regions on the eastern side of the River Corrib. The GSI karst database identified enclosed depressions (K88) adjacent to this route option in the vicinity of Coopers Cave (K89).

It is likely that this route option would encounter the limestone bedrock at the formation level of the route adjacent to the N17 Junction. Where the Orange2 Route Option is in cutting or the formation level is close to rockhead level, additional investigations would be required to assess the potential geohazards from cavities in the rock.

At the eastern end of the route option a number of springs (K131, K144) and enclosed depressions (K139, K317) are indicated on the GSI karst database.

At the eastern end of the option, a number of enclosed depressions (K172, K175 and K179) were confirmed. A number of springs were recorded on the GSI karst database (K161, K176, K178, K180 and K181) but unconfirmed / not found during the karst site survey.

Overview of Historical Land use

The following are historical land use features of the Orange2 Route Option.

Land use in the western extents of the Orange2 Route Option was and is primarily agricultural and residential.

The area along the Terryland River Valley has not been fully developed, partly due to the presence of soft ground. Historical mapping shows that this area was prone to flooding. This flooding was alleviated by flood protection works that commenced in the 19th century.

Much of the land use to the east of the River Corrib has changed from agricultural to commercial, industrial and residential use in recent years.

A series of quarries are shown on the OSI 25" mapping from where the Orange2 Route Option passes Coopers Cave (K89) and the existing N6 at Ballybrit. The backfill materials (if any) in the quarries would require further assessment. The impact of Historical Land use on this route option is assessed as low although further investigation at detailed design stage would be required.

Overview of the Economic Geology

The Orange2 Route Option does not impact on existing quarries or prospective expansion of quarries. This route option passes through a predominantly urban landscape which is unlikely to be suitable for mining or quarrying activities.

A series of historical pits/quarries are shown on the OSI 25" mapping from where the Orange2 Route Option passes Coopers Cave and the existing N6 at Ballybrit. The backfill materials (if any) in the quarries would require further assessment.

It is unlikely that a quarry could be developed outside of the urban areas along this route corridor.

Overview of the Geological Heritage

The Geological Heritage constraints are shown on **Figures 7.6.2.1** and **7.6.2.2**. This route option does not impact on the identified sites

This route option would involve deep excavations in bedrock across the city and would expose a variety of bedrock types. These temporary exposures would provide greater information on the bedrock geology of Galway which could be considered as a beneficial impact of this route option.

Impact assessment

The impact of the Orange2 Route Option on attributes identified in the constraints study are summarised in **Table 7.6.2.6** below.

Table 7.6.2.6. Assessment of the soil and geology impacts for the Orange2 Route Option

Attribute	Attribute importance	Impact	Level of impact
Soils – route wide	Low	Loss of low fertility soil over limited section of route	Minor negative
Peat/soft soils at Terryland	Very High	Ground improvement and/or excavation and replacement would be required	Major negative
Bedrock	Medium	Deep cuttings exposing the bedrock would increase the geological heritage	Minor positive
Karst – route wide	Medium	Karst features may require additional engineered solutions in order to ensure an acceptable risk level for design life of road.	Moderately negative
Karst Feature K89; Coopers Cave	High	The karst features has been listed on SEA Environmental Report of the Galway City Development Plan. The route may impact on the stability of the cave system. Further investigations would be required.	Moderately negative
Historical landuse – route wide	Low	Historical landuses and backfill material (if any) in historic quarries require investigation in order to rule out potential contamination	Minor negative
Economic geology – route wide	Low	There is no impact on existing quarries or prospective expansion of quarries.	Negligible
Geological Heritage – route wide	Medium	The route would provide greater exposure of bedrock underlying Galway.	Minor positive

Yellow2 Route Option

The Yellow2 Route Option has changed in the western areas from that described in **Section 6.1.1**. The revised Yellow2 Route Option is at-grade or in shallow cuttings of less than 3m from the tie-in at the R336 to the proposed roundabout in Na Foraí Maola Thiar. Based on the geological mapping from the GSI, the ground conditions are likely to consist of glacial till overlying weathered and intact rock.

The biggest change which impacts on soil and geology is the increase in the footprint of the cutting at Briarhill to accommodate additional traffic lanes. The level of impact at this location remains as 'High', unchanged from the assessment in **Section 6.5.2 Soils and Geology**.

Overview of the Yellow2 Route Option

The Yellow2 Route Option has a number of significant geotechnical challenges. The principal cuttings and embankments on the Yellow2 Route Option are described in **Tables 7.6.2.7** and **7.6.2.8** below and shown on **Figures 7.6.2.11** and **7.6.2.12.**

Table 7. 6.2.7 Principal cuttings along the Yellow2 Route Option

Section	Name	Location	Length (m)	Max cutting depth (m)	Level of impact
1	Yellow C4	Na Foraí Maola Thoir	270	5 - 10	Low
1	Yellow C7	Trusky East	20	0 - 5	High[1]
1	Yellow C8	Trusky East	180	0 - 5	High[1]
2	Yellow C18	Keeraun	330	10 - 15	Medium
2	Yellow C22	Barnacranny to Dangan Upper	500	10 - 15	Medium
2	Yellow C24	Coolagh to Ballinfoyle	490	5 - 10	Low
2	Yellow C25	Glenanail to Ballybrit	1290	5 - 10	High[2]
2/3	Yellow C26	Ballybrit to N6	2865	10 - 15	High[3]

Note: In addition to the max cutting depth the location impact is influenced by:

1. *Presence of soft ground;*
2. *Presence of a number of Karst Features including K89 and length of cutting; and*
3. *Length of cutting and presence of Karst Features.*

Table 7.6.2.8 Principal embankments along the Yellow2 Route Option

Section	Name	Location	Length (m)	Max embankment height (m)	Level of impact
1	Yellow E4	Na Foraí Maola Thiar to Thoir	520	5 - 10	Low
1	Yellow E5	Trusky West	530	5 - 10	Low
1	Yellow E7	Trusky West	60	0 - 5	High[1]
1	Yellow E8	Trusky East	40	0 - 5	High[1]
1	Yellow E10	Trusky East to Aille	820	5 - 10	Low
1 / 2	Yellow E13	Aille to Cappagh	490	10 - 15	High[1]
2	Yellow E20	Keeraun to Mincloon	1020	10 - 15	High[2]
2	Yellow E21	Rahoon	180	5 - 10	Low
2	Yellow E22	Rahoon to Barnacranny	670	5 - 10	Low
2	Yellow E23	Dangan Upper to Dangan	1190	10 - 15	High[3]
2	Yellow E24	Menlough to Coolagh	1470	>15	High[3]
2	Yellow E26	Ballinfoyle to Glenanail	970	10 - 15	High[2]

Note: In addition to the max embankment depth the location impact is influenced by:

1. *Presence of soft ground;*
2. *Length of embankment; and*
3. *Presence of soft ground and length of embankment.*

The following features are associated with the principal cuttings and embankments and associated infrastructure provision for the Yellow2 Route Option.

In areas where the Yellow2 Route Option is close to grade in the western extent of this route option, it is possible that peat and other soft deposits may need to be excavated and replaced with materials to support the roadbed.

There is a deep cutting in the Dangan area on the Yellow2 Route Option. The maximum depth of this cutting is approximately 14m and would likely be partly in Errisbeg Granite.

This route option is on embankments up to 14m high in Upper Dangan before crossing the River Corrib. Boreholes in the vicinity of the proposed bridge suggest that competent limestone is located at 5m – 10m below ground level in this area.

East of the River Corrib in the Menlough area, Yellow2 Route Option, outside viaduct areas, is on embankment. The foundation soils in this area are largely glacial till over limestone bedrock. Potential geohazards from karst in the limestone would need further investigation. **Figure 7.6.2.6** shows the option being underlain by alluvium for a short section. The nature and extent of these deposits would need further assessment.

This route option enters a cutting in the Caraig Ban area before emerging onto embankment again in the Ballinfoyle area. This route option impacts on residential developments in the area where there is a low potential for encountering contaminated ground associated with the construction of the development.

This route option is on high embankment in a soft ground area adjacent to the Terryland River Valley. The embankments associated with this interchange would likely require piled foundations or extensive ground improvement to ensure that stability and settlement requirements would be achieved.

The Yellow2 Route Option runs over an area close to the Coopers Cave complex (K89) to the rear of Glenanail. There would be a potential impact on the Cave complex due to karstic features in their vicinity. The Yellow2 Route Option enters a cut in the vicinity of the cave complex travelling between the N17 and City East Business Park Junctions. The geology in this area would likely consist of glacial till over limestone.

Following the cutting between the N17 and City East Business Park Junctions the route follows the existing ground profile before entering a deep cutting at Briarhill which is approximately 2,000m long and connects to the existing N6. This cutting would likely be in glacial till and limestone and the depth of the cutting would be up to 15m. The extent of the cutting has been locally increased to accommodate additional traffic lanes from the option assessed at Stage 1. Further investigation would be required in order to determine the geological profile of Yellow2 Route Option.

Overview of Solid Geology, Subsoils and Soils along Yellow2 Route

Bedrock

The bedrock geology underlying this route option is shown on **Figures 7.6.2.3** and **7.6.2.4**. There are two principle forms of bedrock underlying this route option. From the R336 west of Bearna to the Dangan area the bedrock consists of undifferentiated granite and associated rocks. A number of dykes have been mapped running transversely across this route option in the Letteragh area. The geological mapping from the GSI indicates that the Metagabbro and orthogneiss suite may be present for a very limited section of this route option at Dangan. This route option would likely be on embankment and the impact of the bedrock is limited.

The bedrock changes to the Lower Carboniferous (Visean) Age Burren Limestone at Dangan. Limestone underlies the remainder of this route option to the existing N6 tie-in.

Subsoils

The following are subsoil features of the Yellow2 Route Option.

The subsoils underlying this route option are shown on **Figures 7.6.2.7** and **7.6.2.8**. The GSI mapping suggests that from R336 to the Letteragh area the subsoils typically consist of glacial till or sandy gravely clay principally derived from the underlying bedrock. Large granite boulders are likely to be encountered and rock outcropping is widespread.

As the Yellow2 Route Option approaches the River Corrib the subsoils consist of Made Ground, soft alluvial soils and glacial till derived from limestone and granite. On the eastern side of the River Corrib limestone paving dominates much of this

route option in the Menlough area and there are pockets of alluvium associated with the flood plain of the River Corrib. Glacial till derived from Limestone with occasional granite erratics overlie the Limestone bedrock between the River Corrib until this route option enters the Terryland River Valley.

The subsoils in the Terryland River Valley consist of peat overlying calcareous silts overlying organic and inorganic lake muds. These soils are soft, highly compressible and prone to high rates of secondary compression. The geotechnical characteristics and challenges presented during the construction of the existing N6 are described by Flood and Eising (1987), Hunt (1991) and Naughton and Rodgers (2003). The soft soils are bounded by glacial till derived from limestone on the higher ground.

As this route option rises out of the Terryland River the subsoils consist of glacial till derived from the parent limestone rock. The depth to bedrock is variable and outcrops of limestone bedrock are evident for the remainder of the option travelling eastwards.

Soils

The following are soil features of the Yellow2 Route Option.

The soils underlying the Yellow2 Route Option are shown on **Figures 7.6.2.5** and **7.6.2.6**. From the R336 to the Letteragh area the soils are poorly drained clays with sporadic peaty deposits with occasional well drained soils on slopes. The soils are of a moderate to very poor quality from an agricultural perspective. Made Ground in the form of playing fields, sports grounds and residential developments form the western approach to the River Corrib. The soils on the eastern side of the River Corrib consist of well drained glacial till.

This route option enters into the Terryland River Valley where the soils are peaty in nature and are of a very poor quality from an agricultural perspective. This route option terminates in a greenfield site between Briarhill and Cloonagh.

<u>Overview of ground conditions in karst limestone areas</u>

The Yellow2 Route Option passes into the limestone regions in the vicinity of the existing N59. There are springs in the area (K14) which likely originate from the granite/limestone interface. There are further springs (K25 and K45) in the Menlough area. There is a Turlough (K31) in the Menlough area and enclosed depressions (K44 and K49).

The Yellow2 Route Option merges with the Red2 Route Option at Terryland and similar karst geohazards would be encountered. The GSI karst database identifies enclosed depressions (K72 and K88) adjacent to this route option in the vicinity of Coopers Cave (K89).

It is likely that this route option would encounter the limestone bedrock at the formation level of the route adjacent to the N17 junction. Where the Red2 Route Option is in cutting or the formation level is close to rockhead level, additional investigations would be required to assess the potential geohazards from cavities in the rock.

At the eastern end of the option, a number of enclosed depressions (K172, K175 and K179) were confirmed. A number of springs were recorded on the GSI karst

database (K161, K176, K178, K180 and K181) but unconfirmed / not found during the karst site survey.

Overview of Historical Land use

The following are historical land use features of the Yellow2 Route Option.

Land use in the western extents of the Yellow2 Route Option was and is primarily agricultural and residential.

Much of the land use to the east of the River Corrib has changed from agricultural to commercial, industrial and residential use.

The area along the Terryland River Valley has not been fully developed, partly due to the presence of soft ground. Historical maps show that this area was prone to flooding. This flooding was alleviated by flood protection works that commenced in the 19th century.

A series of quarries are shown on the OSI 25" mapping from where the Yellow2 Route Option passes Coopers Cave and the existing N6 at Ballybrit. The backfill materials (if any) in in the quarries merits further investigation.

The impact of Historical Land use on the route is assessed as low although further investigation at detailed design stage would be required.

Overview of the Economic Geology

This route option does not impact on existing quarries or prospective expansion of quarries. The existing environment is unlikely to be suitable for mining or quarrying activities

Overview of the Geological Heritage

The Geological Heritage constraints are shown on **Figures 7.6.2.1** and **7.6.2.2**. This route option does not impact on the identified sites. Coopers Cave is identified as a geological site in the Galway City Development Plan. It is marked as a local important feature and a County Geological site. It is not however, listed as a Geological Heritage Site by the GSI and consequently has no statutory protection.

Impact assessment

The impact of the Yellow2 Route Option on attributes identified in the constraints study are summarised below in **Table 7.6.2.9**.

Table 7.6.2.9 Assessment of the soil and geology impacts for the Yellow2 Route Option

Attribute	Attribute importance	Impact	Level of impact
Soils – route wide	Low	Loss of low fertility soil over limited section of route	Minor negative
Peat/soft soils – route wide	Medium	Excavation and replacement likely to be required for shallow deposits. Disposal of peat and soft soils requires identification of suitable disposal site.	Moderately negative
Bedrock	Medium	Deep cuttings exposing the bedrock would increase the geological heritage	Minor positive
Karst route wide	Medium	Karst features may require additional engineered solutions to ensure an acceptable risk level for the route duing its design life.	Moderately negative
Karst Feature (K89); Coopers Cave	High	The route may impact on the stability of the cave system. Further investigations are required.	Moderately negative
Historical landuse – route wide	Low	Historical landuses and backfill material (if any) in historic quarries require investigation in order to rule out potential contamination	Minor negative
Economic geology – route wide	Low	There is no impact on existing quarries or prospective expansion of quarries.	Negligible
Geological Heritage – route wide	Medium	The route option would provide greater exposure of bedrock underlying Galway.	Minor positive

Blue2 Route Option

The Blue2 Route Option has changed from that described in **Section 6.1.1**. The alignment of the tunnel at Lackagh Quarry has been modified and the N17 Junction has been revised resulting in an increased cutting depth.

Overview of the Blue2 Route Option

The Blue2 Route Option includes tunnels beneath the Lough Corrib cSAC and Galway Racecourse and includes viaducts in the Dangan area and the Menlough area. The principal cuttings and embankments are described in **Tables 7.6.2.10** and **7.6.2.11** below and are shown on **Figures 7.6.2.11** and **7.6.2.12**.

Table 7.6.2.10 Principal cuttings along the Blue2 Option

Section	Name	Location	Length (m)	Max cutting depth (m)	Level of impact
1/2	Blue C3	An chloch Scoilte to Aille	900	5 - 10	Low
2	Blue C6	Keeraun	310	10 - 15	Medium
2	Blue C10	Barnacranny	500	10 - 15	Medium
2	Blue C11	Coolagh	180	10 - 15	Medium[1]
2	Blue C12	Coolagh	50	5 - 10	Low
2	Blue C13	Ballindooley	150	>15	High
2	Blue C15	Castlegar	520	5 - 10	Low
2	Blue C16	Parkmore to Doughiska	3170	>15	High[1]

Note: In addition to the max cutting depth the location impact is influenced by:

1. Presence of a number of Karst Features.

Table 7.6.2.11 Principal embankments along the Blue2 Option

Section	Name	Location	Length (m)	Max embankment height (m)	Level of impact
1	Blue E1	Trusky East	355	5 - 10	Low
2	Blue E4	Aille	110	5 - 10	Low
2	Blue E5	Aille to Ballnahown East	1190	5 - 10	Medium[1]
2	Blue E8	Keeraun to Mincloon	1020	10 - 15	High[1]
2	Blue E9	Rahoon	190	5 - 10	Low
2	Blue E10	Rahoon to Barnacranny	660	5 - 10	Low
2	Blue E11	Dangan Upper to River Corrib	1210	10 - 15	High[2]
2	Blue E12	Menlough	1250	>15	High[2]
2	Blue E13	Coolagh to Ballindooley	370	10 - 15	Medium
2	Blue E14	Ballindooley to Castlegar	680	>15	High[3]
2	Blue E15	Castlegar	310	10 - 15	Medium4
2	Blue E16	Castlegar to Parkmore	460	10 - 15	Medium

Note: In addition to the max embankment depth the location impact is influenced by:

1. *Length of embankment;*
2. *Length of embankment, presence of soft ground and Karst Features;*
3. *Presence of soft ground; and*
4. *Presence of Karst Features.*

The following features are associated with the principal cuttings and embankments and associated infrastructure provision for the Blue2 Route Option.

In areas where the option is close to grade in the western extent of the scheme, it is possible that peat and other soft deposits may need to be excavated and replaced with materials to support the roadbed.

The route option enters a cutting in the Chloch Scoilte area. The maximum depth of the cutting would be approximately 9m and the excavation would extend into the granite.

There is a deep cutting in the Dangan area on the Blue2 Route Option. The maximum depth of this cutting would be approximately 14m and would likely be partly in Errisbeg Granite.

This route option is on embankments up to 14m high in Upper Dangan before crossing the River Corrib. Boreholes in the vicinity of the proposed bridge suggest that competent limestone is located at 5m – 10m below ground level in this area.

This route option, outside viaduct areas in the Menlough area is on embankment. The foundation soils in this area are largely glacial till over limestone bedrock. Potential geohazards from karst in the limestone would need further investigation at detailed design stage.

A tunnel is proposed adjacent to Lackagh Quarry and underneath the Lough Corrib cSAC. This tunnel is proposed to avoid significant impacts on areas of environmental importance. The tunnel would likely be formed using either, drill and blast. Roadheader or a tunnel boring machine. There are a greater number of options for forming the tunnel for this option than the tunnel for the Orange2 Route Option for the following reasons:

- The tunnel would be at a higher elevation than the River Corrib or other waterbodies so recharge of groundwater may nto be as problematic as the Orange2 Route Option; and
- Visual exposure of the limestone is available at Lackagh Quarry. The beddingof the rock appears favourable although the presence of faults in the rock face is evident. Support from rock bolts could be sued to mitigate these unfavourable conditions.

The tunnel emerges into Lackagh Quarry and is supported on an embankment as the alignment rises. A combination of cuttings against the quarry face on the eastern side and embankment on the western side would be used. The stability of the existing quarry face would require closer assessment and remediation such as rock netting or rock traps.

This route option enters a cut and cover tunnel at the Galway Racecourse. This tunnel would likely involve excavation of glacial till and limestone bedrock.

Surface reinstatement requirements would have to be determined through discussions with the Galway Racecourse.

Following the cut and cover tunnel the route enters a deep cutting through Briarhill which is approximately 3,000m long and connects to the existing N6. This cutting would likely be in glacial till and limestone and the depth of the cutting would be up to 15m.

Further investigation is required in order to determine the geological profile of Blue2 Route Option.

Overview of Solid Geology, Subsoils and Soils along Blue2 Route Option

Bedrock

The bedrock geology underlying this route option is shown on **Figures 7.6.2.3** and **7.6.2.4**. There are two principle forms of bedrock underlying this route option. From the R336 to the Dangan area the bedrock consists of undifferentiated granite and associated rocks. A number of dykes have been mapped running transversely across this route option in the Letteragh area. The geological mapping from the GSI indicates that the metagabbro and orthogneiss suite may be present for a very limited section of this route option at Dangan. This route option would likely be on embankment and the impact of the bedrock would be limited.

The bedrock changes to the lower carboniferous (visean) age Burren limestone at Dangan. Limestone underlies the remainder of this route option to the existing N6 tie-in.

Subsoils

The following are subsoil features of the Blue2 Route Option.

The subsoils underlying this route option are shown on **Figures 7.6.2.7** and **7.6.2.8**. The GSI mapping suggests that from the R336 to the Letteragh area the subsoils typically consist of glacial till or sandy gravely clay principally derived from the underlying bedrock. Large granite boulders would likely be encountered and rock outcropping is widespread.

As the Blue2 Route Option approaches the River Corrib the subsoils consist of Made Ground associated with the Dangan NUIG Recreational Facilities, soft alluvial soils and glacial till derived from limestone and granite. On the eastern side of the River Corrib limestone pavment is present over much of this route option extending to the western tunnel portal with pockets of alluvium associated with the flood plain of the River Corrib.

The GSI mappings shows peat associated with Ballindooley Lough encroaching on the design for this route option. Glacial till derived from Limestone with occasional granite erratics overlie the Limestone bedrock and Made Ground dominate this route option from the N84 Headford Road to the existing N6 tie-in.

Soils

The following are soil features of the Blue2 Route Option.

The soils underlying the Blue2 Route Option are shown on **Figures 7.6.2.5** and **7.6.2.6.** From the R336 to the Letteragh area the soils are of a poorly drained clays with sporadic peaty deposits with occasional well drained soils on slopes. The soils

are of a moderate to very poor quality from an agricultural perspective. Made Ground in the form of playing fields, sports grounds and residential developments form the Letteragh area to the River Corrib.

The soils on the eastern side of the River Corrib consist of well drained Glacial till. Made Ground is encountered in the form of residential developments, roads and modifications to the Galway Racecourse. The Blue2 Route Option terminates in a greenfield site between Briarhill and Cloonagh

Overview of ground conditions in karst limestone areas

The Blue2 Route Option passes into the limestone region in the vicinity the existing N59. There are springs in the area (K14) which likely originate from the granite/limestone interface. There are further springs (K25 and K45), a Turlough (K31) and enclosed depressions (K49, K51, K54) noted in the Menlough area.

Further enclosed depressions have been identified (K59, K61, K62, K64, K67, K70, K71 and K97) and noted between Lackagh Quarry and Galway Racecourse.

At the eastern end of this route option at the N6 Tie-in a number of enclosed depressions (K172, K175, K176, K193) were confirmed. A number of springs were recoreded on the GSI karst database (K161, K176, K178, K180 and K181) but unconfirmed/not found during the karst site survey.

Overview of the Historic Land use

The following are historical land use features of the Blue2 Route Option.

Land use in the western extents of the Blue2 Route Option was and is primarily agricultural and residential.

The Blue2 Route Option traverses Lackagh Quarry which is no longer active, the quarry has extended into the surrounding agricultural land. The land use between the Lackagh Quarry and Galway Racecourse is predominantly agricultural and residential. There are a series of commercial properties with an adjacent storage yard housing construction equipment in the N84 area. Additional investigations would be required in this area in order to determine if contaminants are present.

This route option passes existing commercial buildings adjacent to the N17 before entering Galway Racecourse lands. Much of the land use to the east of the River Corrib has changed from agricultural to commercial, industrial and residential use.

The impact of historical land use is assessed as low although further investigation at detailed design stage in order to determine if contaminants are present would be required.

Overview of the Economic Geology

The Blue2 Route Option does not impact on existing active quarries or prospective expansion of quarries. The quarry at Lackagh is currently not an active resource.

Overview of the Geological Heritage

The Geological Heritage constraints are shown on **Figures 7.6.2.1** and **7.6.2.2**. This route option does not impact on the identified sites. The Blue2 Route Option would enter Lackagh Quarry and present panoramic views of extensive rock cuttings on a scale not present on any Irish road. The construction of a cut and cover tunnel and

a bored tunnel would also result in a greater understanding of the lithology of the limestone bedrock. This route option would have a positive impact on Geological Heritage.

Impact assessment

The impact of the Blue2 Route Option on attributes identified in the constraints study are summarised in **Table 7.6.2.12**.

Table 7.6.2.12 Assessment of the soil and geology impacts for the Blue2 Route Option

Attribute	Attribute importance	Impact	Level of impact
Soils – route wide	Low	Loss of low fertility soil over limited section of route	Minor negative
Peat/soft soils – route wide	Medium	Excavation and replacement likely to be required for shallow deposits. Disposal of peat and soft soils would require identification of suitable disposal site.	Moderately negative
Bedrock – route wide	Medium	Deep cuttings exposing the bedrock would increase the geological heritage	Minor positive
Karst – route wide	Medium	Karst features may require additional engineered solutions to ensure an acceptable risk level for the route during its design life.	Moderately negative
Historical landuse – route wide	Low	Historical landuses and backfill material (if any) require investigation in order to rule out potential contamination	Minor Negative
Economic geology – route wide	Low	No impact on existing active quarries or prospective expansion of quarries	Negligible
Geologial Heritage – route wide	Medium	The route option would provide greater exposure of bedrock underlying Galway.	Minor positive

Pink2 Route Option

The Pink2 Route Option has changed from that described in **Section 6.1.1**. The following summarises the amendments which impact on the soils and geology assessment:

- At the western end of this route option the alignment has been modified;
- The N6/N59 Junction has moved slightly north;
- The N59 link road has been realigned reducing the vertical alignment and the impact on the soils and geology;
- The River Corrib crossing has been moved slightly north of the previous crossing point;
- The alignment of the tunnel at Lackagh Quarry has been modified and the alignment of the route option emerging from the tunnel into the disused quarry has been modified;
- The junction with the N84 has been modified. The previous junction has been removed and the cutting has been reduced. This has a positive impact on the assessment;
- The footprint of the embankment at Castlegar has been reduced;
- The cutting depth at the western approach to the N17 Junction has decreased though the footprint is now wider;
- There has been no change to the Galway Racecourse cut and cover tunnel; and
- The eastern tie-in to the existing N6 has been modified to bring this route option and N6 Junction closer to the existing N6. The modification involves placing the route option in a cutting under the R339 Briarhill Road. The Pink2 Route Option would emerge from the cutting in a greenfield environment at Briarhill. The junction with the existing N6 and the R446 would involve a series of cuttings and embankments to create a free flow junction.

The modifications to the eastern tie-in have had a positive impact on the assessment as the depth and extent of the cuttings has been reduced.

Overview of the Route Option

The Pink2 Route Option includes tunnels beneath the Lough Corrib cSAC and Galway Racecourse and includes viaducts in the Dangan area and the Menlough area. The Pink2 Route Option is routed around Galway Racecource before merging with the existing N6. The principal cuttings and embankments are described in **Tables 7.6.2.13** and **7.6.2.14** and are shown on **Figures 7.6.2.11** and **7.6.2.12**.

Table 7.6.2.13 Principal cuttings along the Pink2 Route Option

Section	Name	Location	Length (m)	Max cutting depth (m)	Level of impact
2	Pink C5	Keeraun	340	10 - 15	Medium
2	Pink C8	Barnacranny to Dangan Upper	800	>15	High
2	Pink C9	Coolagh	180	10 - 15	Medium[1]
2	Pink C10	Coolagh	50	5 - 10	Low
2	Pink C11	Ballindooley	150	>15	High
2	Pink C13	Castlegar	590	5 - 10	Low
2 / 3	Pink C14	Parkmore to N6	2259	>15	High[2]

Note: In addition to the max cutting depth the location impact is influenced by:

1. *Presence of karst features;*
2. *Presence of karst features and length of cutting.*

Table 7.6.2.14 Principal embankments along the Pink2 Route Option

Section	Name	Location	Length (m)	Max embankment height (m)	Level of impact
1	Pink E1	Trusky East to Aille	1620	5 - 10	Medium[1]
1 / 2	Pink E4	Aille to Ballnahown East	1350	5 - 10	High[2]
2	Pink E7	Keeraun to Mincloon	1010	10 - 15	High[1]
2	Pink E8	Rahoon	740	10 - 15	Medium
2	Pink E9	Dangan Upper	910	10 - 15	High[3]
2	Pink E10	Menlough	550	>15	High[3]
2	Pink E11	Menlough	350	5 - 10	Medium[4]
2	Pink E12	Coolagh to Ballindooley	370	10 - 15	Medium[4]
2	Pink E13	Ballindooley to Castlegar	680	>15	High
2	Pink E14	Castlegar	310	10 - 15	Medium[4]
2	Pink E15	Castlegar to Parkmore	390	5 - 10	Low

Note: In addition to the max embankment depth the location impact is influenced by:

1. *Length of embankment;*
2. *Length of embankment and presence of soft ground;*
3. *Presence of soft ground and karst features; and*
4. *Presence of karst features.*

The following features are associated with the principal cuttings and embankments and associated infrastructure provision for the Pink2 Route Option.

In areas where the option is close to grade in the western extent of the scheme, it is possible that peat and other soft deposits may need to be excavated and replaced with materials to support the roadbed.

The route option has been rerouted in the Bearna area. This has reduced the impact on soils and geology in the area.

There is a deep cutting in the Dangan area on the Blue2 Route Option. The maximum depth of this cutting is approximately 17m and would likely be partly in Errisbeg Granite.

This route option is on embankments up to 14m high in Upper Dangan before crossing the River Corrib. Boreholes in the vicinity of the proposed bridge suggest that competent limestone is located at 5m – 10m below ground level in this area.

This route option, outside viaduct areas in the Menlough area is on embankment.The foundation soils in this area are largely glacial till over limestone bedrock.Potential geohazards from karst in the limestone would need further investigation at detailed design stage.

A tunnel is proposed adjacent to Lackagh Quarry and underneath the Lough Corrib cSAC. This tunnel is proposed to avoid significant impacts on areas of environmental importance. The tunnel would likely be formed using either drill and blast, roadheader or a tunnel boring machine. There are a greater number of options for forming the tunnel for this option than the tunnel for the Orange2 Route Option for the following reasons:

- The tunnel would be at a higher elevation than the River Corrib groundwater control measures during the construction and design life of the tunnel may not be as problematic as the Orange2 Route Option; and
- Visual exposure of the limestone is available at Lackagh Quarry. The bedding of the rock appears favourable although the presence of faults in the rock face is evident. Support from rock bolts could be used to mitigate these unfavourable conditions.

The tunnel emerges into Lackagh Quarry and is supported on an embankment as the alignment rises. A combination of cuttings against the quarry face on the eastern side and embankment on the western side would be used. The stability of the existing quarry face would require closer assessment and remediation such as rock netting or rock traps.

This route option enters a cut and cover tunnel north of Galway Racecourse. This tunnel would likely involve excavation of glacial till and limestone bedrock. Reinstatement requirements would have to be determined through discussions with the Galway Racecourse and relevant stakeholders.

Following the cut and cover tunnel the route enters a deep cutting connecting to the proposed free flow interchange with the existing N6. The ground conditions consist of a thin covering of glacial till over limestone bedrock. No soft ground would be anticipated at this junction. Some karst features in the form of springs are noted on the mapping but are not evident in the field.

Further investigation is required in order to determine the geological profile of Pink2 Route Option.

Overview of Solid Geology, Subsoils and Soils along Pink2 Route Option

Bedrock

The bedrock geology underlying this route option is shown on **Figures 7.6.2.3** and **7.6.2.4**. There are two principle forms of bedrock underlying this route option. From the R336 west of Bearna to the Dangen area the bedrock consists of undifferentiated granite and associated rocks. A number of dykes have been mapped running transversely across this route option in the Letteragh Area. The geological mapping from the GSI indicates that the Metagabbro and orthogneiss suite may be present for a very limited section of this route option at Dangan. This route option is likely to be on embankment and the impact of the variation of bedrock would be limited.

The bedrock changes to the Lower Carboniferous (Visean) Age Burren Limestone at Dangan. The Limestone underlies the remainder of this route option to the existing N6 tie-in.

Subsoils

The following are subsoil features of the Pink2 Route Option.

The subsoils underlying this route option are shown on **Figures 7.6.2.7** and **7.6.2.8**. Made Ground would be encountered in urban areas in Bearna, principally associated with existing roads and developments. The GSI mapping suggests that from the R336 to the Letteragh area the subsoils typically consist of glacial till or sandy gravely clay principally derived from the underlying bedrock. Large granite boulders would likely be encountered and rock outcropping is widespread. There is also the potential to encounter some shallow blanket peat.

As the Pink2 Route Option approaches the River Corrib the subsoils consist of Made Ground, soft alluvial soils and glacial till derived from limestone and granite. On the eastern side of the River Corrib limestone paving dominates much of this route option in the Menlough area and there are pockets of alluvium associated with the flood plain of the River Corrib.

The GSI mappings shows peat associated with Ballindooley Lough encroaching on the design in the N84 Headford Road area. Limestone with occasional granite erratics overlie the limestone bedrock and made ground dominate this route option from the N84 Headford Road to the existing N6 tie-in.

Soils

The following are soil features of the Pink2 Route Option.

The soils underlying the Pink2 Route Option are shown on **Figures 7.6.2.5** and **7.6.2.6.** From the R336 to the Letteragh area the soils are of a poorly drained clays with sporadic peaty deposits with occasional well drained soils on slopes. The soils are of a moderate to very poor quality from an agricultural perspective. Made Ground is encountered in the form of playing fields, and residential developments form the Letteragh area to the River Corrib.

The soils on the eastern side of the River Corrib consist of well drained Glacial till. Made Ground is encountered in the form of residential developments, roads and modifications to Galway Racecourse. The Pink2 Route Option terminates in a greenfield site between Briarhill and Coolagh.

Overview of ground conditions in karst limestone areas

The Pink2 Route Option passes into the limestone region in the vicinity of the existing N59. There are springs in the area (K14) which likely originate from the granite / limestone interface. There are further springs (K25 and K45), a Turlough (K29) and enclosed depressions (K49, K51, K54) noted in the Menlough area.

Further enclosed depressions have been identified (K59, K61, K62, K64, K67, K70, K71 and K131) and noted between Lackagh Quarry and Galway Racecourse.

At the eastern end of this route option at the N6 tie–in a number of enclosed depressions (K172) were confirmed. A number of springs were recorded on the GSI karst database (K161, K176) but unconfirmed / not found during the karst site survey

Overview of the Historical Land use

The following are historical land use features of the Pink2 Route Option.

Land use in the western extents of the Blue2 Route Option was and is primarily agricultural and residential.

The Pink2 Route Option traverses Lackagh Quarry which is no longer active, the quarry has extended into the surrounding agricultural land. The land use between the Lackagh Quarry and Galway Racecourse is predominantly agricultural and residential. There are a series of commercial properties with an adjacent storage yard housing construction equipment in the N84 area

This route option passes existing commercial buildings adjacent to the N17 before entering Galway Racecourse lands. Much of the land use to the east of the River Corrib has changed from agricultural to commercial, industrial and residential use.

The impact of historical land use is assessed as low although further investigation at detailed design stage in order to determine if contaminants are present would be required.

Overview of the Economic Geology

The Pink2 Route Option does not impact on existing quarries or prospective expansion of quarries. The quarry at Lackagh is currently not an active resource. The existing environment is unlikely to be suitable for mining or quarrying activities.

Overview of the Geological Heritage

The Geological Heritage constraints are shown on **Figures 7.6.2.1** and **7.6.2.2**. This route option does not impact on the identified sites. The Pink2 Route Option would enter Lackagh Quarry and present panoramic views of extensive rock cuttings on a scale not present in any Irish road. The construction of a cut and cover tunnel and a bored tunnel would also result in a greater understanding of the lithology of the limestone bedrock. This route option would have a positive impact on Geological Heritage.

Impact assessment

The impact of this route on attributes identified in the constraints study are summarised in **Table 7.6.2.15** below.

Table 7.6.2.15 Assessment of the soil and geology impacts for the Pink2 Route Option

Attribute	Attribute importance	Impact	Level of impact
Soils – route wide	Low	Loss of low fertility soil over limited section of route	Minor negative
Peat/soft soils – route wide	Medium	Excavation and replacement would likely be required for shallow deposits. Disposal of peat and soft soils requires identification of suitable disposal site.	Moderately negative
Bedrock – route wide	Medium	Deep cuttings exposing the bedrock would increase the geological heritage	Minor positive
Karst – route wide	High	Karst features may require additional engineered solutions to ensure an acceptable risk level for the route during its design life.	Moderately negative
Historical landuse – route wide	Low	Historical landuses and backfill material (if any) require investigation in order to rule out potential contamination	Minor negative
Economic geology – route wide	Low	No impact on existing quarries or prospective expansion of quarries	Negligible
Geological Heritage – route wide	Medium	The route option would provide greater exposure of bedrock underlying Galway.	Minor positive

Green2 Route Option

The Green2 Route Option has changed from that described in **Section 6.1.1**. The following summarises the amendments which impact on the soils and geology assessment;

- The vertical alignment height has been reduced at the western tie-in;
- The vertical alignment height has been reduced between Bearna and the N59;
- The N17 Junction footprint has increased. This would further impact sections of the Roadstone quarry. The volume of excavation would be increased from the cutting;
- The depth of the cutting to the north of the Galway Racecourse has increased. The cutting is deeper all along the section at the rear of the racecourse;
- Impacts on the area would be minimised by utilising a cut and cover tunnel; and
- The layout of the eastern end of the Green2 Route Option has been modified. The alignment comes out of cutting at Breanloughaun and onto an embankment to cross the R339. This route option then goes into a series of shallow cuttings and embankments before merging with the existing N6.

Overview of the Green2 Route Option

The Green2 Route Option is the longest route option presented.

There are viaducts in areas of environmental importance and challenging terrain and there is a crossing of the River Corrib. The river crossing is located in a challenging location where extensive soft soil deposits are present. The cuttings and embankments are described in **Tables 7.6.2.16** and **7.6.2.17** below and are shown on **Figures 7.6.2.11** and **7.6.2.12**.

Table 7.6.2.16 Cuttings along the Green2 Route Option

Section	Name	Location	Length (m)	Max cutting depth (m)	Level of impact
1	Green C4	Trusky East	60	0 - 5	High[1]
2	Green C11	Keeraun	100	5 - 10	Low
2	Green C15	Tonabrocky to Ballagh	660	10 - 15	Medium
2	Green C18	Ballygarraun	470	5 - 10	Low
2	Green C20	Parkmore to Breanloughan	1890	>15	High[2]

Note: In addition to the max cutting depth the location impact is influenced by:

1. *Presence of soft ground; and*
2. *Length of cutting and presense of Karst features.*

Table 7.6.2.17 Embankments along the Green2 Route Option

Section	Name	Location	Length (m)	Max embankment height (m)	Level of impact
1	Green E1	Na Foraí Maola Thiar to Trusky West	1300	5 - 10	Medium[1]
1	Green E3	Trusky West to East	150	0 - 5	High[2]
1	Green E4	Trusky East	30	0 - 5	High[2]
1 / 2	Green E6	Trusky East to Cappagh	1510	10 - 15	High[1]
2	Green E9	Cappagh to Keeraun	640	5 - 10	Low
2	Green E11	Keeraun	640	5 - 10	Low
2	Green E14	Mincloon to Tonabrocky	1030	10 - 15	High[3]
2	Green E15	Ballagh to River Corrib	1370	> 15	High[4]
2	Green E16	Menlough	2530	10 - 15	High[5]
2	Green E17	Killoughter to Ballindooley	730	5 - 10	Low
2	Green E19	Ballindooley to Ballygarraun	1120	>15	High[5]
2	Green E20	Ballygarraun	240	5 - 10	Low
2	Green E21	Ballygarraun to Parkmore	460	5 - 10	Low
2	Green E22	Breanloughan to Coolagh	830	5 - 10	Low

Note: In addition to the max embankment depth the location impact is influenced by:

- *Length of embankment;*

- *Presence of soft ground;*
- *Length of embankment and presence of soft ground;*
- *Length of embankment, presence of soft ground and Karst features; and*
- *Length of embankment and presence of soft ground.*

The following features are associated with the principal cuttings and embankments and associated infrastructure provision for the Green2 Route Option.

In areas where the option is close to grade in the western extent of the scheme, it is possible that peat and other soft deposits may need to be excavated and replaced with materials to support the roadbed.

This option travels on an embankment from Mincloon to Tonabrocky with a maximum height of approximately 11m. The embankment traverses an area of soft compressible ground at Mincloon.

This route option enters a cutting in the Gortacleva area whose maximum depth would be approximately 10m. The cutting would likely encounter Errisbeg Granite. Further information on the stratification would be required for this area for detailed design stage.

This option travels on embankment in the Dangan area prior to crossing the N59. The approach embankment to the river crossing would likely encounter peat and other soft deposits in the flood plain of the river. The high embankment would likely require pile foundations or extensive ground improvement to meet the settlement and stability criteria.

The proposed bridge foundations would likely require pile foundations. Previous studies at the location of the 2006 GCOB proposed river crossing north of the Green2 Route Option suggested that there is a buried glaciated channel. The extent of the glaciated channel has not been determined. If the channel is present under the proposed river crossing for this route option, longer and /or more piles would likely be required to support the bridge.

The need to use a piling rig also brings impacts in terms of getting the heavy plant safely into position. It may be necessary to consider options such as a temporary piled structure or placing a heavily reinforced working platform on the soft ground to accommodate the weight of the piles, piling rig and any cranes and beams required to construct the bridge. Alternatively a barge may be moored into position at the foundations locations to accommodate the foundation equipment.

To the East of the River Corrib the Green2 Route Option is supported on embankments typically founded on glacial till overlying limestone bedrock. Shallow peaty deposits would likely be encountered in depressions. A very high embankment or viaduct (*c*.21m) would span across the low lying area near Ballindooley Lough.

This route option enters a cutting in limestone in Ballygarraun. The maximum depth of the cutting would be approximately 9m. It is likely that karst features would be encountered in the limestone. Further investigation using inclined boreholes and optical televiewers would be required in order to determine the optimum slope cutting angle.

This route option travels across the Roadstone Quarry as the route option approaches the N17 travelling eastwards. This is an active mineral resource.

This route option enters a cut and cover tunnel (maximum cutting depth approximately 24m) north of Galway Racecourse. This tunnel would likely involve excavation of glacial till and limestone bedrock. Reinstatement requirements would have to be determined through discussions with the Galway Racecourse and relevant stakeholders.

Further investigation work would be required in order to determine the Geological profile of Green2 Route Option.

Overview of Solid Geology, Subsoils and Soils along Green2 route

Bedrock geology

The bedrock geology underlying this route option is shown on **Figures 7.6.2.3** and **7.6.2.4**. There are two principal forms of bedrock underlying this route option. From the R336 to the Dangan area the bedrock consists of undifferentiated granite and associated rocks. The geological mapping from the GSI indicates that the metagabbro and orthogneiss suite may be present for a very limited section of this route option at Dangan. This route option is on embankment and the impact of the variation of bedrock would be limited.

The bedrock changes to the lower carboniferous (visean) age Burren limestone at Dangan. The Limestone underlies the remainder of this option route to the existing N6 tie-in.

Subsoils

The following are subsoil features of the Green2 Route Option.

The subsoils underlying this route option are shown on **Figures 7.6.2.7** and **7.6.2.8**. From the R336 to the N59, the subsoils consist of either glacial till or sandy gravely clay with a thin layer of peaty soil sporadically located along this route option. There are many large granite boulders present within the brown stony till.

Along the western banks of the River Corrib in the Bushypark/Upper Dangan area, the proposed route option is underlain by soft calcareous or organic clay and peat over limestone bedrock. Upon crossing the River Corrib, the route option encounters an area of rock outcrop on the eastern side of the bank. The subsoils gradually increase in depth with the GSI mapping showing glacial till derived from limestone becoming more extensive as this route option progresses from Lackagh Quarry to the existing N6 tie-in. Made Ground would be encountered in the form of residential properties, roads and commercial units at Galway Racecourse and the adjacent industrial units.

Soils

The following are soil features of the Green2 Route Option.

The soils underlying this route option are shown on **Figures 7.6.2.5** and **7.6.2.6.** On the western side of the Corrib where outcrops are not present, the soils are of a peaty nature and are of very poor quality from an agricultural perspective. Between the N59 and the River Corrib, there is a small quantity of medium quality soils although the majority of the soils in this area remain poor quality, being peaty in nature. The soil quality improves across the River Corrib, where acid brown earth

soils predominate. This is shallow in areas however, and as a result there is limited tillable land.

Made ground is encountered in the form of playing fields, commercial activities and residential developments across the route option.

Overview of ground conditions in karst limestone areas

The Green2 Route Option passes into the limestone region in the vicinity of the existing N59 at Glenlo Abbey. There are springs (K2, K7, K9) in the area which likely originate from the granite/limestone interface. Enclosed depressions (K10, K11) are noted on the west side of the River Corrib. On the east of the River Corrib Menlough area there is a spring (K17).

There is a Turlough (K20) and an enclosed depressions (K66) in the Menlough/Kilroghter area. Further clusters of depressions (K82, K83, K85, K94, K98, K100), an estavelle (K86) and a confirmed well (K92) are noted between Killoughter and Ballindooley and between Ballindooley and Ballygarraun. A number of sporadic depressions have been mapped in the Ballygarraun area.

In the area from the N17 Tuam Road to Coolagh, Briarhill there are two enclosed depressions (K131 and K165)

Overview of the Historical Land use

Land use in the western extents of the Green2 Route Option was and is primarily agricultural and residential.

The Roadstone Quarry on the Tuam Road has extended its footprint into the surrounding agricultural lands in recent years, the impact of the active quarry is assessed in Economic Geology.

Overview of the Economic Geology

The Green2 Route Option passes through the Roadstone quarry and would impact a significant proportion of the quarry. The quarry is the closest source of aggregates and concrete to Galway City.

There would likely be a buffer zone around this route option in which blasting would not permitted in order to minimise the risks associated with flyrock. Such zones typically range from 75m – 150m and would be dependent on the blasting techniques employed. Further assessments at detailed design stage would be required in order to determine buffer zone requirements.

Overview of the Geological Heritage

The Geological Heritage constraints are shown on **Figures 7.6.2.1** and **7.6.2.2**. The Roadstone Quarry at Twomileditch is a designated County Geological Site (CGS) due to its national/local geological heritage importance. The quarry contains clay wayboards, equivalent to the Ailween Member (terraced limestones) of the Burren formation. The Green2 Route Option would traverses the quarry, opening up the quarry and extensive exposure of the bedrock to the public.

A second CGS is located approximately 250 m from the Green2 Route Option near Menlough. This feature is a mushroom rock which, along with other similar rocks nearby, indicates former lake levels. The impact of the Green2 Route Option on this site is assessed as negligible.

Overall this route option is assessed as having a slightly positive impact on Geological Heritage.

Impact assessment

The impact of the Green2 Route Option on attributes identified in the constraints study are summarised in **Table 7.6.2.18** below.

Table 7.6.2.18 Assessment of the soil and geology impacts for the Green2 Route Option

Attribute	Attribute importance	Impact	Level of impact
Soils – western side of scheme	Low	Loss of low fertility soil over limited section of route	Minor negative
Soils – east side of scheme	Medium	Loss of medium fertility soil over limited section of route	Minor negative
Peat/soft soils – Western part of scheme	Medium	Excavation and replacement likely to be required for shallow deposits. Disposal of peat and soft soils requires identification of suitable disposal site.	Moderately negative
Peat/soft soils – river crossing	High	Extensive ground improvement and / or excavation and replacement of soft soils. Construction of bridge likely to require extensive temporary works.	Major negative
Bedrock	Medium	Deep cuttings exposing the bedrock would increase the geological heritage	Minor positive
Karst – route wide	High	Karst features may require additional engineered solutions to ensure an acceptable risk level for the route during its design life.	Moderately negative
Historical landuse – route wide	Low	Historical landuses may require investigation in order to rule out potential contamination	Minor negative
Econmic geology – Roadstone quarry	Very High	Sterilisation of large portions of quarry.	Major negative
Geological heritage – route wide	Low	The route option would provide greater exposure of bedrock underlying Galway	Minor positive

7.6.2.4 Summary

The route options have been assessed and ranked in terms of impact and preference in **Table 7.6.2.19 below**. The options have been split into Section 1, 2 and 3 as outlined in **Section 7.1**.

Table 7.6.2.19 Summary of Soils and Geology rankings of Route Options

Route Option	Section 1	Section 2	Section 3
Red2	I	LP	I
Orange2	P	LP	I
Yellow2	I	I	I
Blue2	P	I	I
Pink2	I	I	P
Green2	LP	P	P

Note: P = Preferred, I = Intermediate, LP = Least Preferred

Section 1

The Green2 and Yellow2 Route Options have the largest footprint and therefore are likely to have the highest impact. Both route options along with Red2 Option appear to cross a limited area of peaty topsoil. The Green2 Route Option has a series of higher embankments and deeper cuts and is assessed as having a marginally greater impact than the revised Yellow2 Route Option. The Green2 Route Option is deemed as the least preferred route option although it is an acceptable option in terms of impacts.

The rest of the route options are broadly similar. The Orange2, Pink2 and Blue2 Route Options do not traverse areas of soft compressible deposits. The Red2 and Orange2 Route Options have the smallest footprint. The extent of embankment and cutting sections along Blue2 Route Option is less than all other route options.

Blue2, Pink2, Orange2 and Red2 Route Option are considered the preferred routes although the differences between these Route Options are marginal and all are deemed acceptable.

Section 2

The Green2 Route Option is the preferable option from a soils and geology perspective. This route option does not involve a bored or cut and cover tunnel in an urban environment. However, the river crossing is located in a soft ground area and a piled embankment or staged construction would be required. The bridge foundations may be more complex than other options further downstream due to the presence of an in-fill valley feature and the very soft, compressible soils on the approaches to the bridge. The footprint of this route option is the longest. However, its design contains modest cuts similar to those used on many other Irish schemes in limestone and granite. The impact of the Green2 Route Option on historic land use and economic geology is high and more pronounced than any of the other route options. The Green2 Route Option is marginally preferable to the Yellow2, Blue2 and Pink2 Route Options.

The Yellow2 Route Option has a more preferable river crossing than the Green2 Route Option and the approach embankments would likely be constructed using conventional construction techniques. The Yellow2 Route Option avoids the tunnel used in the Blue2 or Pink2 Route Options in the Menlough area and this is deemed as having less impact. The route option would pass over deep deposits of soft, compressible soils in the Terryland River valley and come close to Coopers Cave, (K89).

The Pink2 Route Option has a more favourable river crossing location than the Green2 Route Option. Bedrock would likely be encountered at 5m to 10m below ground level. The Green2 Route Option in contrast would likely require complex pile foundations in an area with extensive soft soil deposits. The tunnel section carries more risk at this stage than surface options or cut and cover tunnels. However, the tunnel would be launched from an existing quarry, avoiding the need for a deep launch shaft, and would not pass under a water body, reducing the risk from groundwater inundation. The western section of the Pink2 Route Option contains some large cuttings which would generate aggregate for the construction of the route option. The exposure of the rock and enhancement of the geological heritage would be considered a mitigating measure. The Pink2 Route Option avoids the cut and cover tunnel through the centre of the Galway Racecourse by adopting a cut and cover tunnel to the north of the race track.

The Blue2 Route Option is similar to the Pink2 Route Option discussed within this section. The cut and cover tunnel under the racecourse would require excavations in glacial till and limestone rock. The reinstatement of the ground over the tunnel would be more complex than for typical tunnels and would have to be determined through discussions with the Galway Racecourse.

The Red2 and Orange2 Route Options are the least preferred options from a soils and geology perspective.

The Red2 Option is predominantly in an urban environment with the vertical profile of the road lowered along sections of this route option. The Red2 Route Option has a tunnel in a residential area which could be constructed using a bored method or a cut and cover method. The cut and cover tunnel along the R338 would likely require excavation of granite and metasediments to achieve the appropriate depth of excavation. This route option passes over the River Corrib and is routed through very soft, compressible soils in the Terryland River valley. Pile foundations or significant ground improvement measures would likely be required along much of this route option in the soft ground areas. The cut and cover sections at the existing N17 would have a lower risk levels than a bored tunnel.

The Orange2 Route Option would involve the construction of a bored tunnel through a variety of bedrock conditions. The tunnel would be launched on the west side in granite bedrock. Blasting would be required to efficiently lower the road profile to a sufficient depth to commence boring. A tunnel boring machine would likely be required to form the tunnel under the residential areas in Newcastle. The progress through the hard granite and Metasediments/Metagabbro/Othrogneiss rocks would likely be slower than in the limestone. The tunnel would pass through a series of contact regions between Granite and Metagabbro/Orthogneiss and then the Limestone and Metagabbro/Orthogneiss which would present challenges to the tunnelling operations. The tunnel would pass under the River Corrib which provides a steady state water source. Ingress of water into the tunnel would be a high concern and appropriate equipment and controls would need to be determined at detailed

design stage. The limestone is rich in karstic features which present challenges in terms of control of the excavation and groundwater control where voids would be encountered. The tunnel would pass under residential areas in Terryland where settlement control from the tunnel alignment may necessitate grouting and other mitigation measures. The eastern tunnel portal would likely be constructed close to the N84/N6 Junction. The existing N6 road alignment would need to be lowered in the Terryland area an area of soft, compressible ground to enter and exit from the tunnel. The impact of these works on the adjacent N6 carriageway would need careful examination at detailed design stage.

Section 3

Green 2 and Pink2 Route Options are deemed as the preferable options from a soils and geology perspective as these route options involve cut or fill sections less than 10m although all route options are broadly similar. Karst constraints have been identified near each of the route options and no soft soil deposits have been recorded resulting in embankment and cut size being used to distinguish the impact of each route option.

The Red2, Orange2, Yellow2 and Pink2 Route options have higher embankments and deeper cuttings, greater than 10m, than the Green2 and Pink2 Route Option. The footprint of each option is similar with the exception of the Green2 Route Option which connects with the N6 slightly further East.

All route options are deemed acceptable in terms of impacts.

7.6.2.5 References

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7.6.3 Hydrogeology

7.6.3.1 Introduction

This section details the Stage 2 assessment of the route options with respect to the hydrogeological constraints identified in Section 4.5 Hydrogeology. The route options as described in Section 7.1 together with the hydrogeology constraints are shown in Figures 7.6.3.1 and 7.6.3.2. Hydrogeology constraints include groundwater dependant terrestrial ecosystems and abstractions. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options.

Section 7.6.3.2 outlines the methodology that was used to carry out the assessment and Section 7.6.3.3 details the options assessment. Principal cuttings referred to in Section 7.6.3.3 are presented in Figures 7.5.2.11 and 7.5.2.12. A summary is presented in Section 7.6.3.4 and references are listed in Section 7.6.3.5.

The Stage 2 assessment comprises an assessment of the route options as described in Section 7.1 above. The Stage 1 assessment is described in Chapter 6. While the Stage 1 assessment identifies receptors which may be impacted by the route options, the Stage 2 assessment estimates the potential impact on the receptor identified as a result of the route option. Like the Stage 1 assessment the Stage 2 assessment relies on constraints study information. The constraints study includes information from desk study, route walkover and a survey of karst landforms.

7.6.3.2 Methodology

The assessment is undertaken in line with NRA (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

The route options were assessed to identify potential impacts on hydrogeological features, groundwater flow and groundwater quality which may subsequently impact on receptors such as groundwater dependent terrestrial ecosystems or groundwater abstraction. The NRA issued guidelines on rating the significance of impacts on hydrogeological features which are summarised below in **Table 7.6.3.1**.

Table 7.6.3.1 Criteria for rating impact significance at route selection stage as outlined in the NRA Guidelines

		Attribute importance				
		Extremely high	**Very high**	**High**	**Medium**	**Low**
Impact level	**Profound**	Any permanent impact on attribute	Permanent impact on significant proportion of attribute			
	Significant	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of attribute		
	Moderate	Temporary impact on small proportion of attribute	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of attribute	
	Slight		Temporary impact on small proportion of attribute	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of attribute
	Imperceptible			Temporary impact on small proportion of attribute	Temporary impact on significant proportion of attribute	Permanent impact on small proportion of attribute

For Stage 2 assessment, the route options are assessed in three sections. Section 1 extends from the R336 to the Galway City Boundary and Section 2 extends from the Galway City Boundary to the existing N6 in the east of the city. An additional break down at the N6 tie in at Coolagh has been incorporated in order to compare the junction layouts at the N6 tie in for the Stage 2 assessment. This section is referred to as Section 3.

The sections of each route option were assessed in terms of their impact level on groundwater dependant terrestrial ecosystems (GWDTE) and groundwater abstraction and ranked from imperceptible to profound. The potential impact from the route option on a GWDTE or groundwater abstraction will differ depending on the underlying geology. Each potential impact on groundwater from the route options are identified and assessed based on the local characteristics.

The analysis to date is based on a desk study and field walkover, which also includes a karst survey for the eastern section. Impact levels are assessed based on the proposed design of the route options and where information is absent any assumptions made regarding water table depths, flow paths and zone of contribution are done so conservatively. Where a Water Dependant Terrestrial Ecosystem (WDTE) is identified that may have groundwater input then these are considered to be as Groundwater Dependant Terrestrial Ecosystems (GWDTE), unless otherwise proven.

Imperceptible impact:

According to the NRA guidelines an imperceptible impact is one without noticeable consequences. Considering this NRA definition, an imperceptible potential impact in this assessment is where a route option and potential impact therefrom is outside of the GWDTE or groundwater abstraction Zone of Contribution (ZoC).

Slight potential impact:

According to the NRA guidelines, a slight potential impact is one which alters the character of the environment without affecting its sensitivities. Considering this NRA definition, a slight potential impact in this assessment is where the likelihood of groundwater impact is minimal and the distance from the receptor is so great that any impact is considered to be low.

Moderate potential impact:

According to the NRA guidelines, a moderate impact is one which alters the character of the environment in a manner that is consistent with existing or emerging trends. Considering this NRA definition, a moderate potential impact in this assessment is where groundwater impact is possible but the distance from receptor provides sufficient offset.

Significant potential impact:

According to the NRA guidelines, a significant impact is one which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment. Considering this NRA definition, a significant potential impact in this assessment is where groundwater impact is likely and the proximity to receptor does not provide sufficient offset.

Profound potential impact:

According to the NRA guidelines a profound impact is one which obliterates all previous sensitive characteristics. Considering this NRA definition, a profound potential impact in this assessment is where a highly valued GWDTE (protected by EU or national legislation e.g. SPA, NHA) is completely removed or the groundwater flow into or out of a GWDTE is completely prevented or the quality so impacted that the WDTE is permanently damaged and the GWDTE characteristic is lost.

7.6.3.3 Option Assessment

Overview of hydrogeology

The hydrogeological characteristics between the west and east of the scheme study area are substantially contrasting. In the west, the granite and orthogneiss are classified as a poor aquifer with groundwater being a limited resource, whilst in the east, the Visean Undifferentiated limestone is considered to be a regionally important aquifer. Refer to **Figures 7.6.3.1** and **7.6.3.2** which show the Pl aquifer in the west (granite and orthogneiss) and the Rkc in the east (limestone). The characteristics of both aquifers are summarised below.

- Groundwater levels in the granite bedrock are generally shallow and within 3m of ground level;

- The groundwater table generally correlates with the surface topography;
- Groundwater flows towards the Galway Bay coastline i.e. southwards and south eastwards;
- The aquifer has a generally low permeability, except for local zones where there is weathering and fracturing near fault lines; and
- The major groundwater pathway will be in the weathered zone, which may be deeper along faults and fractures where the permeability can be higher.

The main features of groundwater flow with the productive limestone aquifer are as follows:

- Groundwater levels in the scheme study area are generally flat lying with the depth to groundwater being deeper in areas of high ground and close to surface in areas of low ground, especially in topographic depressions such as Ballindooley Lough and Coolagh Lakes. There is likely to be significant seasonal and storm event variability to water levels;
- The groundwater level contours in karst aquifers tend not reflect the surface topography. The triple hydraulic properties of karst aquifers (matrix, fracture flow and conduit flow) can generate interactions between pathways that can be complex. However, analyses can give good insight to characterise the aquifer as to which pathway is dominant;
- Comparable with the western part of the scheme study area, the regional groundwater flow direction is towards Galway Bay coast, i.e. to the south and south west;
- Although the regional groundwater flow is in a south or south west direction, local variation in the groundwater flow direction exists; and
- The complexity of the groundwater flow is influenced by:

- Conduit system in the epikarst within which the groundwater moves rapidly; and
- Smaller fissures where groundwater flow is slower and is usually linked to the main conduit system.

Overview of Receptors

Receptors which may be impacted by changed in groundwater flow, level or quality include GWDTE and abstractions.

<u>Groundwater Dependant Terrestrial Ecosystems</u>

A number of water dependant habitats and features which may be impacted by changes in groundwater levels, flows and quality have been identified by the ecologists. Features identified to date include fen, turloughs and wet heaths and are summarised in **Table 4.5.4** of **Chapter 4** and presented in **Figures 7.6.3.1** and **7.6.3.2**. Ecological features which have been identified in the eastern part of the scheme study area are Coolagh lakes (Lough Corrib cSAC, EC34 and EC37), Ballindooley Lough Complex (EC39), an area of marsh and wet grassland at Terryland (EC41), four turloughs (EC35, EC36, EC37 and EC38) and a wetland complex which is part of Lough Corrib cSAC (EC33) (refer to Ecology Constraints Study **Section 4.3**).

Ballindooley Lough, Coolagh Lakes and the turloughs are dependent on water levels being maintained by groundwater and surface water interaction, which will vary locally and seasonally. The wetland complexes are likely to be less sensitive to water table fluctuations yet still require recharge to maintain the wetland habitat. In the western part of the scheme study area, key water dependent habitats include heaths and bog complexes and part of the Lough Corrib cSAC (EC11-20, EC22, EC24, EC25 and EC28-31). The features in the east are more likely to be more sensitive to significant changes in groundwater flow whereas recharge to the bogs and wet heaths in the western part of the scheme study area is likely to be dependent on surface water and localised perching or ponding of shallow groundwater.

All the GWDTE considered in this assessment are protected by international or national legislation and therefore are considered as highly or very highly important features.

Groundwater Abstractions

Groundwater abstractions may be springs, wells or boreholes which are utilised by domestic, agricultural, commercial, industrial, local authority or group water scheme users. Abstractions may be impacted by the reduction in groundwater level, reducing the supply available, and deterioration of groundwater quality. **Table 4.5.5** of **Chapter 4** summarises the groundwater abstractions within the scheme study area.

With the exception of two abstractions (W50-01 and W50-12), all the groundwater abstractions included in this assessment are assumed to be individual agricultural or domestic use which are likely to be supplying fewer than 50 homes. Therefore, according to the NRA guidelines they are of low importance. However further investigations are required to confirm the use of the groundwater abstractions.

W50-01 is a group water scheme located in Knocknacarra which supplies approximately 50 and therefore is considered to be of medium importance according to NRA guidelines.

W50-12 is an industrial supply well for a commercial property and due to the assumed high abstraction rate, approximately 50,000 litres/day, is considered to be of very high importance.

Red2 Route Option

The Red2 Route Option incorporates a number of features including cuttings that have the potential to impact on the groundwater environment. The features of the route option with the potential to impact are listed below in **Table 7.6.3.2.** Each route feature is assessed for Potential Impact Level based upon the hydrogeological setting and proximity to receptors. The resultant Potential Impact levels are detailed in **Table 7.6.3.2**.

Table 7.6.3.2 Cutting along the Red2 Route Option with potential impact levels to receptors

Section	Name	Location	Length (m)	Depth Range (m)	Potential impact level
1	Red2 C1	Knocknacarra to Trusky East	640	5 - 10	Imperceptible
1	Red2 C2	Trusky East	50	0 - 5	Imperceptible
1	Red2 C3	Trusky East to Aille	1190	5 - 10	Significant
2	Red2 C4	Cappagh Road	20	0 - 5	Imperceptible
2	Red2 C5	Western Distributor Road	50	0 - 5	Imperceptible
2	Red2 C6	Western Distributor Road	120	0 - 5	Imperceptible
2	Red2 C7	Western Distributor Road	150	0 - 5	Imperceptible
2	Red2 C8	Western Distributor Road	170	0 - 5	Imperceptible
2	Red2 C9	Western Distributor Road	360	0 - 5	Imperceptible
2	Red2 C10	Rahoon to River Corrib	3420	10 - 15	Significant
2	Red2 C11	Ballinfoyle	30	0 - 5	Imperceptible
2	Red2 C12	Ballinfoyle	140	0 - 5	Significant
2	Red2 C13	Glenanail	40	0 - 5	Significant
2	Red2 C14	Glenanail to Ballybrit	1350	5 - 10	Significant
2 / 3	Red2 C15	Ballybrit to N6	2858	10 - 15	Slight

Cuttings along the Red2 Route Option are likely to have groundwater inflows for both west and east sections. For the western section, the avoidance of WDTE and poor aquifers will significantly reduce potential impacts. Although the eastern section of the route option also avoids WDTE the regional status of the aquifer indicates that drawdown from excavations are likely to have wider zones of potential impact. In particular the WDTE at EC41 is considered to have significant/profound potential risk from groundwater interception. Ground investigation is required to determine the groundwater dependence of individual WDTE and to assess if groundwater impacts from the proposal have the potential to impact on these habitats. Additionally, with excavations being urban it is likely that some inflows will be contaminated. In this regard the ground investigation will need to have a comprehensive suite of parameters to detect and identify compounds so that treatment can be designed to deal with waters to be discharged.

Orange2 Route Option

The Orange2 Route Option uses a tunnel below the River Corrib. Cuttings are required on the western and eastern sides of the River Corrib through urban areas, in addition to the tunnel entrance and exit. The cuttings by location are summarised in **Table 7.6.3.3**. As this route is largely urban it is possible that contaminated ground will be encountered and ground investigation should include review of historical land use to determine potential contaminants of concern.

Table 7.6.3.3 Cutting along the Orange2 Route Option with potential impact levels to receptors

Section	Name	Location	Length	Cut Range	Potential impact level
1	Orange2 C1	Knocknacarra to Trusky East	640	5 - 10	Imperceptible
1	Orange2 C2	Trusky East	50	0 - 5	Imperceptible
1	Orange2 C3	Trusky East to Aille	1170	5 - 10	Significant
1	Orange2 C4	Aille	160	0 - 5	Moderate
2	Orange2 C5	Cappagh to Keeraun	1570	10 - 15	Significant
2	Orange2C 6	Keeraun	160	0 - 5	Imperceptible
2	Orange2 C7	Keeraun	40	0 - 5	Imperceptible
2	Orange2 C8	Mincloon	70	0 - 5	Imperceptible
2	Orange2 C9	Mincloon	40	0 - 5	Imperceptible
2	Orange2 C10	Mincloon	160	0 - 5	Imperceptible
2	Orange2 C11	Rahoon	50	0 - 5	Imperceptible
2	Orange2 C12	Rahoon to Letteragh	1010	>15	Imperceptible
2	Orange2 C13	Ballinfoyle	750	10 - 15	Moderate
2	Orange2 C14	Glenanail	40	0 - 5	Significant
2	Orange2 C15	Glenanail to Ballybrit	1400	5 - 10	Significant
2 / 3	Orange2 C16	Ballybrit to N6	2865	10 - 15	Slight

The granite and orthogneiss bedrock aquifer is classified as a Poor Aquifer (Pl) in which the bedrock is generally of low permeability except for weathered and fractured zones near faults where permeability will be higher. It is noted that the footprint of the Orange2 Route Option lies on the periphery of the WDTE EC17-

19 and crosses WDTE EC20 as a cutting to a maximum depth of 11.5 m. Significant impacts are predicted at EC41, EC20, EC31, Coolagh Lakes (part of Lough Corrib cSAC) and Lough Corrib cSAC at Menlough to Jordans Island. Moderate impacts are predicted at EC18. Water strikes in the cutting are likely but inflows moderate to low. The desk study indicates that these habitats are likely fed by subsoil groundwater rather than bedrock.

The tunnel extends through a fault zone which may provide an important local groundwater flow pathway. Most of the groundwater movement will be in a weathered zone which tends to be shallow but can deepen where fractured. Groundwater pathways are expected to be relatively short with low storage.

The construction of the tunnel has the potential to impact groundwater levels and water quality in the scheme study area, if not designed or constructed correctly. The water table may be impacted by drawdown due to dewatering but also by rise caused by impoundment of groundwater by the restriction of a flow path. Features in closest proximity to the tunnel for this route option are Coolagh Lakes (0.5km) and Ballindooley Lough (EC39) (2km) both of which are located on the Visean undifferentiated limestones. Further site specific investigation would be necessary to establish the extent of the impact on the hydrogeology and in particular surface water and groundwater interactions at the WDTE. The tunnel emerges into a cutting on the eastern side of the River Corrib. The cutting may lower the groundwater levels locally. However, by the application of modern tunnelling techniques and construction controls, the risk of the tunnel affecting the existing hydrogeological regime is as low as reasonably practical.

The flow regime in the regionally important Visean limestone is dominated by fracture flow as well as conduits. Although the primary permeability is low, the fracture and conduit connectivity can provide very high connectivity and storage. Flow pathways can be complicated and potentially can extend over large areas. East of the tunnel, the Orange2 Route Option makes two crossings of the Terryland River. The land use remains urban until the Galway Racecourse, of which it passes to the south at-grade.

Impacts on groundwater abstraction wells are predicted to be Imperceptible to Slight.

In summary, the Orange2 Route Option has potential significant hydrogeological impacts on EC41, EC20, EC31, Coolagh Lakes (part of Lough Corrib cSAC) and Lough Corrib cSAC at Menlough to Jordans Island if not designed or constructed correctly. In this regards ground investigation is required to determine the groundwater dependence of individual WDTE and to assess potential groundwater impacts on these habitats. Additionally, with excavations being urban it is likely that some inflows will be contaminated and as such appropriate treatment will be required prior to being discharged. By the application of modern tunnelling techniques and construction controls, the risk of the tunnel affecting the existing hydrogeological regime is as low as reasonably practical, potentially reducing possible hydrogeological impacts to moderate which are temporary impacts.

Yellow2 Route Option

The Yellow2 Route Option skirts around the west of the city and crosses the River Corrib near Coolagh Lakes. On the eastern side of the River Corrib, this route option passes to the north of Coolagh Lakes and then curves south to Terryland connects to the existing N6 and follows this road for the remainder of its path. In the west

the route option is largely on embankment although there are three sections of cutting. On the eastern side of the River Corrib, the route option is a combination of embankment and cutting to accommodate the more undulating topography. Cuttings are considered in **Table 7.6.3.4** below and summarised with potential impacts on nearby water dependent habitat and groundwater abstraction wells.

Table 7.6.3.4 Cutting and nearby water dependent habitats along the Yellow2 Route Option

Section	Name	Location	Length	Cut Range	Potential impact level
1	Yellow2 C1	Na Foraí Maola Thiar	460	0 - 5	Imperceptible
1	Yellow2 C2	Na Foraí Maola Thiar	90	0 - 5	Significant
1	Yellow2 C3	Na Foraí Maola Thiar	120	0 - 5	Significant
1	Yellow2 C4	Na Foraí Maola Thoir	270	5 - 10	Significant
1	Yellow2 C5	Trusky West	30	0 - 5	Moderate
1	Yellow2 C6	Trusky West	150	0 - 5	Significant
1	Yellow2 C7	Trusky East	20	0 - 5	Significant
1	Yellow2 C8	Trusky East	180	0 - 5	Moderate
1	Yellow2 C9	Trusky East	10	0 - 5	Imperceptible
1	Yellow2 C10	Aille	50	0 - 5	Significant
1	Yellow2 C11	Aille	60	0 - 5	Significant
1	Yellow2 C12	Aille	40	0 - 5	Significant
2	Yellow2 C13	Cappagh	30	0 - 5	Imperceptible
2	Yellow2 C14	Cappagh	20	0 - 5	Imperceptible
2	Yellow2 C15	Cappagh	160	0 - 5	Significant
2	Yellow2 C16	Ballnahown East	20	0 - 5	Significant
2	Yellow2 C17	Keeraun	30	0 - 5	Significant
2	Yellow2 C18	Keeraun	330	10 - 15	Significant
2	Yellow2 C19	Keeraun	20	0 - 5	Slight

Section	Name	Location	Length	Cut Range	Potential impact level
2	Yellow2 C20	Mincloon	110	0 - 5	Imperceptible
2	Yellow2 C21	Rahoon	20	0 - 5	Imperceptible
2	Yellow2 C22	Barnacranny to Dangan Upper	500	10 - 15	Significant
2	Yellow2 C23	Coolagh	50	0 - 5	Moderate
2	Yellow2 C24	Coolagh to Ballinfoyle	490	5 - 10	Moderate
2	Yellow2 C25	Glenanail to Ballybrit	1290	5 - 10	Significant
2 / 3	Yellow2 C26	Ballybrit to N6	2865	10 - 15	Slight

The footprint of the Yellow2 Route Option crosses the WDTE EC11 in a small cutting (c.2.5 m) which although shallow may develop drawdown and have a significant impact to the WDTE. This route option also crosses EC18 on embankment and lies on the periphery of WDTE EC12 and EC14. A significant impact is predicted at EC12. As the Yellow2 Route Option passes through the WDTE EC20 it consists of a cutting approximately 10 m deep (see **Table 7.6.3.3**) which has groundwater inflow and lower groundwater levels. A significant impact is predicted at EC20. The desk study indicates that these habitats are likely fed by subsoil groundwater rather than bedrock.

The flow regime in the regionally important Visean limestone is dominated by fracture flow as well as conduits. Although the primary permeability is low, the fracture and conduit connectivity can provide very high connectivity and storage. Flow pathways can be complicated and potentially can extend over large areas. Moderate impacts are predicted at Coolagh Lakes, EC36, EC37 and on W50-12 (commercial property).

There are no cuttings on the Yellow2 Route Option in the vicinity of Coolagh Lakes and therefore this route option is considered to be low risk in terms of dewatering impacts. In the area of Terryland River the road is on embankment, however, there is a cutting east of Terryland close to WDTE EC41 that could impact groundwater levels locally.

In summary, significant impacts are predicted for the Yellow2 Route Option at EC11, EC12 and EC20. Moderate impacts are predicted at Coolagh Lakes, EC36 and EC37. A moderate impact is predicted on W50-12 (industrial supply well for commercial property). Impacts on other groundwater abstraction wells are predicted to be Imperceptible to Slight.

Blue2 Route Option

The Blue2 Route Option skirts around the west of the city and crosses the River Corrib near Coolagh Lakes. On the eastern side of the River Corrib, this route option passes to the north of Coolagh Lakes where it enters a tunnel that emerges in Lackagh Quarry. From here this route option passes to the south of Ballindooley

Lough on embankment and then via cuttings into a tunnel beneath the racetrack of Galway Racecourse. The cuttings by location are summarised in **Table 7.6.3.5**.

Table 7.6.3.5 Cutting and nearby water dependent habitats along the Blue2 Route Option

Section	Name	Location	Length	Cut Depth Range	Potential impact level
1	Blue2 C1	Trusky East	20	0 - 5	Imperceptible
1	Blue2 C2	Trusky East	10	0 - 5	Imperceptible
1	Blue2 C3	An Cloch Scoilte to Aille	900	5 - 10	Significant
2	Blue2 C4	Aille	30	0 - 5	Imperceptible
2	Blue2 C5	Ballnahown East	40	0 - 5	Significant
2	Blue2 C6	Keeraun	310	10 - 15	Significant
2	Blue2 C7	Keeraun	20	0 - 5	Imperceptible
2	Blue2 C8	Mincloon	110	0 - 5	Imperceptible
2	Blue2 C9	Rahoon	20	0 - 5	Imperceptible
2	Blue2 C10	Barnacranny	500	10 - 15	Significant
2	Blue2 C11	Coolagh	180	10 - 15	Moderate
2	Blue2 C12	Coolagh	50	5 - 10	Moderate
2	Blue2 C13	Ballindooley	150	>15	Significant
2	Blue2 C14	Castlegar	180	0 - 5	Significant
2	Blue2 C15	Castlegar	520	5 - 10	Moderate
2 / 3	Blue2 C16	Parkmore to Doughiska	3170	>15	Slight

The footprint of this route option crosses WDTE EC20 on embankment and then enters a cutting north of EC20. Water strikes in excavations are likely but inflows would be moderate to low. This route option also lies on the periphery of EC17 and EC18. The desk study indicates that these habitats are likely fed by subsoil groundwater rather than bedrock. Moderate impacts are predicted at EC17 and EC18.

East of the Coolagh Lakes the Blue2 Route Option descends into a tunnel that dips to 0.9m above mean sea level (msl) at its deepest point, which is c.16m below the Coolagh Lakes and c.18m below Ballindooley Lough. From Lackagh Quarry the Blue2 Route Option emerges in a cutting and then crosses the lowland at Ballindooley Lough on embankment and goes into cutting again at Castlegar before entering a cut and cover tunnel beneath the racetrack of Galway Racecourse. Construction of the tunnels and cuttings into the Visean undifferentiated limestone will likely have significant groundwater inflows, if not designed or constructed correctly. Construction phase impacts are possible if dewatering is required for driving the tunnel or excavating the cuttings. There may also be an operation phase impact from dewatering if permanent drainage is required or impoundment if flow paths are intercepted and sealed. The assessment of potential impacts from the tunnel is conservative at this stage due to limited data on groundwater flows in the catchment. However by the application of modern tunnelling techniques and

construction controls, the risk of the tunnel affecting the existing hydrogeological regime is as low as reasonably practical, potentially reducing possible hydrogeological impacts to moderate from profound/significant. In this regard moderate hydrogeological impacts which are temporary are predicted at EC36 and Coolagh Lakes. Moderate impacts are predicted at EC35, EC37, EC38 and EC39.

In summary the Blue2 Route Option has a tunnel at Lackagh and a cut and cover tunnel at Galway Racecourse as well as a number of cuttings along the route. There are likely to be inflows to the cuttings and tunnels and these have the potential to impact on groundwater levels where intercepted. Assessment of these impacts remain conservative based on the data available at this project stage. Information on water level and characterisation of flow paths will allow quantification of drawdown and qualitative assessment of potential impacts.

Moderate hydrogeological impacts are predicted at EC36 and Coolagh Lakes, EC17, EC18, EC35, EC37, EC38 and EC39. A significant impact is predicted at W50-12 (commercial property). Impacts on other groundwater abstraction wells are predicted to be Imperceptible to Slight.

Pink2 Route Option

The Pink2 Route Option skirts around the west of the city and crosses the River Corrib near Coolagh Lakes. On the eastern side of the River Corrib this route option passes to the north of Coolagh Lakes where it enters a tunnel that emerges in Lackagh Quarry. From here the this route option passes to the south of Ballindooley Lough on embankment and then skirts north of Galway Racecourse in a cut and cover tunnel. The cuttings are listed below with proximity to water dependent habitat are summarised in **Table 7.6.3.6**.

Table 7.6.3.6 Cutting and nearby water dependent habitats along the Pink2 Option

Section	Name	Location	Length (m)	Cut Depth Range (m)	Potential impact level
1	Pink2 C1	Aille	30	0 - 5	Significant
1	Pink2 C2	Aille	70	0 - 5	Significant
1	Pink2 C3	Aille	40	0 - 5	Significant
2	Pink2 C4	Ballnahown East	40	0 - 5	Significant
2	Pink2 C5	Keeraun	340	10 - 15	Significant
2	Pink2 C6	Keeraun	20	0 - 5	Imperceptible
2	Pink2 C7	Mincloon	110	0 - 5	Imperceptible
2	Pink2 C8	Barnacranny to Dangan Upper	800	>15	Significant
2	Pink2 C9	Coolagh	180	10 - 15	Significant/Profound
2	Pink2 C10	Coolagh	50	5 - 10	Moderate
2	Pink2 C11	Ballindooley	150	>15	Significant
2	Pink2 C12	Castlegar	180	0 - 5	Significant
2	Pink2 C13	Castlegar	590	5 - 10	Moderate
2 / 3	Pink2 C14	Parkmore to N6	2259	>15	Slight

The footprint of this route option crosses WDTE EC18 and EC20 on embankments and then enters a cutting north of EC20. The desk study indicates that these habitats are likely fed by subsoil groundwater rather than bedrock.

The flow regime in the regionally important Visean limestone is dominated by fracture flow as well as conduits. Although the primary permeability is low the fracture and conduit connectivity can provide very high connectivity and storage. Flow pathways can be complicated and potentially can extend over large areas. East of the Coolagh Lakes the Pink2 Route Option passes into a tunnel that dips to 0.9m above msl at its deepest point, which is c.16m below the Coolagh Lakes and c.18m below Ballindooley Lough. Note that as this is the approximate finished road level the excavation depth may be 5m deeper. From Lackagh Quarry this route option emerges into a cutting and crosses the lowland at Ballindooley Lough on embankment and then passes to the north of the racetrack of Galway Racecourse in a cut and cover tunnel.

Construction of the tunnel and cuttings for the Pink2 Route Option in the Visean undifferentiated limestone will likely have significant groundwater inflows. It is

likely that there will be a construction phase impact from the tunnel drilling due to dewatering of groundwater intercepted if not designed and constructed correctly. There may also be a construction phase impact from dewatering if permanent drains are required or from impoundment if flow paths are intercepted and sealed. However, by the application of modern tunnelling techniques and construction controls, the risk of the tunnel affecting the existing hydrogeological regime is as low as reasonably practical, potentially reducing possible hydrogeological impacts to moderate from profound/significant. Moderate hydrogeological impacts are predicted at EC36 and Coolagh Lakes, EC17, EC18, EC35, EC37, EC38 and EC39. A significant impact is predicted at W50-12 (commercial property). Impacts on other groundwater abstraction wells are predicted to be Imperceptible to Slight.

In summary the Pink2 Route Option includes a tunnel and cutting in the Visean undifferentiated limestone. These will likely intercept groundwater and inflows will likely have an impact on groundwater levels, potentially impacting on Coolagh Lakes if not designed and constructed correctly. However, by the application of modern tunnelling techniques and construction controls, the risk of the tunnel affecting the existing hydrogeological regime is as low as reasonably practical. Additional studies are required to determine the degree of impact on groundwater and these need to be assessed in terms of potential indirect impact on GWDTE.

Green2 Route Option

The Green2 Route Option remains mostly at-grade or on embankment in the west and crosses the River Corrib immediately south of Coolanillaun Wetlands. On the eastern side of the River Corrib, this route option passes to the north of Lough Corrib cSAC and continues north of Ballindooley Lough (EC39) on embankment. Continuing eastwards, this route option passes north of the Galway Racecourse in a cutting. The cuttings by location are summarised in **Table 7.6.3.7**.

Table 7.6.3.7 Cutting and nearby water dependent habitats along the Green2 Route Option

Name	Location	Length	Cut Range	Potential impact level
Green2 C1	Na Foraí Maola Thiar	510	0 - 5	Imperceptible
Green2 C2	Trusky West	220	0 - 5	Significant
Green2 C3	Trusky West	40	0 - 5	Significant
Green2 C4	Trusky East	60	0 - 5	Moderate
Green2 C5	Trusky East	40	0 - 5	Imperceptible
Green2 C6	Trusky East	40	0 - 5	Imperceptible
Green2 C7	Cappagh	30	0 - 5	Imperceptible
Green2 C8	Cappagh	20	0 - 5	Imperceptible
Green2 C9	Cappagh	160	0 - 5	Significant
Green2 C10	Keeraun	30	0 - 5	Significant
Green2 C11	Keeraun	100	5 - 10	Significant
Green2 C12	Keeraun	100	0 - 5	Imperceptible
Green2 C13	Keeraun	20	0 - 5	Imperceptible
Green2 C14	Keeraun	60	0 - 5	Slight
Green2 C15	Tonabrocky to Ballagh	660	10 - 15	Moderate
Green2 C16	Ballindooley	30	0 - 5	Slight
Green2 C17	Ballindooley	50	0 - 5	Moderate
Green2 C18	Ballygarraun	470	5 - 10	Moderate
Green2 C19	Ballygarraun	100	0 - 5	Imperceptible
Green2 C20	Parkmore to Breanloughan	1890	>15	Slight
Green2 C21	Coolagh	210	0 - 5	Imperceptible
Green2 C22	Garraun North	580	0 - 5	Imperceptible

This route option is mostly on embankment or at grade west of the River Corrib with the exception of three cuttings, none of which are within WDTEs and are unlikely to have significant inflows. The footprint for this route option crosses the WDTEs EC11, EC14 and EC20 and lies on the periphery of EC12, EC13, EC17 and EC18. Water strikes in excavations are likely but inflows moderate to low. The desk study indicates that these habitats are likely fed by subsoil groundwater rather than bedrock.

The Green2 Route Option passes north of Ballindooley Lough (EC39) on embankment and then enters a cutting. A significant impact is predicted at EC39 Ballindooley Lough due to the 9.7m cut. There are a number of cuttings at the eastern end of this route option where it passes to the north of the Galway Racecourse. These cutting at its maximum depth would be c.24m deep and is likely to have significant inflows. Impacts on groundwater abstraction wells are predicted to be Imperceptible to Slight.

In summary this route option is largely at grade or on embankment, with one significant cutting in the east of the Green2 Route Option where a significant impact

is predicted at EC39 Ballindooley Lough. Impacts on groundwater abstraction wells are predicted to be Imperceptible to Slight.

7.6.3.4 Summary

The assessment of the route options has been divided into three sections and these are summarised below.

The scheme study area has two main aquifer units. In the west (Section 1), the poor bedrock aquifers tend to have limited flow paths and cause ponding above rock head and in the subsoils. In the east (Section 2 and 3), the limestone is a regionally important aquifer and all recharge goes to ground. In this regard there is significant storage in the limestones of the east and a relatively low storage in the granites of the west. As the limestone aquifer is karstic, there is also a high connectivity via fracture and conduit pathways and these also include surface landforms such as springs, turloughs, seasonal lakes and enclosed depressions.

All available hydrogeology data for the route options has been assessed. The route options assessments have been made based on this data which includes data from the ecologists and geologists and the NRA guidelines. This available data allows for a review of the risks for each route option but there are gaps in the data knowledge that restrict further quantification of these risks. Due to these data gaps, a conservative approach has been taken that all WDTE identified are groundwater dependant.

These assessments have taken into account the length and depth of cuttings and tunnels for each route option, their proximity to and importance of WDTE and groundwater abstractions as well as locations of likely flow paths and connectivity.

Table 7.6.3.8, Table 7.6.3.9 and **Table 7.6.3.10** summarises the potential impacts from cuttings on WDTE and groundwater abstractions within Section 1, Section 2 and Section 3 respectively. The potential impacts are imperceptible (I), slight (Sl), moderate (M), significant (Sg) or profound (P)

Table 7.6.3.8 Potential impacts on receptors in Section 1

WDTE / Groundwater abstraction ID	Description	Potential impact from route option					
		Red	Orange	Yellow	Blue	Pink	Green
EC11	Bog			Sg			I
EC12	Heath			Sg			I
EC13	Bog/wet grassland						
EC14	Heath/bog	I	I		I		
EC15	Wet grassland/Heath						
EC16	Wet grassland/Heath/bog						
EC17	Heath bog wet grassland	I	I		M		
EC18	Wet grassland/Heath	M	I		M	I	

Table 7.6.3.9 Potential impacts on receptors in Section 2

WDTE / Groundwater abstraction ID	Description	Potential impact from route option					
		Red	Orange	Yellow	Blue	Pink	Green
EC19	Heath/bog		I				
EC20	Heath/bog	I	Sg	Sg	Sl	Sl	I
EC22	Tonabrocky Bog			I	I	I	I
EC24	Bog/heath wet grassland						I
EC25	Moycullen Bogs		I	I	I	I	I
Lough Corrib cSAC, EC28	Kentfield/NUI Galway wetlands			I		I	
Lough Corrib cSAC,	Coolagh lakes		I		Sg/ P	Sg/ P	
Lough Corrib cSAC,	Coolanillaun wetland						
Lough Corrib cSAC/EC31	Dangan wetlands	I	Sg	I			
EC35	Turlough				Sg	Sg	
EC36	Turlough			I	Sg/ P	Sg/ P	
EC37	Turlough				Sg	Sg	
EC38	Turlough				Sg	Sg	
EC39	Ballindooley Lough				Sg	Sg	S g
EC41	Marsh/ grassland/karst	S g	Sg				
W50-01	Group water scheme groundwater abstraction, >30 homes						
W50-02	Domestic/agricultural groundwater abstraction, <30 homes						
W50-03	Groundwater abstraction, unknown use						
W50-04	Groundwater abstraction, unknown use						
W50-05	Groundwater abstraction, unknown use						
W50-06	Groundwater abstraction, unknown use						
W50-07	Groundwater abstraction, unknown use						
W50-08	Groundwater abstraction, unknown use						

WDTE / Groundwater abstraction ID	Description	Potential impact from route option					
		Red	Orange	Yellow	Blue	Pink	Green
W50-09	Domestic groundwater abstraction, <30 homes						
W50-10	Groundwater abstraction, unknown use		I		I		
W50-11	Groundwater abstraction, unknown use	I	I	I		I	
W50-12	Industrial groundwater abstraction			M		SG	
W100-01	Domestic groundwater abstraction, <30 homes	I	I	S	I		
W100-02	Domestic groundwater abstraction, <30 homes	I	I	I	I		
W100-03	Domestic groundwater abstraction, <30 homes				I	I	I
W100-04	Domestic groundwater abstraction, <30 homes				I	I	I
W100-05	Domestic groundwater abstraction, <30 homes				I	I	I
W100-06	Domestic groundwater abstraction, <30 homes				I	I	I
W500-01	Domestic /agricultural groundwater abstraction, <30 homes						
W1000-01	Domestic /agricultural groundwater abstraction, <30 homes		I	I		I	I
W1000-03	Groundwater abstraction, unknown use						

Table 7.6.3.10 Potential impacts on receptors in Section 3

WDTE / Groundwater abstraction ID	Description	Potential impact from route option					
		Red2	Orange2	Yellow2	Blue2	Pink2	Green2
W50-10	Domestic groundwater abstraction, <30 homes	I	I	I	I	Sl	I
W1000-02	Domestic groundwater abstraction, <30 homes	Sl	Sl	Sl	Sl	Sl	I
W1000-04	Domestic /agricultural groundwater abstraction, <30 homes						I

Based on the analysis in **Tables 7.6.3.8** to **7.6.3.9**, **Table 7.6.3.10** presents a summary of the route options and their rankings. This ranking considers the level and frequency of potential impacts along each section

Section 1

All route options in Section 1 avoid WDTE. Due to the relatively low yields of the aquifer in Section 1 the likely drawdown extent from cutting will be limited. In this regard only the Yellow2 Route Option has potential significant hydrogeological impacts and these are related to cuttings near WDTE EC11 and EC12. Moderate potential impacts occur on Red2 and Blue2 Route Options. The Orange2, Pink2 and Green2 Route Options have potential impacts lower than moderate.

Section 2

All the route options have cuttings in Section 2 which may have a significant potential impact on a receptor. The Pink2 and Blue2 Route Options may have a significant/profound potential impact on WDTE at Coolagh Lakes from the proposed Lackagh tunnel. However, by the application of modern tunnelling techniques and construction controls, the risk of the tunnel affecting the existing hydrogeological regime is as low as reasonably practical, potentially reducing possible hydrogeological impacts to moderate which are temporary impacts.

The Pink2 and Blue2 Route Options are also considered to have a potential significantly impact a large groundwater abstraction near Ballindooley (W50-12). Cuttings on the Red2 and Orange2 Route Options at Terryland (EC41) also have the potential to have a significant impact on WDTE.

The Yellow2 and Red2 Route Options both have one potential significant impact. On assessment the Red2 Route Option is considered the preferred option due to the lower number of moderate impacts along its route.

Section 3

All the cuttings in Section 3 have the potential to slightly impact on a nearby groundwater abstraction.

Table 7.6.31.11 summarises the ranking for each route option for each section.

Table 7.6.3.11 Summary of Hydrogeology ranking of Route Options

Route Option	Section 1	Section 2	N6 Junction
Red2	I	P	I
Orange2	I	I	I
Yellow2	LP	I	I
Blue2	LP	LP	I
Pink2	P	LP	LP
Green2	I	I	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

Whilst the route options have been divided into three sections for the Stage 2 assessment, it is important to recognise that the sections are different in length and the sensitivity of the hydrogeology differs from west to east. Whilst section 3 considers just the N6 Junction, Sections 1 and 2 cover kilometres of the route options.

The Stage 2 assessment on potential impact on receptors remains conservative at this desk study phase but serves to highlight the potential impacts for each route option. The Stage 2 assessment also aids to identify those receptors where data is lacking and ground investigation should be focused.

7.6.3.5 References

Ordance Survey Ireland. (2015) *Current and historical maps*, available; http://maps.osi.ie/publicviewer/#V1,591271,743300,0,10.

Geological Survey of Ireland. (2014) *Bedrock Geology 1:100,000, Bedrock Boreholes, Karst Features, Groundwater Aquifers, National Draft Generalised Bedrock map (Groundwater Rock units), National Vulnerability and National Groundwater Recharge maps*, available; www.dcenr.gov.ie.

Department of the Environment and Local Government (DELG). The Environmental Protection Agency (EPA) and the Geological Survey of Ireland (GSI) (1999), *Protection Schemes Guidelines,* available; http://www.gsi.ie/Programmes/Groundwater/Projects/Protection+Schemes+Guidelines.htm#summary.

7.6.4 Hydrology

7.6.4.1 Introduction

This section details the Stage 2 assessment of the route options with respect to the hydrology constraints identified in **Section 4.6 Hydrology** of this report. The route options as described in **Section 7.1** with the hydrology constraints are presented in **Figure 7.6.4.1** to **7.6.4.6**. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options.

Section 7.6.4.2 outlines the methodology that was used to carry out the study and **Section 7.6.4.3** details the options assessment. The impact on each route option from west to east for Section 1, Section 2 and the N6 Junction is also described. A summary is presented in **Section 7.6.4.4** and references are listed in **Section 7.6.4.5**.

7.6.4.2 Methodology

The assessment has been carried out according to stage 2 of the route selection process outlined in the NRA PMGs 2010 and in line with the NRA (2008) Guidelines on Procedures for Assessment and treatment of Geology, Hydrology and Hydrogeology for National Road Schemes. The hydrology assessment examines the six route options as described in **Section 7.1** in respect to potential impacts to the Hydrology within the scheme study area. The route options are evaluated and ranked based on the following hydrological criteria:

- River Corrib crossing - potential channel and flood plain encroachment;
- Watercourses and lake (permanent and seasonal loughs) crossings and floodplain encroachments and water quality impacts;
- Road Drainage Issues - urbanised area, pumping of tunnel drainage, lack of surface drains in eastern section of the scheme study area and proximity to streams for outfalling;
- Flood Risk Area (pluvial, fluvial, groundwater and coastal flood sources);
- Public Water supply – Galway City Council's Terryland Water Treatment Plant drinking water abstraction; and
- Hydro-ecology impacts aquatic habitats and species such as Wet heath, Blanket bog, Transmission mires, Calcareous fens, Salmonid waters and the Natura 2000 sites (Lough Corrib cSAC and the Galway Bay Complex cSAC).

Table 7.6.4.1 and **7.6.4.2** below has been extracted from the Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes and defines the impacts levels.

Table 7.6.4.1 Definition of Impact Assessment Criteria

Impact level	Description
Imperceptible	An impact capable of measurement but without noticeable consequences
Slight	An impact that alters the character of the environment without affecting its sensitivities
Moderate	An impact that alters the character of the environment in a manner that is consistent with existing or emerging trends
Significant	An impact, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Profound	An impact which obliterates all previous sensitive characteristics

The impact level will depend on the Attribute importance as per box 5.4 of NRA Guidelines (2008) on Procedure for Assessment and Treatment of Geology Hydrology Hydrogeology for National Road Schemes.

Table 7.6.4.2 Criteria for Rating Impact Significance at Route Selection Stage

Impact Level	Attribute Importance				
	Extremely High	Very High	High	Medium	Low
Profound	Any Permanent Impact on attribute	Permanent Impact on Significant Proportion of Attribute			
Significant	Temporary Impact on Significant proportion of attribute	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of attribute		
Moderate	Temporary Impact on Small Proportion of Attribute	Temporary Impact on significant Proportion of Attribute	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of attribute	
Slight		Temporary Impact on Small Proportion of Attribute	Temporary Impact on significant Proportion of Attribute	Permanent impact on small proportion of attribute	Permanent impact on significant proportion of attribute
Imperceptible			Temporary Impact on Small Proportion of Attribute	Temporary Impact on significant Proportion of Attribute	Permanent impact on small proportion of attribute

For example a small short-term water quality impact such as short-term small spillage of sediment runoff or small disturbance of the river bed during construction on the River Corrib (European Site – extremely High) could be viewed as producing a Temporary Impact on a Small Proportion of the Attribute and representing a moderate impact level on this attribute. The discharge of road drainage to the River Corrib with some attenuation and settlement represents a significant level impact.

7.6.4.3 Option Assessment

A detailed description for each of the route options is described in **Section 7.1**. The assessment of impacts on the hydrological attributes, as outlined in the hydrological constraints **Section 4.4**, is provided below for each of the routes.

Section 1

Red2 and Orange2 Route Option

The most preferred route option in respect to hydrology is the Red2/Orange2 Route Option as it does not cross any of the watercourses described and avoids encroaching the floodplain areas of these streams. The Red2 and Orange2 Route Option will have to outfall to surface waters of the Bearna and Trusky Stream, as groundwater infiltration will not be possible given the likely poor drainage characteristics of the overburden and bedrock along this section. The Trusky Stream discharges to the sea at Bearna Quay. A moderate flood risk from the Trusky Streams exists at Bearna Village.

The flood risk associated with the Bearna Stream at Knocknacarra is small. The impact on the stream hydrology and flood risk can be reduced to slight to imperceptible through the implementation of storm water management Sustainable Drainage Systems (SuDS) of attenuation and controlled discharge and appropriate culvert design for the crossing.

The Red2 and Orange2 Route Option has the shortest length of the route options commencing to the east of Bearna Village and thus these route options will have the least volume of runoff for discharge to the Trusky Stream. In this section the route option is likely to concentrate its discharge to the Trusky Stream which outfalls to the sea at Bearna Quay, which is located 1.5km west of the Galway Bay Complex cSAC and also to the Bearna Stream whose downstream estuarine reach is within the Galway Bay Complex cSAC. This route option, through standard drainage mitigation, can reduce potential impact of the route option on water quality to an impact magnitude of locally slight and a downstream imperceptible impact on the Galway Bay Complex cSAC.

The Red2 and Orange2 Route Option generally avoids aquatic sensitive Annex I habitats and encounters the least area of Wet heath and wet grassland compared to the other route options. To the north of Ballard it passes to the north of an Annex I Wet heath habitat but is sufficiently remote not to cause significant impact, as it distance is greater than 100m. The route option in this area encounters three small areas of wet grassland which have a local high value. The impact level on hydro-ecology is considered to represent a locally slight permanent impact as a result of the road drainage and road formation which could result in local dewatering through drainage. The Red2 and Orange2 Route Option are the preferred route options with respect to hydro-ecology.

Yellow2 Route Option

The Yellow2 Route Option crosses the Sruthán na Libeirti, the Trusky and the Bearna Streams with potentially six crossings in total in Section 1. The potential encroachment of floodplains by this route option is reasonably small with the main encroachment occurring on the Sruthán na Libeirti stream. The road drainage discharge for the Yellow2 Route Option can be spread over a wider area discharging to all three drainage catchments encountered (Sruthán na Libeirti, Trusky and

Bearna streams). This results in potentially a slight to moderate impact on the downstream flow and flood risk. The impact on the stream hydrology and flood risk can be reduced to slight to imperceptible through the implementation of a storm water management SuDS of attenuation and controlled discharge and appropriate culvert design for the crossing points.

The road drainage discharge for the Yellow2 Option will be spread over a wider area with an ability to discharge to the Sruthán na Liberiti, Trusky and Bearna streams, resulting in a lower potential impact on the downstream flow and water quality. This option through normal drainage mitigation can reduce potential impact on water quality to an impact magnitude of slight and an imperceptible impact on the Galway Bay Complex cSAC Water quality.

The Yellow2 Route Option, similar to the Green2 Route Option, encounters and is in close proximity, over a large portion of its route, to locally important wet grassland and Wet heath and is in close proximity to Annex I Blanket bog habitat and Annex I Wet heath habitat. One section of the Yellow2 Route Option crosses through Annex I Wet/Dry heath habitat. This route option comes potentially closest to a Blanket bog section near the Sruthán na Libeirti crossing point (EC11, EC12, EC13, see **Section 4.3 Ecology**), potentially within a 40m crossing through wet grassland. The impact level on hydro-ecology is considered to represent potentially a locally moderate permanent impact and will require mitigation to avoid direct and indirect impacts on Annex I habitat. This option is slightly better than the Green2 Route Option in terms of hydro-ecology.

Blue2 Route Option

The Blue2 Route Option incorporates the Bearna Relief Road to the north of Bearna Village has potentially five crossings of the Trusky Stream channel and its tributaries which is upstream of the Bearna flood risk area. The Blue2 Route Option also crosses the Bearna Stream and its tributary. This Blue2 Route Option potentially encroaches for a significant distance on the identified fluvial flood risk zone of the Trusky Stream based on the Office of Public Works (OPW) National Preliminary Flood Risk Assessment Mapping (PFRA). This route option will potentially outfall to the Trusky Stream system which is upstream of the Bearna Flood Risk Area. The impact on the stream hydrology and flood risk can be reduced to slight to imperceptible through the implementation of a storm water management SuDS of attenuation and controlled discharge and appropriate culvert design for the crossing.

In terms of water quality impact the Blue2 Route Option concentrates its road runoff to the Trusky and Bearna Streams, with the Bearna Stream lower estuarine reach within the Galway Bay Complex cSAC. Given close proximity of this route option to the Trusky stream and floodplain area, whose sea outfall is closest to the Galway Bay Complex cSAC, there is a potential for construction runoff impacts. The Blue2 Route Option, through standard drainage mitigation, can reduce potential impact on water quality to an impact magnitude of slight and an imperceptible impact on the Galway Bay Complex cSAC.

The Blue2 Route Option generally avoids aquatic sensitive Annex I habitats except at two locations where it encounters Annex I Wet heath habitat. This route option encounters a significant area of wet grassland along its route to the south of Na hAille. Within the corridor identified there is sufficient space to avoid completely

Annex I habitats. The impact level on hydro-ecology is considered to represent a locally slight to moderate permanent impact.

The Blue2 Route Option passes in close proximity (south) to Annex I Wet heath habitat associated with EC17 (see **Section 4.3 Ecology)** and encounters a number of sections of wet grassland. Within the Blue2 Route Option Corridor there is sufficient room to avoid completely Annex I habitats. The impact level on hydro-ecology is considered to represent a locally slight to moderate permanent impact through the potential for dewatering of wet grassland and heath and will require drainage mitigation to avoid such impacts.

Pink2 Route Option

The Pink2 Route Option which incorporates the Bearna Relief Road to the north of Bearna Village has potentially five crossings of the Trusky Stream channel and its tributaries which are upstream of the Bearna flood risk area. The Pink2 Route Option, with its proposed link to the Western Distributor Road, crosses the Bearna Stream twice and a minor tributary to the west. This route option potentially encroaches for a significant distance on the identified fluvial Flood Risk zone of the Trusky Stream based on the Office of Public Works (OPW) National Preliminary Flood Risk Assessment Mapping (PFRA). The proposed new link road to the Western Distributer Road encroaches the Bearna Stream floodplain and identified flood risk area. This route option will potentially outfall to the Trusky Stream system which is upstream of the Bearna Flood Risk Area. The impact on the stream hydrology and flood risk can be reduced to slight to imperceptible through the implementation of a storm water management SuDS of attenuation and controlled discharge and appropriate culvert design for the crossing. In terms of flood risk and watercourses the Pink2 Route Option is the least favourable.

In terms of water quality impact the Pink2 Route Option could concentrate its road runoff to the Trusky and Bearna streams, with the Bearna stream's lower estuarine reach within the Galway Bay Complex cSAC. Given its close proximity to both the Trusky and Bearna stream and floodplain areas, there is a potential for construction runoff impacts. This route option through normal drainage mitigation can reduce potential impact on water quality to an impact magnitude of slight and an imperceptible impact on the Galway Bay Complex cSAC.

The Pink2 Route Option encounters at EC18 (see **Section 4.3 Ecology)** Annex I Wet heath habitat and encounters a number of sections of wet grassland. The potential impact level on hydro-ecology is considered to represent a locally moderate permanent impact through potential dewatering of wet grassland and heath and will require drainage mitigation to avoid such impacts.

Green2 Route Option

The Green2 Route Option crosses the Sruthán na Libeirti, the Trusky and the Bearna Streams with potentially six stream crossings in total in Section 1. The potential encroachment of floodplains by this route option is reasonably small with the main encroachment occurring on the Sruthán na Libeirti stream. The road drainage discharge for the Green2 Route Option could be spread over a wider area discharging to all three drainage catchments encountered (Sruthán na Libeirti, the Trusky and Bearna streams) and resulting in a potentially lower impact on the downstream flow regime and flood risk. The impact on the stream hydrology and flood risk can be reduced to slight to imperceptible through the implementation of

a storm water management SuDS of attenuation and controlled discharge and appropriate culvert design at the crossing points and outfall locations.

The road drainage discharge for the Green2 Route Option is similar to the Yellow2 Route Options and will be spread over a wider area with the ability to discharge to the Sruthán na Liberiti, Trusky and Bearna streams. This results in a lower potential impact on the downstream flow regime and water quality. This route option, through normal drainage mitigation, can reduce potential impact on water quality to an impact magnitude of slight and an imperceptible impact on the Galway Bay Complex cSAC water quality.

The Green2 Route Option comes within close proximity, over a large portion of its location, to locally important wet grassland and Wet heath and is in close proximity to Annex I Blanket bog and Annex I Wet heath habtiats. Two sections of this route option crosses through Annex I Wet/dry heath and wet grassland. This route option comes potentially closest to a Blanket bog section near the Sruthán na Libeirti crossing point (EC11, EC12, EC13 (see **Section 4.3 Ecology**)), potentially within 40m through wet grassland. The impact level on hydro-ecology is considered to represent a locally moderate permanent impact and will require mitigation to avoid direct and indirect impacts on Annex I habitat. The Green2 Route Option has the potential to have greatest impact on hydro-ecology of all the route options.

Summary of Section 1 Assessment

The impact of the route options in Section 1 on hydrology has been assessed based on impact to water quality, flood risk and water course hydrology and on hydro-ecology. **Table 7.6.4.3** below outlines the order of preference for the hydrological aspects with respect to each of the route options. The route options have been ranked from 1 to 5 with 1 being the most favourable and 5 being the least favourable in terms of hydrological impacts along each of the route options. Assessment rankings have been assigned under the following headings: Flood Risk, Hydro-Ecology and Water Quality. The sum of the rankings for each route option was calculated and the order of preference for the route options was assigned.

The assessment indicates that all of the route options considered are acceptable and will not result in any significant hydrological impact that cannot be mitigated for. The Red2 and Orange2 Route Options are the preferred route option with the Pink2 Route Option being the least preferred.

Table 7.6.4.3 Section 1 Hydrology Assessment

Route Option	Hydro-ecology	Flood Risk and watercourse crossings	Water Quality	Total Score	Rank	Preference
Red2 / Orange2	1	1	3	5	1st	P
Yellow2	4	3	1	8	2nd	I
Blue2	2	4	4	10	4th	I
Pink2	3	5	5	13	5th	LP
Green2	5	3	1	9	3rd	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

Section 2 - River Corrib Crossing

Red2 Route Option

The River Corrib Crossing on the Red2 Route Option is likely to have supports downstream of the existing piers at Quincentenary Bridge. In terms of changes to the hydrological regime and flood risk for the Red2 Route Option the placement of piers is likely to have only local minor impacts on flow velocities and upstream flood levels and negligible impact on downstream flood levels.

This route option has the potential to impact on flow conveyance, velocities, and water levels and local changes to the bed morphology as a result of the placement of piers within the flow channel. The associated constructional impacts involving temporary works to construct such piers could temporarily impact the flow conveyance and give rise to sediment release and potential for spillages of grout and concrete during the construction of such piers. Temporary encroachment works are likely to be required in order to construct the bridge piers.

The flow conveyance in the River Corrib at the Red2 Route Option crossing point, even under extreme flooding conditions, is confined to the channel as a result of the existing road embankment, with overbank flows of limited extent and of little assistance to flood flow conveyance. The loss of flood storage volume as a result of the crossings will be inconsequential given the large storage capacity within the upstream lakes and within the catchment itself. This storage produces a highly damped flood hydrograph, which is slow to rise and recede.

The impact of the proposed bridge for the Red2 Route Option crossing on the hydrology of the Lough Corrib cSAC is considered to be localised having a moderate impact magnitude based on the very high attribute value of the River Corrib. This moderate impact applies to both construction and operational phases. The new piers and abutments are proposed to be aligned with the existing piers and abutments of the Quincentenary Bridge which will minimise the disturbance to the River Corrib flows and upstream afflux.

The Red2 Route Option is the least preferred option of the six route options in respect to potential impact to the Hydrology of the River Corrib. This is due to the requirement for in stream piers and their associated construction works.

Orange2 Route Option

The Orange2 Route Option involves a deep tunnel which avoids any encroachment into the River Corrib channel and floodplain during both the operational and constructional phases. This ensures that the Orange2 Route Option is the most preferred option in respect to the River Corrib crossing having no constructional or operational impacts on the hydrology of the River Corrib. The entrance and exit to the tunnel are outside the River Corrib flood extents.

Yellow2 Route Option

The River Corrib crossing point for the Yellow2 Route Option involves a viaduct structure to minimise direct impacts to the Lough Corrib cSAC and to avoid any permanent encroachment into the River Corrib channel. The Yellow2 Route Option is designed to provide a full span of the River Corrib channel which avoids any in stream constructional works associated with piers and abutments. The bridge is to be designed to ensure there is no constraint to river navigation or boat passage.

Therefore the soffit level of the bridge will be well elevated above the design flood water level of the river.

The flow conveyance in the River Corrib at the crossing point in the vicinity of the NUIG Recreational Facilities and Menlough, even under extreme flooding conditions, is confined to the river channel with overbank flood areas of limited conveyance contribution. The loss of flood storage as a result of the support piers of the long bridge will be inconsequential given the small volume associated with these piers in comparison to the River Corrib flood volume. There is large storage capacity within the upstream lakes and catchment system which gives rise to the damped nature of the Corrib flood hydrograph which remains almost steady state for many days during the flood peak. Under such conditions flood storage has little influence on flood attenuation.

During construction of the viaduct there will be temporary works within and close to the floodplain. There will be no works within the river channel associated with the pier construction as it will be full spanning. However the construction of the deck may require a pontoon or barge within the channel to assist access and construction.

The impact magnitude of the proposed viaduct crossing option for the Yellow2 Route Option is classified as a slight constructional and operational impact assuming good construction management for works within the floodplain area and no temporary works within the river channel itself. Where temporary in-stream construction works involving a barge/temporary platform is required to construct the long bridge Span of approximately 130m then the construction impact level increases to a temporary moderate impact.

Blue2 Route Option

The River Corrib Crossing for the Blue2 Route Option involves a viaduct structure to minimise direct impact to the Lough Corrib cSAC and to avoid encroachment into the river channel. This option is designed to provide a full span of the River Corrib channel which avoids any in-stream constructional works. The bridge is to be designed to ensure no constraint to river navigation or boat passage and therefore the soffit level of the bridge will be well elevated above the design flood water level of the river. The flow conveyance in the River Corrib at the crossing point, even under extreme flooding conditions, is confined to the channel with overbank flows of limited conveyance capacity at the crossing point. The loss of flood storage as a result of the viaduct piers will be inconsequential given the large storage capacity within the upstream lakes and catchment, the damped nature of the flood hydrograph and the small volume associated with the support piers.

During construction of the viaduct there will be temporary works within and close to the floodplain. There will be no works within the river channel associated with the pier construction as it will be full spanning. However the construction of the deck may require a pontoon or barge within the channel to assist access and construction.

The impact magnitude of the proposed bridge crossing for the Blue2 Route Option is classified as a slight constructional and operational impact assuming good construction management for works within the floodplain area and no temporary works within the river channel. Where temporary in-stream construction works involving a Barge/temporary platform is required to construct the central bridge

span of approximately 130m then the construction impact level increases to a temporary moderate impact.

Pink2 Route Option

The River Corrib crossing for the Pink2 Route Option is located slightly upstream of the Blue2 and Yellow2 Route Options bridge crossing. This crossing is slightly skewed to the river channel and similarly involves a viaduct structure to minimise direct impact to the Lough Corrib cSAC and to avoid encroachment into the river channel involving a mid-span length in excess of 150m. This option is designed to provide a full span of the River Corrib channel which avoids any in-stream constructional works. The bridge is to be designed to ensure no constraint to river navigation or boat passage and therefore the soffit level of the bridge will be well elevated above the design flood level of the river.

In terms of floodplain encroachment, this crossing location is shown to have a narrower flood plain width of 165m in comparison to the Blue2 and Yellow2 Route Options which are in the order of 210m, however the main channel span is almost 20m wider to avoid encroaching the river channel.

The flow conveyance in the River Corrib at the crossing point of the Pink2 Route Option, even under extreme flooding conditions, is confined to the channel with overbank flow of very limited capacity and situated immediately adjacent to the river banks. The loss of flood storage as a result of the viaduct piers will be inconsequential given the large storage capacity within the upstream lakes and catchment, the damped nature of the flood hydrograph and the small volume associated with the support piers.

During construction of the viaduct there will be temporary works within and close to the floodplain. There will be no works within the river channel associated with any pier construction.

The impact magnitude of the proposed viaduct crossing option for the Pink2 Route Option is classified as a slight constructional and operational impact assuming good construction management for works within the floodplain area and no temporary works within the river channel itself. Where temporary in-stream works are required to construct the central bridge span of approximately 130m then the construction impact level increases to a temporary moderate impact.

Green2 Route Option

The River Corrib crossing for the Green2 Route Option represents the widest section of floodplain encroachment of all the route options measuring some 460m width. The river channel is approximately 130m wide at the crossing point. The proposed crossing involves a viaduct structure to minimise direct impact to the Lough Corrib cSAC. This option is designed to provide a full span of the River Corrib channel which avoids any in-stream constructional works associated with piers and foundations. The bridge is to be designed to ensure no constraint to river navigation or boat passage and therefore the soffit level of the bridge will be well elevated above the design flood level of the river.

The flow conveyance in the River Corrib at the crossing point, even under extreme flooding conditions, is confined to the channel with overbank flows of limited conveyance capacity at the crossing point. The loss of flood storage as a result of the viaduct piers will be inconsequential given the large storage capacity within the

upstream lakes and catchment, the damped nature of the flood hydrograph and the small volume associated with the support piers.

During construction of the viaduct there will be temporary works within and close to the flood plain. There will be no works within the River channel associated with any in-stream piers.

The impact magnitude of the proposed viaduct crossing option for the Green2 Route Options is classified as a slight constructional and operational impact assuming good construction management for works within the floodplain area and no temporary works within the river channel. Where temporary in-stream works are required to construct the central bridge span (possibly using a pontoon or barge) then the construction impact level increases to a temporary moderate impact due to it being part of a European site.

Summary – River Corrib Crossing

The Red2 Route Option is the least preferred option due to the requirement for in-stream piers and associated construction works. The Orange2 Route Option is considered to be most preferred as it avoids through tunnelling the watercourse and its floodplain. The remaining Blue2, Pink2 and Yellow2 Route Options are all ranked equally as second as they avoid any piers within the sensitive water course and have a narrow flood plain crossing width than the Green2 Route Option which is ranked fifth.

Section 2 - Watercourse Crossings

Red2 Route Option

To the west of the River Corrib the Red2 Route Option crosses three minor tributaries of the Bearna Stream and four tributaries of the Knocknacarra Stream. These watercourses discharge to the Galway Bay Complex cSAC and can be classified as locally high and medium value watercourses with the Knocknacarra Stream highly urbanised. All of its tributaries are already culverted under the existing Western Distributor Road and receive urban storm discharges. The potential impact magnitude of these crossings and associated road outfall discharges is considered to represent a permanent moderate impact that can be reduced to slight permanent impact through the appropriate culvert design and implementation of storm water management SuDS. The Bearna Stream has fishery potential and is part of the Galway Bay Complex cSAC in its downstream reach and will require careful management of construction discharges, road discharges and fishery friendly culvert design for example, full spanning bottomless culverts or small bridges for the crossings.

To the east of the River Corrib the Red2 Route Option significantly encroaches into the Terryland River basin and requires a long viaduct structure to avoid significant impact to the Terryland River channel and floodplain area. The Terryland River is classified as a low value river with respect to fishery potential, as it disappears underground via swallow-holes near Castlegar, and it is believed to emerge somewhere in Inner Galway Bay. The swallow-hole capacity is likely to be sensitive to the potential release of construction sediment into the Terryland River. This sediment could result in reduced flow capacity and potential blockage of the underground flow paths. The constructional and operational impacts of the Red2 Route Option on the Terryland River are classified as a potentially moderate and slight impacts respectively.

Orange2 Route Option

The Orange2 Route Option crosses three minor tributaries of the Bearna Stream and four tributaries of the Knocknacarra Stream. These watercourses discharge to the Galway Bay Complex cSAC and can be classified as locally high and medium value watercourses. The Knocknacarra Stream is highly urbanised and all of its tributaries are already culverted under the existing Western Distributor Road. The potential impact magnitude of these crossings and potential outfall discharges is considered to represent a permanent moderate impact that can be reduced to slight permanent impact through the appropriate culvert design and implementation of storm water management SuDS. The Bearna Stream has fishery potential and appropriate culvert design will be required.

To the east of the River Corrib the Orange2 Route Option on emerging from its tunnel encroaches into the Terryland River basin and potentially involves construction of an embankment within the floodplain area and the culverting or bridging of the stream channel. The Terryland River is classified as a low value river in respect to fishery potential as it disappears underground near Castlegar via swallow hole and is believed to emerge somewhere in Inner Galway Bay. The swallow hole capacity may be limited and potentially very sensitive to sediment release during construction that could cause blockages within the underground conduit system. Therefore both the construction and operational impacts of the Orange2 Route Option on the Terryland River is classified as a potentially moderate impact.

Yellow2 Route Option

The Yellow2 Route Option crosses three minor tributaries of the Bearna Stream and passes to the north of Knocknacarra Stream channel. The Bearna Stream discharges to the Galway Bay Complex cSAC and can be classified as a locally high value watercourse. The potential impact magnitude of these crossings and potential outfall discharges is considered to represent a permanent moderate impact that can be reduced to slight permanent impact through the appropriate culvert design and implementation of storm water management SuDS. The Bearna Stream has fishery potential and fishery friendly culvert design may be required.

To the east of the River Corrib the Yellow2 Route Option encroaches the floodplain extents of the Coolagh Lakes and crosses the drainage channel that conveys spring flow to the Coolagh Lakes near Coolagh Village. It also passes in close vicinity to a second spring and drainage channel that supplies the lake to the north closer to the River Corrib. The Coolagh Lake system, which includes its floodplain and contributing drainage channels, has an extremely high attribute value given its ecological value and is also part of the Lough Corrib cSAC. The proposal is to provide a long bridge crossing through the Lough cSAC to minimise encroachment within the cSAC boundary. The flood extent for the Coolagh Lakes area, defined by the CFRAM draft mapping, does not coincide with the cSAC boundary and indicates a potential for road embankment to be placed within flood risk zone A and flood zone B of the River Corrib. The potential impact of Yellow2 Route Option including constructional works within and close to the flood zone of the Coolagh Lakes and the potential for permanent encroachment within the flood zone of the lough is considered to represent a moderate temporary and permanent impact magnitude.

The Yellow2 Route Option crosses the Terryland River floodplain and stream channel and involves construction of an embankment within the floodplain area and the culverting or bridging of the stream channel. The Terryland River is classified as a low value river in respect to fishery potential as it disappears underground near Castlegar via swallow holes and is believed to emerge somewhere in Inner Galway Bay. The swallow hole capacity may be limited and potentially very sensitive to sediment release during construction that could cause blockages within the underground conduit system. Therefore both the construction and operational impacts of the Yellow2 Route Option on the Terryland River is classified as a potentially moderate impact.

Blue2 Route Option

The Blue2 Route Option crosses three minor tributaries of the Bearna Stream and passes to the north of Knocknacarra Stream channel. The Bearna Stream discharges to the Galway Bay Complex cSAC and can be classified as a locally high value watercourse. The potential impact magnitude of these crossings and potential outfall discharges is considered to represent a permanent moderate impact that can be reduced to slight permanent impact through the appropriate culvert design and implementation of storm water management (SuDS). The Bearna Stream has fishery potential and fishery friendly culvert design will be required to avoid impact.

To the East of the Corrib the Blue2 Route Option avoids the Coolagh Lakes floodplain area and the Terryland River Basin. This route option passes to the south of Ballindooley Lough just avoiding the potential flood zone of the lough.

Pink2 Route Option

The Pink2 Route Option crosses three minor tributaries of the Bearna Stream and passes to the north of Knocknacarra Stream channel. The Bearna Stream discharges to the Galway Bay Complex cSAC and can be classified as locally high value watercourse. The potential impact magnitude of these crossings and potential outfall discharges is considered to represent a permanent moderate impact that can be reduced to slight permanent impact through the appropriate culvert design and implementation of storm water management (SuDS). The Bearna Stream has fishery potential and fishery friendly culvert design may be required.

To the east of the River Corrib the Pink2 Route Option avoids the Coolagh Lakes floodplain area and the Terryland River Basin. This route option passes to the south of Ballindooley Lough just avoiding the Flood Zone of the lough.

Green2 Route Option

The Green2 Route Option crosses three tributaries (including the Toonabrooky Stream) of the Bearna Stream and passes to the north of Knocknacarra Stream drainage channels. This route option crosses again the Toonabrooky Stream and passes close to Lough Nabrocky. The Bearna Stream discharges to the Galway Bay Complex cSAC and can be classified as a locally high attribute watercourse. The potential impact magnitude of these four crossings and potential outfall discharges is considered to represent a permanent moderate impact that can be reduced to slight permanent impact through the appropriate culvert design and implementation of storm water management (SuDS). The Bearna Stream has fishery potential and fishery friendly culvert design may be required. It is worth noting that at the

crossing points these tributary streams are steep hillside channels and unlikely to be salmonid.

To the east of the River Corrib the Green2 Route Option avoids the Coolagh Lakes floodplain area and the Terryland River Basin. This route option passes to the north and within the flood zone and recharge zone of Ballindooley Lough. This Lough is classified as high attribute value and the potential impact to this lough is rated moderate. The impact to the lough may arise from constructional runoff, road drainage runoff via outfall discharges, encroachment within the floodplain of Ballindooley Lough and potential for interference with groundwater recharge from the north.

Summary - Watercourse Crossings

In terms of impact to watercourses resulting from potential culverting, outfalls and channel diversions the least preferrable is the Yellow2 Route Option flowed by the Green2 Route Option, and then by Blue2/Pink2 Route Options. The preferred is the Orange2 Route Option with the Red2 Route Option second. The impact scale on watercourses is slight to moderate construction and permanent impacts.

Section 2 - Flood Risk

The streams and flood risk areas encountered to the west of the River Corrib are considered to be minor and localised to the immediate areas surrounding the channel banks and present little difference in impact level in respect to flood risk and flood impact. The principal flood risk areas are the crossing of the River Corrib and encroachment of the Terryland River Basin which is shown to be a defended area in the CFRAM study.

Flood risk has been assessed using combination of local anecdotal and historical flood information, the OPW pFRA mapping which includes coastal, fluvial, pluvial and groundwater preliminary flood risk areas and the recent more detailed Draft CFRAM mapping of fluvial and coastal flood risk for the River Corrib and its tributary the Terryland River. The impact level for each of the route options is determined based on the length of the route option that encroaches a Flood risk area, the potential flood risk to the development and potential impact on existing flood risk.

Red2 Route Option

The Red2 Route option proposes a bridge crossing of the River Corrib adjacent to the existing Quincentenary Bridge. This represents the shortest crossing point of the River Corrib floodplain of all the route options. This route option however, does involve a considerable encroachment distance (1.4km) through the defended flood zone of the Terryland River Basin. The most significant risk is the potential impact to the Terryland River and the potential blockage to its swallow holes, posed by the construction of the Red2 Route Option. The Terryland River system is defended by flood embankments along the Dyke Road from the River Corrib. Should the Terryland River swallow holes become blocked the flood level in the area will revert to that of the River Corrib flood level. The proposal is for the construction of a viaduct supported on piers up through the Terryland River basin which will reduce the potential impact of flooding and flood risk from significant to moderate.

The Red2 Route Option which is primarily an on-line upgrade option avoids the majority of the Pluvial Flood risk areas based on the OPW pFRA mapping. In the

Westside/Newcastle area pluvial flooding is indicated in the vicinity of the Red2 Route Option. This area has urban drainage that discharges to the Distillery Stream through NUI Galway and such pluvial flooding risk is unlikely to be realised or significant.

The flood risk impacts on the minor watercourses to the west of the River Corrib are small and have been included for in the assessment of watercourses above.

Orange2 Route Option

The River Corrib Floodplain is avoided by the proposed bored tunnel. The most significant risk is the potential impact to the Terryland River and the potential blockage to its swallow holes, posed by the construction of the Orange2 Route Option. The Terryland system is defended by flood embankment along the Dyke Road from the River Corrib and should the Terryland River swallow holes become blocked the flood level in the area will revert to that of the River Corrib flood level. The section of embankment leading to the proposed tunnel entrance is located within the Terryland River floodplain area and will resilt in a loss of flood storage. The potential impact on flooding and flood risk by this route option is assessed to be a moderate permanent impact.

The flood risk impacts on the minor watercourses to the west of the River Corrib are small and have been included for in the assessment of Watercourses above.

Yellow2 Route Option

The Yellow2 Route Option crosses the River Corrib downstream of Menlo Castle similar to the Blue2 Route Option and only slightly downstream of the Pink2 Route Option having a total flood zone width of 220m and a channel width of *c*.130m. The Yellow2 Route Option is a proposed viaduct crossing of the River Corrib and floodplain with no proposed in-stream piers.

The Yellow2 Route Option then encroaches into the River Corrib flood zones to the northwest and north of the Coolagh Lakes for a distance of 240m and then crosses the defended flood zone of the Terryland River.

The Yellow2 Route Option involves encroachment into the flood zone area adjacent to the Coolagh Lakes and also encroaches into the Terryland River floodplain.

The flood risk impacts on the minor watercourses to the west of the River Corrib are small and have been included for in the assessment of watercourses above.

The potential floodplain and flood risk impact of this route option will be a moderate permanent impact.

Blue2 Route Option

The Blue2 Route Option crosses the River Corrib downstream of Menlo Castle similar to the Yellow2 Route Option having a total flood zone width of 220m and a channel width of *c*.130m. The Blue2 Route Option is a proposed viaduct crossing of the River Corrib with no proposed in-stream piers. This route option avoids the Coolagh Lakes flood zone and the Terryland River Basin. This route option passes close to the Ballindooley Lough flood area to the south of the lough.

The flood risk impacts on the minor watercourses to the west of the River Corrib are small and have been included for in the assessment of watercourses above.

The potential floodplain and flood risk impact of this route option will be a moderate permanent impact.

Pink2 Route Option

The Pink2 Route Option crosses the River Corrib downstream of Menlo Castle and slightly upstream of the Blue2 and Yellow2 Route Options having a total flood zone width of 165m and a main channel width of *c.*150m. The Pink2 Route Option is a proposed viaduct crossing of the River Corrib with no proposed in-stream piers. This route option avoids the Coolagh Lakes flood Area and the Terryland River Basin. This route option passes close to the Ballindooley Lough flood area to the south of the lough. The viaduct option allows it to minimise encroachment into the Lough Corrib cSAC.

The flood risk impacts on the minor watercourses to the west of the Corrib are small and have been included for in the assessment of watercourses above.

The potential floodplain and flood risk impact of this route option will be a moderate permanent impact.

Green2 Route Option

The Green2 Route Option represents the widest crossing length of the River Corrib floodplain and flood zone having an encroachment distance of 460m within the River Corrib flood zone. This route option is shown to encroach slightly the flood zone area surrounding Ballindooley Lough to the north.

To the east of the River Corrib, in the limestone basin, there are no surface watercourses encountered with generally only pluvial and groundwater flood risk being identified for a number of small local depressions which are considered insignificant.

The flood risk impacts on the minor watercourses to the west of the River Corrib are small and have been included for in the assessment of watercourses above.

The potential floodplain and flood risk impact of this route option will be a moderate permanent impact.

Summary – Flood Risk

In terms of flood Risk and watercourse impacts the least preferred option is the Yellow2 Route Option which crosses the River Corrib downstream of Menlo Castle similar to the Blue2 Route Option but then encroaches the River Corrib flood zones again to the northwest and north assocaiated with the Coolagh Lakes for a distance of 240m and then crosses the defended flood zone of the Terryland River.

The Pink2 Route Option is the most preferred route option as the Corrib flood zone crossing width is reasonably modest having a total width of 165m, with the main channel width of some 150m (slightly skewed crossing of the River Corrib). This route option is only slightly preferable to the Blue2 Route Option as it has a shorter floodplain encroachment width and avoids the flood areas surrounding the Coolagh Lakes and the Terryland River Basin.

The Orange2 Route Option is ranked third representing a deep tunnel crossing of the Corrib but does encroach the defended Flood Zones of the Terryland River Basin.

The Green2 Route Option is ranked fourth and represents the widest crossing of the River Corrib Floodplain and Flood Zones as outlined above. This option also crosses flood zone of the Ballindooley Lough and has a number of minor pluvial flood risk zones along its corridor.

The Red2 Route Option is ranked fifth, this involves a bridge option adjacent to the existing Quincentenary Bridge which represents the shortest crossing point of the Corrib floodplain of all the route options. This option however, does involve a considerable encroachment distance (1.4km) through the defended flood zone of the Terryland River basin.

Section 2 - Hydro-Ecology

Detailed ecological habitat mapping has been carried out for the scheme study area and based on this mapping and site walkovers an assessment of the impact to hydro-ecology of the various route options has been carried out. The main impacts in relation to hydrology are the potential for hydrological regime change and potential for changes to water quality and water chemistry of aquatic habitats. These impacts could be as a result of the road development; through its drainage networks and outfall discharges, potential for localised dewatering, and potential for flooding or water quality impact. To the west of the River Corrib the ecological habitat mapping shows the proposed route options avoiding Annex I habitats such as Blanket bog [7130], Transition mires and Quaking bogs [7140] and Wet heath [4010] with a number of the route options passing within close proximity of such habitats. Refer to **Section 4.3** for Ecology Constraints and **Section 7.6.1** for the ecological assessment of the route options.

To the east of the River Corrib the habitats change due to the limestone bedrock with sensitive habitats of Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* surrounding the Coolagh Lakes just to the east of the River Corrib. The assessment identified the route options most proximal to these habitats and whether they were upstream or downstream of them.

The River Corrib, as a salmonid water and with the downstream Galway Bay Complex cSAC, was not included under this assessment as the impacts on this water body have already been considered under the water quality assessment.

<u>Red2 Route Option</u>

East of the River Corrib the Red2 Route Option avoids impacts to all of the identified aquatic habitats primarily as it follows an existing on-line route. The Red2 Route Option will require in-stream works in the river and consequently, in the Lough Corrib cSAC for the two proposed bridge support piers. This is considered to represent a moderate to high magnitude impact due to the sensitivity of the Lough Corrib cSAC salmonid waters.

<u>Orange2 Route Option</u>

To the east of the River Corrib the Orange2 Route Option crosses through section of wet and dry heath associated with EC19 and EC20 which have attribute values of low to high. The Wet heath complex is sensitive to hydrological regime changes through drainage and potential dewatering effects caused by constructing the route option. The potential impact of this route option on this receptor is classified as moderate to high and through appropriate drainage design this impact can be reduced to slight to moderate.

The Orange2 Route Option avoids impacts, both direct and indirect to the Lough Corrib cSAC through tunnelling.

Yellow2 Route Option

To the east of the River Corrib the Yellow2 Route Option crosses through section of Wet and Dry heath associated with EC19 and EC20 which have attribute values of low to high. The Wet heath complex is sensitive to hydrological regime change through drainage and potential dewatering effects caused by construction of this route option. The potential impact of the road on this receptor is classified as moderate to high and through appropriate drainage design this impact can be reduced to slight to moderate. The link road to the N59 for the Yellow2 Route Option passes through an extensive area of wet Grassland adjacent to the Moycullen Bog NHA (EC25) which is given a local high attribute value. The edge of this route option corridor comes to within 40m of Annex I Blanket bog habitat. Within the corridor it is likely that this route option can be kept 100m from the Blanket bog habitat which would ensure that drainage and dewatering impacts are imperceptible. The impact on the wet grass land habitat is classified as a moderate impact.

To the west of the River Corrib the Yellow2 Route Option crosses through a section of the Coolagh Lakes fen flood area and Lough Corrib cSAC area. The proposal is to provide a viaduct crossing so as to minimise direct impact to the Lough Corrib cSAC. It is recommended that this long bridge be extended to bridge the full flood risk/flood plain area. Potential drainage discharge and local placement of support piers for this viaduct have the potential to result in a hydrological impact to this habitat both during construction and operation. Given its attribute importance of extremely high represents a high impact magnitude.

Blue2 Route Option

To the east of the River Corrib the Blue2 Route Option crosses through section of wet and dry heath associated with EC19 and EC20 which have attribute values of low to high. The Wet heath complex is sensitive to hydrological regime changes through drainage and potential dewatering effects caused by construction of this route option. The potential impact of this route option on this receptor is classified as moderate to high. Through appropriate drainage design this impact can be reduced to slight to moderate. The link road to the N59 for the Blue2 Route Option passes through an extensive area of wet grassland adjacent to the Moycullen Bog NHA (EC25) which is given a local high attribute value. The edge of the Blue2 Route Option Corridor comes to within 40m of Annex I Blanket bog habitat. Within this route option corridor it is likely that the alignment can be kept 100m from the Blanket bog habitat which would ensure that drainage and dewatering impacts are imperceptible. The impact on the wet grassland habitat is classified as a moderate impact.

To the west of the River Corrib there is little impact to hydro-ecological receptors with only slight direct impact to the Ballindooley Lough EC39 with a small section of the route option corridor just encroaching Annex I Molinia meadows habitat. Within the route option corridor there is ample width to avoid encroaching this habitat. A potential indirect impact may arise on this habitat and Ballindooley Lough from road drainage discharge which can be mitigated through appropriate storm water management (SuDS). The impact magnitude on Ballindooley Lough EC39 is considered to be a moderate magnitude impact.

The Blue2 Route Option passes through the recharge zone of the Coolagh Lakes which could impact on the Calcareous fens surrounding the lake. This impact is dealt with and accounted for within the hydrogeology assessment, see **Section 7.6.3.**

Pink2 Route Option

To the east of the River Corrib the Pink2 Route Option crosses through section of wet and dry heath associated with EC19 and EC20 which have attribute values of low to high. The Wet heath complex is sensitive to hydrological regime changes through drainage and potential dewatering effects caused by construction of this route option. The potential impact of this route option on this receptor is classified as moderate to high and through appropriate drainage design and storm water management this impact can be reduced to slight to moderate. The link road to the N59 for the Pink2 Route Option passes through an extensive area of wet grassland adjacent to the Moycullen Bog NHA (EC25) which is given a local high attribute value. The edge of this route option corridor comes to within 40m of Annex I Blanket bog habitat. Within this route option corridor it is likely that the alignment can be kept 100m from the Blanket bog habitat which will ensure that drainage and dewatering impacts are imperceptible. The impact on the wet grass land habitat is classified as a moderate impact.

To the west of the River Corrib there is little impact to hydro-ecological receptors with only slight direct impact to Ballindooley Lough EC39 with a small section of the corridor just encroaching Annex I Molinia meadows habitat. Within this route option corridor there is ample width to avoid encroaching this habitat. A potential indirect impact may arise on this habitat and Ballindooley Lough from road drainage discharge which can be mitigated through appropriate storm water management (SuDS). The impact magnitude on Ballindooley Lough EC39 is considered to be a moderate magnitude impact.

The Pink2 Route Option passes through the recharge zone of the Coolagh Lakes which could impact on the Calcareous fens surrounding the lough. This impact is dealt with and accounted for within the Hydrogeology assessment, see **Section 7.6.3.**

Green2 Route Option

The Green2 Route Option passes in close proximity to internationally important Blanket bog, Wet heath and transition mire and quaking bog habitats east of the River Corrib associated with the Moycullen Bog NHA at Tonabrocky EC22 and at Ballagh EC25. The potential indirect impacts of the road construction and operation could result in dewatering and drainage impacts to these habitats having a high impact magnitude.

Similar to a number of the other route options the corridor crosses through section of wet and dry heath associated with EC19 and EC20 which have attribute values of low to high. The Wet heath complex is sensitive to hydrological regime change through drainage and potential dewatering and the potential impact of the road on this receptor is classified as moderate to high and through appropriate drainage design this impact can be reduced to slight to moderate.

At the River Corrib crossing the road comes in close proximity to Alkaline fens on both sides of the River. The route also crosses the wet grassland area associated

with the Ballindooley Lough riparian Zone EC 39 with the potential for a moderate magnitude impact during construction and operational stages.

Summary - Hydro-Ecology

Overall the least preferred route of the six route options is the Green2 Route Option due to its close proximity to internationally important Blanket bog habitats west of the River Corrib (Moycullen Bog NHA at Tonabrocky EC22 and at Ballagh EC25) and its close proximity to Alkaline fens at the River Corrib crossing located on both sides of the River. The Green2 Route Option also takes it across wet grassland area associated with the Ballindooley Lough riparian zone of EC39.

The preferred route option is the Orange2 Route Option as it has the least potential for impact to wetland habitats east of the River Corrib, it avoids the river and floodplain area through tunnelling. It also avoids impact to important aquatic habitats east of the river.

The Red2 Route Option represents the second ranked option as it is similar in terms of potential impact, but it requires in-stream works in the River Corrib for its bridge support piers (two piers likely to be proposed).

The Blue2, Pink2 and Yellow2 Route Options and associated link road with the N59 pass to the east of the Blanket bog and Wet heat/Wet grassland habitats associated with the Moycullen Bog NHA at Ballagh. These route options also encounter at a number of locations, wet grassland habitat of local importance. At the breakpoint between Section 1 and Section 2 all of the route options encounter a small section of wet and dry heath of international importance and locally important wet grassland (at EC19 and 20). The crossing of the River Corrib and its floodplain will be by long spanning bridge sections which limits the potential impact to wetland habitats associated with the river and its floodplain, similar to the Green2 Route Option. These route options pass upstream of the Coolagh Lakes and its associated Alkaline fens and Calcareous springs with the Yellow2 Route Option passing within the floodplain area of this lake system with the potential for impact to the water flow towards these fens. The Blue2 and Pink2 Route Options are ranked third and the Yellow2 Route Option is ranked fifth in terms of hydro-ecology impacts.

Section 2 -Water Quality

The River Corrib is classified as Salmonid waters which is a qualifying interest of the Lough Corrib cSAC. The Bearna Stream and the Knocknacarra Stream outflow into the Galway Bay Complex cSAC and are considered sensitive to both operational and constructional pollution. The River Corrib and the Terryland River also discharge into the Galway Bay Complex cSAC and therefore are also considered sensitive to potential water quality impacts. Water quality impacts to these watercourses represent a moderate to significant impact and requires mitigation to avoid contaminated discharges both during construction and throughout the operational phases of the road.

A major public water supply abstraction is present at Terryland with the abstracton point located in the Jordan's Island channel upstream of the Quincentenary Bridge on the River Corrib. Such a large and important water supply, which is rated as having a very high attribute value, is highly sensitive to water quality impacts both during construction and operational phases of the project (i.e. in the event of routine road runoff discharges and accidental spillages). There are plans by Irish Water to

relocate the abstraction point out into the River Corrib main channel downstream of Jordan's Island. All of the route options fall within the source protection area of both the existing supply and proposed new abstraction point. The closest route options to the intake in the upstream direction are considered to have the greatest potential for impact both during construction and operation given the distance, speed and mixing volume available. This potentially represents a significant impact on a very high importance attribute both during construction and potentially during the operational phase of the road from road runoff via road drainage outfalls.

Lough Atalia is part of the Galway Bay Complex cSAC and is a coastal lagoon priority habitat. The route options are unlikely to result in any significant impact to water quality, salinity or to the hydrological regime within the coastal lagoon. The overall impact, provided appropriate mitigation is carried out, is likely to have an imperceptible impact on the Galway Bay Complex cSAC.

The Bearna Stream and all watercourses moving eastwards from it eventually discharge into the Galway Bay Complex cSAC which is a sensitive water body in respect to water quality. The Terryland River by virtue of it disappearing underground and representing a point source to the regionally important karst bedrock aquifer makes it highly sensitive watercourse in respect to pollution.

Red2 Route Option

The Red2 Route Option is located downstream of the Terryland Water Works supply intake and consequently both operational and constructional works are unlikely to result in a significant upstream impact to the water abstraction. The potential for migration of disturbed sediment during construction and potential surface plumes of oil from road spillage during operation, cannot be ruled out as a risk which may occur during gate closure at the salmon weirs and during prevailing south to south-easterly winds blowing against the River Corrib. However, the risk of this is considered low and the potential impact on such an abstraction is rated as a slight to moderate temporary impact. The river Corrib is a salmonid river. The potential impact of road runoff discharges on the water quality of the River Corrib is rated as high as is the potential water quality impacts associated with the bridge crossing during construction. The impact for the smaller watercourses have been assessed under the watercourse assessment. This route option involves works and drainage discharge to the Terryland River. This river discharges underground and thus represents a source of groundwater pollution to a regionally important karst aquifer and potential source of pollution to the inner Galway Bay Complex cSAC. This potential impact is rated as high in respect to groundwater and slight in respect to the Galway Bay Complex cSAC.

Orange2 Route Option

The tunnel on the Orange2 Route Option avoids the River Corrib during construction and its road runoff is unlikely to discharge directly to the River Corrib. The impact for the smaller watercourses has been assessed under watercourse assessment. This option involves works and drainage discharges to the Terryland River. This river discharges underground and thus represents a point source of groundwater pollution to a regionally important karst limestone bedrock aquifer and potential source of pollution to the inner Galway Bay Complex cSAC. This potential impact is rated as high in respect to groundwater and slight in respect to the Galway Bay Complex cSAC.

Yellow2 Route Option

The Yellow2 Route Option crosses the River Corrib upstream of the Terryland Water Works supply intake and consequently represents a significant risk to a very high attribute water supply receptor being within 1.4 km of the intake which at a modest flow velocity of 0.5m/s could see a plume reaching the intake within *c*.50 minutes. The proposed crossing of the river will be a full spanning structure and therefore avoids any in-stream works associated with construction of the piers. Construction impacts of constructing the bridge deck and floodplain piers remain which could potentially cause sedimentation and construction spillages (concretes, hydrocarbons etc.) being released into the River Corrib. During the operation stage road drainage discharge presents a significant risk to the intake and as a Salmonid Water in respect to accidental spillages. Mitigation will be required to minimise or eliminate this risk by preventing direct untreated discharge of road drainage to the river. Routine road runoff is unlikely to cause a significant impact given the high dilution available within the River Corrib.

The water quality impact for the smaller watercourses to the west of the River Corrib have been assessed under watercourse assessment.

The Yellow2 Route Option involves works adjacent to the Coolagh Lakes which are connected directly to the River Corrib 900m upstream of the intake. This combined with the river crossing increases the works area and road distance that could give rise to serious impact on Lough Corrib cSAC and on the Terryland city water supply intake. The potential water quality impact on the Lough Corrib cSAC is assessed as moderate and the potential impact on the Terryland Water Works city water supply abstraction, is assessed as high both for construction and operational phases. The operational phase impact can be mitigated to a slight and moderate impact through preventing direct discharge of road drainage to the river and the Coolagh Lakes area by providing spillage containment and treatment.

The Yellow2 Route Option involves works and drainage discharges to the Terryland River which discharges underground and thus represents a point source of groundwater pollution to a regionally important karst limestone bedrock aquifer and potential source of pollution to the Galway Bay Complex cSAC. This potential impact is rated as high in respect to groundwater and slight in respect to the Galway Bay Complex cSAC.

Blue2 Route Option

The Blue2 Route Option crosses the River Corrib upstream of the Terryland Water Works supply abstraction point and consequently represents a significant risk to a very high attribute water supply receptor being within 1.4 km of the intake which at a modest flow velocity of 0.5m/s could see a plume reaching the intake within *c*.50 minutes. The proposed crossing of the river will be a full spanning structure and therefore avoids any in-stream works associated with construction of the piers. Construction impacts of constructing the bridge deck, which may involve some instream works from a barge, and floodplain piers remain, which could potentially cause sedimentation, disturbance of the river bed and construction spillages (concretes, hydrocarbons etc.) into the River Corrib. During the operational phase, road drainage discharge presents a significant risk to the water abstraction and to the Salmonid waters in respect to accidental spillages. Mitigation will be required to minimise or eliminate this risk by preventing direct untreated discharge of road drainage to the River Corrib. Routine road runoff is unlikely to cause a significant

impact to the water quality given the high dilution available within the River Corrib relative to road drainage discharges and pollutant loads.

The Blue2 Route Option involves works adjacent to the Coolagh Lakes which are connected directly to the River Corrib 900m upstream of the abstraction point for the Terryland Water Works. This combined with the river crossing increases the works area and road distance that could give rise to serious impact on Lough Corrib cSAC and on the city water supply. The potential water quality impact on the Lough Corrib cSAC is assessed as moderate and the potential impact on the Terryland Water Works abstraction point is assessed as high both for construction and operational phases. Operation phase impacts can be mitigated to a slight and moderate impact through preventing direct untreated discharge of road drainage to the River Corrib and the Coolagh Lakes area by providing spillage containment and treatment.

The impact on the smaller watercourses has been assessed and included for earlier under the assessment of watercourses. The Blue2 Route Option avoids the Terryland River basin but passes south of Ballindooley Lough. There is potential for road drainage discharge to the lough and construction impacts caused by the proximity of the road to the flood area of this lough. This is a high attribute receptor and the water quality potential impact is rated as moderate but can be reduced to slight with mitigation by providing appropriate treatment and spillage containment of road runoff drainage.

Pink2 Route Option

The Pink2 Route Option crosses the River Corrib upstream of the Terryland Water Works supply intake and consequently represents a significant risk to a very high attribute water supply receptor being within 1.4 km of the intake which at a modest flow velocity of 0.5m/s could see a plume reaching the intake within *c*.50 minutes. The proposed crossing of the River Corrib will be a full spanning structure and therefore avoids any in-stream works associated with construction of the piers. Construction impacts of constructing the bridge deck, which may involve some in-stream works from a barge, and floodplain piers remain, which could potentially cause sedimentation, disturbance of the river bed and construction spillages (concretes, hydrocarbons etc.) into the River Corrib. During the operation stage the road drainage discharge presents a significant risk to the water supply intake and to the salmonid waters in respect to accidental spillages. Mitigation will be required to minimise or eliminate this risk by preventing direct untreated discharge of road drainage to the River Corrib. Routine road runoff is unlikely to cause a significant impact to the water quality given the high dilution available within the River Corrib relative to road drainage discharges and pollutant loads.

The Pink2 Route Option involves works adjacent to the Coolagh Lakes which are connected directly to the River Corrib 900m upstream of the water in-take. This combined with the River Corrib crossing increases the works area and road distance that could give rise to serious impact on Lough Corrib cSAC and on the Terryland city water supply intake. The potential water quality impact on the Lough Corrib cSAC is assessed as moderate and the potential impact on the Terryland city water supply intake is assessed as high both for construction and operational phases. Operation phase impact can be mitigated to a slight and moderate impact through preventing direct untreated discharge of road drainage to the River Corrib and the Coolagh Lakes area and providing appropriate spillage containment and treatment.

The impact on the smaller watercourses has been assessed and included for earlier under the assessment of watercourses. The Pink2 Route Option avoids the Terryland River Basin but passes south of Ballindooley Lough with the potential for road drainage discharge to the lough and construction impacts caused by the proximity of the road to the flood area of this lough. This is a high attribute receptor and the water quality potential impact is rated as moderate but can be reduced to slight with mitigation in respect to appropriate treatment of the road drainage discharge.

Green2 Route Option

The Green2 Route Option crosses the River Corrib upstream of the Terryland Water Works abstraction point and consequently represents a significant risk to a very high attribute water supply receptor being within 2.2 km of the intake which at a modest flow velocity of 0.5m/s could see a plume reaching the intake within *c*.90 minutes. The proposed crossing of the River Corrib will be a full spanning structure and therefore avoids any in-stream works associated with construction of the piers. Construction impacts of constructing the bridge deck, which may involve some in-stream works from a barge, and floodplain piers remain, which could potentially cause sedimentation, disturbance of the river bed and construction spillages (concretes, hydrocarbons etc.) into the River Corrib. During the operational stage the road drainage discharge presents a significant risk to the water supply intake and to the Salmonid waters in respect to accidental spillages. Mitigation will be required to minimise or eliminate this risk by preventing direct untreated discharge of road drainage to the River Corrib. Appropriate treatment and containment will be provided. Routine road runoff is unlikely to cause a significant impact to the water quality given the high dilution available within the River Corrib relative to road drainage discharges and pollutant loads.

The impact on the smaller watercourses has been assessed and included for earlier under the assessment of watercourses. The Green2 Route Option avoids the Terryland River Basin but passes north of Ballindooley Lough with the potential for road drainage discharge to the lough and construction impacts caused by the proximity of the road to the flood area of this lough. This is a high attribute receptor and the water quality potential impact is rated as moderate but can be reduced to slight with mitigation in respect to appropriate treatment of the road drainage in the form of surface water management systems.

Summary - Water Quality

The Orange2 Route Option is considered to be the most preferred option as it avoids the River Corrib during construction and its road runoff discharges are unlikely to discharge to the River Corrib. This route option involves works and drainage discharges to the Terryland River. The Red2 Route Option is ranked second as it is located downstream of the Terryland city water supply intake notwithstanding the in-stream works associated with its bridge piers and the degree of encroachment within the Terryland River basin and potential outfalls to the Terryland River.

The Green2 Route Option is ranked third having the furthest upstream river crossing from Terryland city water supply intake, followed in fourth by the Blue2 and Pink2 Route Options and in fifth by the Yellow2 Route Option which involves works and drainage discharges to the Terryland River.

Summary of Section 2

The route options have been assessed in respect to four headings, namely the River Corrib crossing, flood risk and watercourses, hydro-ecology and water quality. **Table 7.6.4.4** below outlines the order of preference for the hydrological aspects with respect to each of the route options. The route options have been ranked from 1 to 6 with 1 being the most favourable and 6 being the least favourable in terms of hydrological impacts along each of the route options. The sum of the rankings for each route option was calculated and the order of preference for the routes was assigned.

Table 7.6.4.4 Section 2 Hydrology Assessment

Route Option	River Corrib crossing	Hydro-ecology	Flood Risk and Watercourses	Water Quality	Total Score	Rank	Preference
Red2	6	2	4	2	14	4	I
Orange2	1	1	3	1	6	1	P
Yellow2	2	5	6	6	19	6	I/ LP
Blue2	2	3	2	4	11	3	I
Pink2	2	3	1	4	10	2	I
Green2	5	6	5	3	19	5	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

Section 3

The N6 Junction tie-in was assessed for hydrology impacts. At this location there are few surface hydrology features present to be impacted by the various route option. In this area rainwater and surface drainage discharge to groundwater with no natural surface drains and streams present. The main hydrological impact assessment criteria is identified to be a groundwater/pluvial flood risk zone at Doughiska defined from the OPW PFRA mapping. It is also noted that this groundwater flood risk area has a flood relief storm water culvert piped through Merlin Park to relieve flooding and to facilitate urban development in Doughiska. The existing N6 dual carriageway has a sizable storm water discharge to ground water near the existing roundabout tie-in. The majority of the development in this area percolates to groundwater which has limited capacity during extreme storm conditions, which gives rise to groundwater and pluvial flooding on the lower-lying currently undeveloped lands at Doughiska immediately downstream of the N6. A storm pipe draining this area through Merlin Park University Hospital grounds to swallow holes near the entrance was installed in more recent years (*c.*2006/2007). This provides some drainage relief to this area.

All of the route options are up gradient of this flood area and their hydrological ranking is assessed based on the distance up gradient from the Doughiska Flood Area. Based on this the Green2 Route Option N6 Junction is the preferred junction option and the Pink2 Route Option N6 Junction is the least preferred. In terms of flood risk and hydrological impact all of the junction options are acceptable. See **Table 7.6.4.5** below for the assessment summary.

Table 7.6.4.5 Section 3 - Hydrology Assessment

Route Option	Hydro-ecology	Flood Risk	Water Quality	Total Score	Rank	Preference
Red2	1	2	1	4	2	I
Orange2	1	2	1	4	2	I
Yellow2	1	2	1	4	2	I
Blue2	1	2	1	4	2	I
Pink2	1	6	1	8	6	LP
Green2	1	1	1	3	1	P

Note: P = Preferred, I = Intermediate, LP = Least Preferred

7.6.4.4 Summary

For Section 1, the assessment indicates that all of the route options considered are acceptable and will not result in any significant hydrological impact that cannot be mitigated for. The Red2/Orange2 Route Option is the preferred option with the Pink2 Route Option being the least preferred. The Yellow2, Green2 and Blue2 Route Options are similar and are ranked intermediate.

For Section 2, overall the Yellow2 Route Option is the least preferred in terms of Hydrology. The Orange2 Route Option is the preferred Option. The Red2, Pink2, Blue2 and Green2 Route Options all similar and are ranked intermediate from a hydrological perspective. The assessment indicates that all of the route options considered are acceptable and will not result in any significant hydrological impact that cannot be mitigated for.

For Section 3, the Green2 Junction Option is the preferred option. The Pink2 Junction Option is the least preferred. The other junction options all rank similarly for hydrology.

In terms of impact to hydrology all of the route options are considered to be feasible with engineering solutions available to mitigate all significant impacts both during construction and during operation.

Table 7.6.4.6 below summaries the Hydrology ranking of the route options.

Table 7.6.4.6 Summary of Hydrology ranking of Route Options

Route Option	Section 1	Section 2	Section 3
Red2	P	I	I
Orange2	P	P	I
Yellow2	I	I/LP	I
Blue2	I	I	I
Pink2	LP	I	LP
Green2	I	I	P

Note: P = Preferred, I = Intermediate, LP = Least Preferred

7.6.4.5 References

Office of Public Works. (1987) *Hydraulic and Hydrologic Investigation of Lough Corrib Flow Regime and of Gate Manipulation Policy at Galway Sluice Barrage.*

Office of Public Works Catchment Flood Risk and Management. *Western Basin Corrib Catchment – Inception Report*

Office of Public Works. *Preliminary Flood Risk Assessment (pFRA) Mapping for County Galway*

Office of Public Works Catchment Flood Risk and Management. *Flood Extent and Flood Zone Mapping – Corrib Catchment Galway City*

Tobin Consulting Engineers. (1999) *Terryland River Valley Drainage Scheme* for Galway Corporation

Hydro Environmental Ltd. (Oct 2011) *Strategic Flood Risk Assessment Study of NUI Galway Campus*

Galway Harbour Extension EIS – (2014) Chapter 8 Water

Office of Public Works. *Flood Studies update* web Portal
http://opw.hydronet.com/

Office of Public Works. *Network of live gauged Water level data*
http://waterlevel.ie/

Office of Public Works. Floodmaps.ie Historical archived flood events web site
http://floodmaps.ie/

Environmental Protection Agency. *Hydrotool web site for estimating low flow and flow duration in gauged and ungauged Irish rivers and streams*
http://watermaps.wfdireland.ie/HydroTool/

N6 Galway Outer Bypass – *Constraints Study 2006*

N6 Galway Outer Bypass – *Route Selection Study 2006*

N6 Galway Outer Bypass – *EIS Report 2008*

Environmental Protection Agency. (2015) *Water Quality in Ireland 2010-2012*

Western River Basin Management Plan 2009-2015

Water Maps Mapping Information System to support River Basin Management Plans http://www.wfdireland.ie/maps.html

National Roads Authority. (2008) *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*

7.6.5 Landscape and Visual

7.6.5.1 Introduction

This section details the Stage 2 assessment of the route options with respect to the landscape and visual constraints identified in **Section 4.7 Landscape and Visual** of this report. The route options as described in **Section 7.1** with the landscape and visual constraints are presented in **Figures 7.6.5.1** to **7.6.5.6**. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options.

Section 7.6.5.2 outlines the methodology that was used to carry out the study and **Section 7.6.5.3** details the options assessment. A summary is presented in **Section 7.6.5.4** and references are listed in **Section 7.6.5.5**.

7.6.5.2 Methodology

The Landscape and Visual assessment focuses on the potential impacts on both the physical landscape/townscape and visual environments.

The landscape/townscape and visual assessment is based on the methodology provided by the Advice Notes and Guidelines for Environmental Impact Assessment as prepared by the Environmental Protection Agency (EPA), supplemented by the Guidelines for Landscape and Visual Impact Assessment (3rd Ed.) produced by the Landscape Institute (UK) and Institute of Environmental Assessment, as well as the Environmental Assessment and Construction Guidelines produced by the NRA.

For the purposes of the assessment, drawings of horizontal and vertical alignment of each route option were analysed as was information on associated link roads, bridges and junction strategies.

The nature of the existing environment is varied ranging from established city suburbs comprising the typical mix and interaction of residential estates, community/social uses, commercial and business uses as well as amenity and recreational assets – to rural (city edge) landscapes comprising a diverse mix of agricultural landscapes, trees, hedgerows, scrub and small woodlands, river, lake and wetland corridors, areas of peat bog and rock outcrop, shallow valleys and low hills – some with deep rock quarries, as well as significant residential development along local roads and in village clusters.

The development of any route option within such an environment will result in significant landscape/townscape and visual impacts. The nature, extent and duration of such impacts will depend on the intensity of the development; the proximity of residential and related amenity uses; the magnitude of direct impact – and/or removal; the degree and duration of disruption; the sensitivity of the resource and the rarity and/or uniqueness of the landscape. Impacts on landscape/townscape and visual environment are also influenced by interaction with other effects such as community/human beings, noise, air quality, heritage, etc.

The significance of impacts on the landscape/townscape and visual environment is focused the likely profound and significant impacts of each feasible route option, where a:

Profound Impact: Is an impact that obliterates sensitive characteristics.

Significant Impact: Is an impact, which by its character, magnitude, duration or intensity, alters a sensitive aspect of the environment.

The likely profound and significant impacts on the physical landscape/townscape and visual environments are presented in the following sections on a route-by-route basis. Thereafter a ranking of preference – based on landscape/townscape and visual impacts – is provided for the feasible route options.

Figures indicating likely profound and significant impacts on the landscape/townscape and visual environment are also provided for each route option.

7.6.5.3 Option Assessment

Red2 Route Option

One principal change/variation has been introduced to the Red2 Route Option. Otherwise the assessment for the Red2 Route Option is as reported in Section 6.5.4.3 of Chapter 6.

1. The revised Red2 Route Option provides for an additional local link road parallel to the existing and proposed N6 alignment at Ballybrit. The new alignment has a very minor encroachment into the existing roadside landscape corridor west of Briarhill Business Park, Ballybrit. The overall effect of the change/variation is **neutral** in landscape and visual terms.

Orange2 Route Option

Two principal changes/variations have been introduced to the Orange2 Route Option. Otherwise the assessment for the Orange2 Route Option is as reported in Section 6.5.4.3 of Chapter 6.

1. The revised Orange2 Route Option provides for a new alignment for the proposed N59 Link Road – particularly along its northern end and where it ties-in with the existing N59 at Bushypark. The main effect is a reduced impact on the graveyard at St James's Church Bushypark and a slightly reduced impact on residential property. The effect of the change/variation is **positive** in landscape and visual terms.
2. The revised Orange2 Route Option provides for an additional local link road parallel to the existing and proposed N6 alignment at Ballybrit. The new alignment has a very minor encroachment into the existing roadside landscape corridor west of Briarhill Business Park, Ballybrit. The overall effect of the change/variation is **neutral** in landscape and visual terms.

Blue2 Route Option

Two principal changes/variations have been introduced to the Blue2 Route Option. Otherwise the assessment for the Blue2 Route Option is as reported in Section 6.5.4.3 of Chapter 6.

1. The revised Blue2 Route Option introduces a revised N17 and local road access arrangement between Castlegar and Ballybrit. The main effect is a slightly reduced footprint through Castlegar with a consequent widened

footprint where it crosses the N17 at Cloonacauneen. This route option has a slight reduction in landscape and visual impact at Castlegar, without increased impact at Cloonacauneen. The effect of the change/variation is **positive** in landscape and visual terms; and

2. The revised Blue2 Route Option provides for a more rationalised junction with the existing N6 at Coolagh-Briarhill, east of Galway. However, there is no appreciable change in landscape or visual terms. The effect of the change/variation is **neutral** in landscape and visual terms.

Yellow2 Route Option

Three principal changes/variations have been introduced to the Yellow2 Route Option. Otherwise the assessment for the Yellow2 Route Option is as reported in Section 6.5.4.3 of Chapter 6.

1. The revised Yellow2 Route Option introduces a significantly revised alignment for the route through the full extent of the Section 1 portion (Bearna) of the Study area. In effect the alignment seeks to reduce direct impact on residential properties and as such has a more curving alignment between properties within the landscape. Therefore, the revised alignment avoids direct impact for up to 15 less properties. The effect of the change/variation is notably **positive** in landscape and visual terms;
2. The revised Yellow2 Route Option provides for a new alignment for the proposed N59 Link Road where it passes through Ballagh/Bushypark and ties-in with the existing N59 at Glenlo Abbey. The main effect is a reduced impact on residential properties. The effect of the change/variation is **positive** in landscape and visual terms; and
3. The revised Yellow2 Route Option provides for a more rationalised road arrangement, with reduced footprint crossing Terryland Forest Park. The effect of the change/variation is **neutral** in landscape and visual terms.

Pink2 Route Option

Five principal changes/variations have been introduced to the Pink2 Route Option. Otherwise the assessment for the Pink2 Route Option is as reported in Section 6.5.4.3 of Chapter 6.

1. The revised Pink2 Route Option has a slightly revised tie-in to the R336 at the western end of Bearna. This avoids a direct impact on 1 residential property but increases visual impact on a number of additional properties. The effect of the change/variation is **neutral/negative** in landscape and visual terms;
2. The revised Pink2 Route Option has a more easterly alignment at Ballard West – resulting in reduced severance of and visual impact on existing residential communities. The effect of the change/variation is **positive** in landscape and visual terms;
3. The revised Pink2 Route Option provides for a new alignment between the crossing of the existing N59 at Dangan Lower and the east side of the River Corrib. In effect the alignment is revised a maximum of *c.*175m north where it passes through NUIG's Recreational Facilities at Dangan. The effect is to increase direct and visual impact on residential properties at Aughnacurra and to reduce direct impact on the more significant all-weather sports

infrastructure at the NUIG grounds. The alignment is also *c.*130m closer to the riverside location of Menlo Castle, with increased landscape and visual impact on its setting. The effect of the change/variation is **neutral/negative** in landscape and visual terms;

4. The revised Pink2 Route Option provides for a revised junction and local road arrangement in providing a junction between the N84 north of Ballinfoyle and the N17 at Cappanaborina. The widened footprint at the crossing of the N84 increases direct impact on residential properties and greater local road works are required northwest of Ballybrit. The revised alignment does reduce road footprint though Castlegar, but not significantly. The effect of the change/variation is **negative** in landscape and visual terms; and
5. The revised Pink2 Route Option provides for a revised junction and tie-in to the existing N6 at Briarhill. The revised arrangement is notably more compact and setback from residential development at Coolagh-Briarhill, with consequent reduction in visual impact. The effect of the change/variation is notably **positive** in landscape and visual terms.

Green2 Route Option

Two principal changes/variations have been introduced to the Green2 Route Option. Otherwise the assessment for the Green2 Route Option is as reported in Section 6.5.4.3 of Chapter 6.

1. The revised Green2 Route Option introduces a new interchange with the N17 at the crossing point between Cappanabornia and Two Mile Ditch. This increased footprint will remove in the order of five additional residential properties. The effect of the change/variation is **negative** in landscape and visual terms; and
2. The revised Green2 Route Option includes for an alternative tie-in to the existing N6 east of Coolagh. Approaching Ballybrit Crescent at Breanloughaun the revised route option takes a more northerly alignment crossing the southern end of Ballintemple Road, close to its junction with the R339. From there the option forms a new tie-in junction with the existing N6 at Glenrevagh. In so this route option avoids very significant landscape and visual impacts on a large number of residential properties at Ballybrit Crescent/at the R339 and at Coolagh-Briarhill. However, this route option does result in very significant landscape and visual impacts for other residential properties in crossing Ballintemple Road/R339 further east – albeit the impact is on a smaller number of properties. The effect of the change/variation is **positive** in landscape and visual terms.

7.6.5.4 Summary

The majority of the modifications to the route options outlined in Section 7.1 are positive for landscape and visual impacts. This is most notable in terms of:

- the full re-alignment of the Yellow2 Route Option within Section 1;
- the shorter re-alignment for the Pink2 Route Option within Section 1;
- the revised alignment options for all of the N59 Links Options; and
- the revised N6 Junction arrangement for the Pink2 Route Option.

While other revisions are neutral, a number of proposed revisions are also negative or potentially negative in landscape and visual terms.

It is noted that given the nature of the urban and suburban landscape of the scheme study area, in totality, all of the route options continue to give rise to significant landscape and visual issues. Nevertheless, the changes proposed have in the overall benefited many of the route options – so much so that the Yellow2 Route Option is now a notably preferred route option though Section 1 and likewise the Pink2 Route Option is a notably preferred route option through Section 3. The tunnel option (Orange2 Route Option) remains the preferred route from a landscape and visual perspective through the central Section 2 area, and likewise the Pink2 Route Option remains an intermediate preference.

The landscape and visual ranking of the route options is presented in **Table 7.6.5.1** below.

Table 7.6.5.1 Summary of Landscape and Visual Aspects ranking of Route Options

Route Option	Section 1	Section 2	Section 3
Red2	LP	LP	LP
Orange2	LP	P	LP
Yellow2	P	LP	LP
Blue2	LP	LP	LP
Pink2	I	I	P
Green2	LP	LP	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

7.6.5.5 References

Environmental Protection Agency. (2003) *Advice Notes on Information Advice Notes on Current Practice* (in the preparation of Environmental Impact Statements).

Environmental Protection Agency. (2002) *Guidelines on Information to be contained in Environmental Impact Statements.*

Galway City Council. (2011): *Galway County Development Plan 2011-2017;*

Galway County Council. (2007): *Bearna Local Area Plan 2007-2017;*

Galway County Council. (2015): *Galway County Development Plan 2015-2021;*

Landscape Institute & IEMA. (2014): *Guidelines for Landscape and Visual Impact Assessment,* 3rd Ed.

National Roads Authority. (2008) *Environmental Impact Assessment of National Road Schemes – A Practical Guide*.

7.6.6 Archaeological, Architectural and Cultural Heritage

7.6.6.1 Introduction

This section details the Stage 2 assessment of the route options with respect to the archaeological, architectural and cultural heritage identified in **Section 4.11 Archaeological, Architectural and Cultural Heritage** of this report. The route options as described in **Section 7.1** with the archaeological, architectural and cultural heritage constraints are presented in **Figure 7.6.6.1** to **7.6.6.6**. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options.

Section 7.6.6.2 outlines the methodology that was used to carry out the study and **Section 7.6.6.3** details the options assessment. A summary is presented in **Section 7.6.6.4** and references are listed in **Section 7.6.6.5**. An inventory of recorded archaeological and architectural heritage sites within the each route option corridors is included in **Appendix A.7.5.1** to **A.7.5.6.**

7.6.6.2 Methodology

In order to define the most preferred route option from an archaeological, architectural and cultural heritage, a detailed route options assessment has been carried out in order to identify potential impacts upon the archaeological, architectural and cultural heritage resource. This follows on from an initial Constraints Study detailed in **Chapter 4** of this report and preliminary route selection assessment detailed in **Chapter 6** of this report.

The study for this assessment involved detailed interrogation of the archaeological, historical and architectural background of the receiving environment containing the route options, with specific assessment paid to a corridor of 200m either side of the designed route options.

Research has been undertaken in several phases. The first phase comprised a paper survey of all available archaeological, architectural, historical and cartographic sources. The second phase involved a drive over of the study area containing the route options in an attempt to assess the current state of any recorded archaeological and built heritage sites that were accessible from the existing road network. The third phase involved a public consultation, which resulted in the identification of additional sites from local knowledge and oral history.

The study has been carried out in accordance with the NRA *Guidelines for the Assessment of Archaeological Heritage Impacts of National Road Schemes and Guidelines for the Assessment Architectural Heritage Impacts of National Road Schemes' 2005.* These guidelines require that a detailed archaeological/architectural heritage assessment be carried out as part of the route selection process.

All measurements referenced in this chapter are taken from the centre of the edge of the route option to the upstanding remains of the recorded site (or to the centre of the site, where no remains occur).

The following sources were consulted as part of the paper survey:

- Record of Monuments and Places for County Galway;
- Sites and Monuments Record for County Galway;
- Monuments in State Care Database County Galway;
- Preservation Orders County Galway;
- Register of Historic Monuments County Galway;
- Topographical Files of the National Museum of Ireland;
- Cartographic and written sources relating to the scheme study area;
- National Inventory of Architectural Heritage County Galway (Architectural & Garden Survey);
- Excavations Bulletin (1970-2014);
- Galway County Development Plan;
- Galway City Development Plan; and
- Aerial photographic coverage.

Record of Monuments and Places (RMP) Section 12 (1) of the National Monuments Act (1994 amendment) provides that the Minister for Arts, Heritage, Gaeltacht and the Islands (now the Minister for Arts, Heritage and the Gaeltacht) shall establish and maintain a record of monuments and places (RMP) where it is known that such monuments exist. The record comprises of a list of monuments and relevant places and mapping showing each monument and relevant place in respect of each county in the State. Sites recorded on the Record of Monuments and Places all receive statutory protection under the National Monuments Act. All recorded monuments are referred to as Archaeological Heritage (AH sites) within this assessment.

Sites and Monuments Record (SMR) holds documentary evidence and field inspections of all known archaeological sites and monuments. Some information is also held about archaeological sites and monuments whose precise location is not known e.g. only a site type and townland are recorded. These are known to the National Monuments Section as 'un-located sites' and cannot be afforded legal protection. As a result these are omitted from the Record of Monuments and Places. SMR sites are also listed on a website maintained by the DoAHG – www.archaeology.ie. All recorded monuments are referred to as Archaeological Heritage (AH sites) within this assessment.

National Monuments in the State Care Database is a list of all the National Monuments in the State guardianship or ownership. Each is assigned a National Monument number whether in guardianship or ownership and has a brief description of the remains of each Monument.

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

The Minister for the Department of Environment, Heritage and Local Government may acquire national monuments by agreement or by compulsory order. The state

or local authority may assume guardianship of any national monument (other than dwellings). The owners of national monuments (other than dwellings) may also appoint the Minister or the local authority as guardian of that monument if the state or local authority agrees. Once the site is in ownership or guardianship of the state, it may not be interfered with without the written consent of the Minister. There are no national monuments located within any of the route options under assessment.

Preservation Orders List and/or Temporary Preservation Orders (**Table 4.11.2**), can be assigned to a site or sites that are deemed to be in danger of injury or destruction. These are allocated under the 1930 Act. Preservation Orders make any interference with the site illegal. Temporary Preservation Orders can be attached under the 1954 Act. These perform the same function as a Preservation Order but have a time limit of six months, after which the situation must be reviewed. Work may only be undertaken on or in the vicinity of sites under Preservation Orders with the written consent, and at the discretion, of the Minister (DoAHG). There are four sites that possess Preservation Orders within the corridors of the route options under assessment. These are referred to as Archaeological Heritage (AH sites) within this assessment.

Register of Historic Monuments was established under Section 5 of the 1987 National Monuments Act, which requires the Minister to establish and maintain such a record. Historic monuments and archaeological areas present on the register are afforded statutory protection under the 1987 Act. The register also includes sites under Preservation Orders and Temporary Preservation Orders. All registered monuments are included in the Record of Monuments and Places.

Topographical files of the National Museum of Ireland is the national archive of all known finds recorded by the National Museum. This archive relates primarily to artefacts but also includes references to monuments and unique records of previous excavations. The find spots of artefacts are important sources of information on the discovery of sites of archaeological significance.

Cartographic sources are important in tracing land use development within the development area as well as providing important topographical information on areas of archaeological potential and the development of buildings. Cartographic analysis of all relevant maps has been made to identify any topographical anomalies or structures that no longer remain within the landscape. These included current and former townland and parish boundaries. All sites of potential archaeological or architectural heritage merit identified during the map analysis are listed as Cultural Heritage (CH) sites within this assessment. All townland boundaries are listed as TB 1, 2 etc. In addition all Areas of Archaeological Potential identified during the analysis are referred to as AAPs within this assessment.

Ordnance Survey 6” and 25” maps of Co. Galway (1838/9, 1915/20)

Documentary sources were consulted to gain background information on the archaeological, architectural and cultural heritage landscape of the proposed development area.

Aerial photographic coverage is an important source of information regarding the precise location of sites and their extent. It also provides initial information on the terrain and its likely potential for archaeology. Ordnance Survey aerial photographs (1995, 2000, 2005), Google Earth coverage (2003-2012) and Bing Maps were examined for this assessment. All sites identified during cartographic or aerial photographic assessment as identified as Cultural Heritage (CH) sites within this

assessment. All Areas of Archaeological Potential identified during the analysis are referred to as AAPs within this assessment.

Development Plans contain a catalogue of all the Protected Structures, archaeological sites and Architectural Conservation Areas within every county. The development plans for County Galway (2015-2021) and Galway City (2011-2017) were examined as part of this assessment. All protected structures are referred to as Built Heritage sites (BH) as part of this assessment. There are no Architectural Conservation Areas located within any of the route option corridors under assessment.

The **National Inventory of Architectural Heritage** is a government based organisation tasked with making a nationwide record of significant local, regional, national and international structures, which in turn provides county councils with a guide as to what structures to list within the Record of Protected Structures. The NIAH have also carried out a nationwide desk based survey of historic gardens, including demesnes that surround large houses. All NIAH structures are referred to as Built Heritage sites (BH) as part of this assessment.

Whilst the NIAH Garden Survey was utilised as part of this assessment, this was carried out in conjunction with detailed analysis of the first edition OS maps in order to identify all designed landscapes (DL) within the route option corridors.

Excavations Bulletin is a summary publication that has been produced every year since 1970. This summarises every archaeological excavation that has taken place in Ireland during that year up until 2010 and since 1987 has been edited by Isabel Bennett. This information is vital when examining the archaeological content of any area, which may not have been recorded under the SMR and RMP files. This information is also available online (www.excavations.ie) from 1970-2014.

Once all the baseline data had been assembled for each route option, an assessment of how many impacts the route option might potentially have on the archaeological, architectural and cultural heritage resource was made. Based on this assessment, the most preferable route option was selected for both Section 1 and Section 2 of the proposed scheme.

Baseline details relating to the archaeological, architectural and cultural heritage sites are listed in appendices 1-6 associated with this chapter.

7.6.6.3 Definitions

For Stage 2 assessment, the route options are assessed in three sections. The location of the breakline between Section 1 & Section 2 has been moved eastwards towards the Galway City boundary. Section 1 extends from the R336 to the Galway City boundary and Section 2 extends from the Galway City boundary to the existing N6 in the east of the city. An additional break down at the N6 tie-in at Coolagh has been incorporated in order to compare the junction layouts at the N6 tie-in for the Stage 2 assessment. This section is referred to as Section 3.

Please see **Section 6.5.6.2** of this report for impact definitions relating to the archaeological, architectural and cultural heritage resource.It should be noted that the significance of any one site (including any statutory protection) is taken into account when the impact assessment is made.

7.6.6.4 Archaeological & Architectural Heritage Background

Prehistoric Period (*c.*7000 BC – AD 500)

The Mesolithic Period (*c.*7000–4000 BC) is the earliest time for which there is clear evidence of prehistoric activity in Ireland. During this period people hunted, foraged and gathered food and appear to have had a mobile lifestyle. The most common evidence indicative of Mesolithic activity at a site comprises of scatters of worked flint material; a by-product from the production of flint implements or rubbish middens consisting largely of shells (Stout & Stout, 1997). The latter are commonly discovered in coastal regions or at the edge of lakes and some worked flakes have been found near Oughterard (Robinson 1997, 331) to the north-west of the scheme study area. It is likely that nearby coastal and riverine environments were an important element for the Mesolithic populations in this landscape, as a food and travelling resource. Some Mesolithic flints have been discovered during recent excavations in Terryland to the immediate north of the Red2 Route Option (AH 62/ BH 20) (Moore Group website). In addition a large amount of lithics, some of which possess a Mesolithic date, have been retrieved from Terryland, to the north of the Orange2 Route Option and are listed within the National Museum of Ireland (NMI) topographical files.

During the Neolithic period (*c.*4000–2500 BC) communities became less mobile and their economy became based on the rearing of stock and cereal cultivation. This transition was accompanied by major social change. Agriculture demanded an altering of the physical landscape, forests were rapidly cleared and field boundaries constructed. There was a greater concern for territory, which saw the construction of large communal ritual monuments called megalithic tombs, which are characteristic of the period. In Ireland four main types of megalithic tomb have been identified: court-tombs, portal-tombs, passage-tombs and wedge-tombs. The first three types are earlier in date (pre-2000 BC) and are largely confined to the northern half of the country, while wedge-tombs are slightly later in date and are most numerous in the west and south-west.

No definite Neolithic sites are recorded within the receiving environments of the route options. In 2006, a possible megalithic structure was identified as part of the EIA for the N6 Galway City Outer Bypass Environmental Impact Statement (2006) in Menlough (CH 22) that is located within the footprint of the Yellow2 Route Option and immediate adjacent to the Pink2 and Blue2 Route Options. In addition, seven polished stone axeheads have been recovered from the townland of Menlough (NMI files) and Neolithic flints are recorded from the townland of Terryland (NMI files and Moore Group Website).

The Bronze Age (*c.*2500 - 800 BC) was characterised by the introduction of metalworking technology to Ireland and coincides with many changes in the archaeological record, both in terms of material culture as well as the nature of the sites and monuments themselves. Although this activity had markedly different characteristics to that of the preceding Neolithic period, including new structural forms and new artefacts (such as Beaker pottery), it also reflects a degree of continuity. Megalithic tombs were no longer constructed and the burial of the individual became more typical. Cremated or inhumed bodies were often placed in a cist, a small stone box set into the ground, or a stone lined grave. Burials were often made within cemeteries and marked within the landscape with the construction of an earthen barrow or cairn of stones. Only one barrow is recorded

within the receiving environment of the route options. AH 42 is located 140m to the south of the Blue2 and Yellow2 Route Options within the townland of Dangan Lower.

The most common Bronze Age site within the archaeological record is the burnt mound or *fulacht fiadh*. Over 4500 *fulachta fiadh* have been recorded in the country making them the most common prehistoric monument in Ireland (Waddell, 1998, 174). Although burnt mounds of shattered stone occur as a result of various activities that have been practiced from the Mesolithic to the present day, those noted in close proximity to a trough are generally interpreted as Bronze Age cooking/industrial sites. *Fulachta fiadh* generally consist of a low mound of burnt stone, commonly in a horsesoe shape, centred around an earth-cut trough. They are found in low lying marshy areas or close to streams or rivers. Often these sites have been ploughed out and survive as a spread of heat shattered stones in charcoal rich soil with no surface expression in close proximity to a trough. A number of *fulachta fiadh* have been excavated within the townland of Doughiska, outside the receiving environment of the route options. In addition, several burnt mound sites (where no trough was noted) were also excavated in Doughiska during 2006 *c.*250m south-west of the route options (Bennett 2006:790). Geophysical survey of the 2006 GCOB identified several potential *fulachta fiadh* sites within the footprint of the Green2 Route Option (CH 46, 47, 49). In addition, a possible site was identified during that EIS (CH 28) *c.*34m to the north of the Green2 Route Option.

Another common feature of the Bronze Age landscapeis the standing stone, usually a single upright orthostat. They are known by various names including *Gallán*, *dallán*, *leacht* and long stone (Power et. al. 1992, 45). Although it is thought that the standing stones were erected across a wide time span and had multiple functions they are most often associated with the Bronze Age. They are generally unworked stones and often have packing stones around their base providing additional support. A large number of standing stones are orientated on a north-east–south-west axis corresponding with those of other megalithic architecture, such as stone rows or circles (Ronan, Egan and Byrne 2009, 22). A wide variety of functions have been attributed to these stones, such as burial markers and route or territorial markers. More recent stones have been erected as scratching posts for cattle. There are no recorded monuments of this type within the receiving environment of the route options. However, two possible examples were identified during the 2006 GCOB EIS are located in proximity to the Green2 Route Option (CH 18 and CH 34).

There is increasing evidence for Iron Age (*c.*800 BC – AD 500) settlement and activity in recent years as a result of development-led excavations. There are two phases of the Iron Age in Ireland, the *Hallstatt* and the *La Tène*, which are associated with distinct artwork and metalwork. Whilst there are no Iron Age sites recorded within the vicinity of the route options, the River Corrib (Newcastle area) produced a *La Tène* sword of Iron Age origins adjacent to a possible fording point in the Dangan Lower/ Newcastle area.

Early Medieval Period (AD 500-1169)

During the early medieval period Ireland was not a united country but rather a patchwork of minor monarchies all scrambling for dominance, with their borders ever changing as alliances were formed and battles fought. Kingdoms were a conglomerate of clannish principalities with the basic territorial unit known as a

túath. Byrne (1973) estimates that there were probably at least 150 kings in Ireland at any given time during this period, each ruling over his own *túath*. These kings were distributed strategically throughout the region and ruled over many tribal units.

The most common indicator of settlement during the early medieval period is the ringfort. Ringforts, (also known as *rath*, *lios*, *caiseal*, *cathair* and *dún*) are a type of defended homestead comprising of a central site enclosed by a number of circular banks and ditches. The number of ditches can vary from one (univallate) to two or three (bivallate or tri-vallate) and is thought to reflect the status and affluence of the inhabitants. Another morphological variation consists of the platform or raised ringfort – the former resulting from the construction of the ringfort on a naturally raised area. Ringforts are most commonly located at sites with commanding views of the surrounding environs which provided an element of security. While ringforts, for the most part, avoid the extreme low and uplands, they also show a preference for the most productive soils (Stout 1997, 107). The most recent study of the ringfort (Stout 1997) has suggested that there is a total of 45,119 potential ringforts or enclosure sites throughout Ireland. While the names *rath* and *lios* refer to earthen ringforts, *caiseal* (cashel) and *cathair* refer to their stone-walled equivalents. Cashels are more frequent in the west of the country, where bed rock would have been relatively easy to source as a building material.

There are four ringforts recorded within the receiving environments of the route options (AH 161, 27, 44, 19) along with two cashels (AH 66 and 152). A cashel (CH 142) was also excavated during works associated with the N6 Galway to Ballinasloe Road Scheme to the immediate east of the termination point of all the route options (with the exception of Green2 Route Option) (Bennett 2006:779).A further four enclosures are recorded within the receiving environment of the route options, which have the potential to represent ringfort sites (AH 26, 159, 18, 58). A number of additional possible enclosures have been identified during desktop analysis and during the 2006 GCOB EIS in 2006.

Another feature commonly found in conjunction with ringforts is the souterrain. These are underground passageways and it has been suggested that they were food stores. or used as hiding places during times of strife. The majority of souterrains comprise of earth cut passageways and chambers that are lined with either stone or wood, although stone cut examples are also known. County Galway has a particularly high recorded density of souterrains, however only one is recorded within the receiving environment and this is associated with a cashel and children's burial ground in Ballybrit (AH 152).

Crannóga or lake dwellings are normally associated with the early medieval period, although artefacts found during field walking and excavations have revealed occupation as early as the Bronze Age and as late as the post-medieval period. *Crannóga* are not as numerous as ringforts, but nonetheless represent an important settlement type for this period. It is estimated that based on current records of known or potential sites that there are *c.*1200 *crannóg*a in Ireland, confined largely to parts of the country with a large number of lakes and other stretches of shallow water (Edwards 1996, 37). Although sometimes located on natural islands, *crannóga* are generally constructed on entirely artificial foundations, with the *crannóg* material kept in place by a ring of close-set vertical piles forming a palisade (*ibid*., 34-5). The site locations are naturally defensive and accessed by boat, causeway or wooden bridge. Some of the *crannóga* on open water survive as small, often wooded islands, while others have been submerged by rising water levels or

when the *crannóg* material has compacted and sunk. Drainage operations have often revealed sunken sites, recognisable in older reclaimed land as grassy or tree-grown hummocks. By their very nature, *crannóga* are waterlogged, thus allowing for the preservation of normally perishable organic material, such as wood, leather and environmental evidence. There is one *crannóg* recorded within the receiving environment of the Green2 Route Option on the shores of Ballindooley Lough (AH 49).

This period was also characterised by the introduction of Christianity to Ireland. The new religion was a catalyst for many changes, one of the most important being literacy. Irish was written down for the first time using the ogham script. The ogham alphabet is thought to be based on the Latin alphabet of the later Roman Empire and today the majority of the inscriptions that survive are located on pillar stones or boulders. A possible ecclesiastical enclosure (along with the site of a church and graveyard) are recorded within Rahoon, within the footprint of the Red2 Route Option (AH 59). The church is thought to represent the site of the medieval parish church of St. James, with the traces of a possible earlier enclosure fossilised within the graveyard boundary. A holy well (AH 57) is recorded to the north-west of this site and are characteristically associated with early medieval religious sites.

Medieval Period (AD 1169-1600)

The beginning of the medieval period was characterised by political unrest that originated from the death of Brian Borumha in 1014. Diarmait MacMurchadha, deposed King of Leinster, sought the support of mercenaries from England, Wales and Flanders to assist him in his challenge for kingship. Norman involvement in Ireland began in 1169, when Richard de Clare and his followers landed in Wexford to support MacMurchadha. Two years later de Clare (Strongbow) inherited the Kingdom of Leinster and by the end of the 12th century the Normans had succeeded in conquering much of the country (Stout & Stout 1997, 53). The first series of castles in Ireland consisted of earth and timber features and began appearing near the start of the Norman invasion of Ireland and lasted steadily until 1225. These castles were built hastily to establish territorial claims and were later replaced by stone castles.

In 1230, the existing settlement of Galway was attacked by Richard de Burgo as part of the Anglo-Norman invasion of Connacht. The first written reference to Galway is the recording in the annals of the building of the castle of Bun Gaillmhe, 'the mouth of the [river] Gaillimh' in 1124. This fortification was part of the deliberate en-castellation of lands which Toirdhealbhach Ó Conchobhair, King of Connacht, pursued in the second quarter of the 12th century. It shows that Galway's strategic position was already recognised. De Burgo's attack did not prove successful and he withdrew, returning two years later in 1232 when he met with greater success and erected a castle. This castle did not last long, as it was destroyed in 1233. Its replacement suffered a similar fate in 1247, when the annals record the burning of both the town and the castle. The 1247 record is the first mention of the town proper, and it probably consisted of little more than a cluster of cabins nestled in the shadow of the castle (Walsh 2004, 273). However, it must have been of sufficient size to warrant it being called a town (Walsh 1996, 52). The town is recorded as being burnt again in 1266-7.

It was not until the later part of the medieval period that evidence of developing prosperity begins to emerge from the historical record, as the Galway merchants capitalised on their trading links with ports on Europe's Atlantic seaboard and

established the town as a substantial part of the mercantile life in the west of Ireland. The town cultivated a Spanish wine trade, with the wool trade and the growing importance of the fish trade also contributing to the growth of the town. During this period and into the 17th century Galway was ruled by an oligarchy. This is defined as a group of families known as the 'tribes' who between then managed every important position of church and state. Galway remained mostly loyal to the English crown during the Gaelic resurgence as a matter of survival, yet by 1642 the city allied itself with the Catholic Confederation of Kilkenny. During the Cromwellian conquest of Ireland English forces captured the city after a nine-month siege. At the end of the 17th century the city supported James II (against William of Orange) and was captured by the Williamites after a very short siege following the Battle of Aughrim in 1691.

There are a number of medieval sites located within the receiving environment of the route options, although the medieval centre of Galway City will not be affected by any of the route options. Menlo Castle (AH 11/BH 2) is located just outside of the receiving environment of the Green2 Route Option and within the receiving environment of the Pink2 and Blue2 Route Options. The castle was in existence in 1574 when it was in the possession of 'Thomas Colman' (Nolan 1901, 115), although there is some debate as to the exact location of the original structure. It may have been incorporated into the later 17th century house.

Carrowbrowne Castle (AH 163) is located to the west of a link that that forms part of the Green2 Route Option. Again the castle is recorded in 1754 as being occupied by 'Donnell Oge Ohologhan' (Nolan 1901, 115). Today all that survives at the site are the ruins of a later post medieval house that was constructed on the site of the castle.

Terryland Castle (AH 62/ BH 20) is located to the immediate north of the Red2 Route Option. Nolan (1901, 115) records that there was a castle here in 1574, at which time it was in the possession of 'Domynick Lynch'. No visible surface trace of this structure survives. The present fragmentary ruins are those of a 17th century gabled house. Excavations at the site in 2003 revealed buried portions of foundations associated with the castle, as well as a possible boundary ditch separating the bawn of the castle from the River Corrib (Bennett 2003:554). In 2013 ten post medieval burials were excavated *c.*75m to the east of the castle and to the immediate north of the Red2 Route Option. Whilst some of the burials were 17th century in date, some were considerably earlier (Moore Group website).

In the eastern part of the scheme study area, within the townland of Ballybrit, a tower house stands at the centre of Galway Racecourse along with a deserted medieval settlement (AH 25/ BH 6 and AH 24). In 1574 the tower house was recorded as being in the ownership of 'Redmud Mc Thomus' (Nolan 1901, 115). The medieval settlement was located to the west of the castle and is shown on Grand Jury mapping dating to 1819. Today the site is characterised by a series of hollows and platforms that represent the site of house platforms. No obvious sign of medieval settlement was identified during the geophysical survey undertaken within the Galway Racecourse. However, the area has been subject to large amounts of disturbance over recent years. A report of this geophysical survey in included in **Appendix A.4.5** of this report.

A tower house is also recorded within the small settlement of Castlegar (AH 74/ BH 72) over 150m south of the Blue2 and Pink2 Route Options. This building was also in existence in 1574, when it was in the possession of 'Rolland Skeret' (Nolan

1901, 115). The building is slightly more substantial than the relatively small tower house recorded at Ballybrit, and survives in reasonable conditions, although most of southeast and southwest walls are no longer extant.

Post Medieval Period (1600-1900 AD)

The 18th century saw a dramatic rise in the establishment of large residential houses around the country. This was largely due to the fact that after the turbulence of the preceding centuries, the success of the Protestant cause and effective removal of any political opposition, the country was at peace. The large country house was only a small part of the overall estate of a large landowner and provided a base to manage often large areas of land that could be dispersed nationally. During the latter part of the 18th century, the establishment of a parkland context (or demesnes) for large houses was the fashion. Although the creation of a parkland landscape involved working with nature, rather than against it, considerable constructional effort went into their creation. Earth was moved, field boundaries disappeared, streams were diverted to form lakes and quite often roads were completely diverted to avoid travelling anywhere near the main house or across the estate. Major topographical features likes rivers and mountains were desirable features for inclusion into, and as a setting, for the large house and parkland. This was achieved at all scales, from a modest Rectory Glebe to demesne landscapes that covered thousands of acres.

From the mid to late 19th century, the landowning classes began to slowly lose their grip on the thousands of acres of Irish landscape that formed a large part of their estates. The house and demesne were often only a small part of the visible wealth possessed by such families and their demise was brought about by a number of factors including The Famine; the loss of a younger generation to the first world war and the fight for independence by the Republicans. The lower classes resented the amount of land that was owned by the Anglo-Irish gentry and in 1922 the Land Commission was established. The purpose of the Commission was to purchase these estates (often for a greatly reduced price) so they could be re-distributed amongst the lower classes. As a result of this, many families became little more than upper class farmers and as a result many left Ireland to return to England. The large houses and demesnes were often left to decay with the houses often demolished for building materials and the demesnes subsumed back into the landscape.

Whilst there were many large houses and demesnes located within the overall scheme study area, today few examples survive intact. Many of the large houses and their demesnes have been completely lost, such as Ballybrit House and demesne (DL 25). In other cases the demesne has been lost but the principal structure has been incorporated into suburban developments, such as Rahoon House (AH 56/ BH 16).

Arguably the best preserved demesne landscape within the receiving environment of the Green2, Blue2 and Pink2 Route Options, is the landscape associated with Menlo Castle (DL 10). Although it has lost some of its landscape characteristics, it remains as green field for the most part. The main house (AH 11/ BH 2), whilst in ruins after a fire in 1910, remains as a landmark structure dominating its stretch of the River Corrib. The original 17th century house possessed two storeys over a basement. The house was then extended and altered during the 18th and 19th centuries. Spelissy (1999) notes that corbels from the bartizans of the original Menlo Castle were re-incorporated into the fabric of the summer house in Dangan

Lower located on the opposite bank of the river (AH 41/ BH 13). Whilst the summer house may have been connected with Menlo Castle, it did stand within a demesne landscape associated with Dangan House (CH 40/ DL 8).

Vernacular Architecture is defined in James Steven Curl's Encyclopedia of Architectural Terms as 'a term used to describe the local regional traditional building forms and types using indigenous materials, and without grand architectural pretensions', i.e. the homes and workplaces of the ordinary people built by local people using local materials. This is in contrast to formal architecture, such as the grand estate houses of the gentry, churches and public buildings, which were often designed by architects or engineers. The majority of vernacular buildings are domestic dwellings. Examples of other structures that may fall into this category include shops, outbuildings, mills, limekilns, farmsteads, forges, gates and gate piers. A number of thatched houses that would be considered to represent the real vernacular of Ireland are listed as protected structures within the scheme study area. These buildings generally date from the late 18th to early 19th centuries and are rare survivals when consideration is given to the amount of vernacular architecture that has been lost in the past 175 years.

There are a number of recorded examples within the village of Menlough (BH 31/ CH 141), one of which is located within the footprint of the Green2 Route Option (BH 9). BH 11 and 12 are thatched cottages located within the receiving environment of all the route options except Red2 Route Option. A well preserved cottage in Coolagh (CH 132) is located to the south of the Yellow2 Route Option (BH 95), whilst in Castlegar a cottage (BH 73) is recorded to the immediate north of a link road associated with the Blue2 and Pink2 Route Options. As part of the stage 2 detailed route assessment, multiple vernacular sites were identified within the receiving environment of the route options. These included intact and ruined cottages and small vernacular farmsteads along with clusters of vernacular buildings.

Another widespread feature of the post-medieval rural landscape is the Children's Burial Ground, of which two are recorded within the receiving environment of the route options (AH 146, AH 152). The Archaeological Inventory for West Galway identifies 61 CBGs ranging from those with no visible surface to those with physical/cartographic and or written references (Gosling 1993, 146). The practice of burying children and infants in a separately designated place appears to have proliferated in Ireland from the 17th century onwards and continued in some cases into the last century (Donnelly & Murphy 2008, 28). In part this reflects the refusal by church authorities to allow the burial of unbaptised children on consecrated ground, but also perhaps the view that unnamed children had not attained full status within the communities they lived in. Occasionally adults who were viewed as outcasts in one way or another were also buried in such places. Often these places are known as 'cillín', or 'ceallúnach'. In many instances burials are marked by low un-inscribed upright slabs and the deaths were not mourned or waked in the traditional ways.

7.6.6.5 Option Assessment

Red2 Route Option

The Red2 Route Option travels through the baronies, parishes and townlands listed in **Table 7.6.6.1**.

Table 7.6.6.1 Baronies, Parishes and Townlands – Red2 Route Option

Barony	Parish	Townland
Galway	Rahoon	Aille , Ballard West, Ballyburke, Ballynahown East, Ballynahown West, Cappagh, Lenabower, Kimmeenmore, Clybaun, Shantallow, An Chloch Scoilte, Freeport, Knocknacarra, Newcastle, Rahoon, Townparks, Trusky East
	St. Nicholas	Ballinfoyle, Ballybrit, Terryland, Glenanail, Parkmore
	Oranmore	Doughiska, Ballindooley, Cappagh
Dunkellin		Coolagh

National Museum of Ireland: Topographical Files

A total of 14 entries indicate a variety of recovered artefacts from the townland of Newcastle. A number of these include sword fragments from a range of typologies, including 18 Bronze Age sword and dagger fragments of the 'rapier' style (4323:W116); a sword fragment of the La Tene style (E269:1); an iron sword of possible Viking date (E269:2) and a very fragmented iron sword of unclassified typology (E269:3). A small tanged iron knife was also recovered (E269:30). A number of spearheads have also been recovered from the townland, including six iron socketed spearheads (E269:12, E269:16, E269:17, E269:9, E269:95 and E269:96) and a looped and socketed bronze spearhead (E269:15).

Some 30 lithic artefacts including cores, flakes, amphorous worked objects and debitage were listed from the townland of Terryland. The artefacts were all collected from an active erosion scar beside the River Corrib. The artefacts include two cores (2005C1:803 and 2005C1:828), the latter of which was a chert multi-platform example, along with 18 flakes (2005C1:804-21) (three flint, one quartzite); five amphorous worked objects (2005C1:822-827) and five pieces of debitage (2005C1:829-832).

In the townland of Townparks, four baselard knives were recovered from the River Corrib (E269:7:1-2, E269:8-9).

Summary of Previous Archaeological Fieldwork

A review of the Excavations Bulletin (1970-2014) has shown that the following programmes of fieldwork included in **Table 7.6.6.2** below have been carried out within the receiving environment of the Red2 Route Option.

Table 7.6.6.2 Summary of Previous Archaeological Fieldwork – Red2 Route Option

Excavations Bulletin Ref.:	Licence Ref.:	Townland:	Description:
2001:497	01E0992	Coolagh/ Castlegar/ Ballybrit/ Parkmore/ Cappanabornia/ Glenanail/ Ballybane Beg,	Nothing of archaeological significance was identified during the course of monitoring 4.1km of pipeline construction.
2005:579 & 2006:779	Ministerial Dir.: A024/1.3 & A024/5 E2435	Coolagh	Archaeological testing and excavation were carried out prior to the development of the existing N6. A possible cashel (53m x 60m) was identified in the townland of Coolagh within the footprint of the scheme (although an associated annex wall was noted to the south of the CPO). A secure date for the site was not secured due to the lack of stratified finds. However, a red bead and fragments of lignite bracelet as well as two possible lime kilns were noted within the interior along with the oval foundations of a stone structure. It is possible the site represents an earlier medieval cashel. It has been included within this assessment as CH 142 as associated remains with the site are located to the south of the N6 and to the immediate east of the end of the Red2 Route Option.
2008:553	08E0618 & 08R212	Newcastle	Archaeological testing 175m south of the Red2 Route Option (where it will be in tunnel) resulted in the discovery of a Bronze Age halberd. The copper blade measured 160mm in length by 110.5mm, had a central ridge tapering to a point along its blade and near the butt were two centrally placed circular perforations with evidence for three rivet holes along its back edge. The immediate area around the findspot was metal-detected. No further artefacts or features of archaeological significance were recovered. The halberd was considered an ex situ artefact.
1999:297	99E0012	Newcastle	Nothing of archaeological significance identified during works associated with the NUIG Campus.
2002:0749	02E0915	Newcastle	
2007:621	07E1116	Newcastle	
2008:551	08E0507	Newcastle	
2008:552	08E0508	Newcastle	
2009:399	09E0217	Newcastle	
2009:400	09E377	Newcastle	
2010:340	10E0369	Newcastle	
2010:341	09E0217ext	Newcastle	
2012:276	10E0369	Newcastle	

Excavations Bulletin Ref.:	Licence Ref.:	Townland:	Description:
2000:0368	00E0144	Ballinfoyle, Glenanail, Castlegar	Monitoring of the Terryland drainage scheme in the landscape to the north of the proposed Red2 Route Option failed to identify any features of archaeological significance.
2005:592 2006:790	A024/1.1 E2052	Doughiska	A series of burnt mounds were found during testing and then excavated *c.*250m south-west of the proposed Red2 Route Option although only one shallow pit was found with the remains. Presumed to be prehistoric in date.
2008:540	E3588	Doughiska	During monitoring as part of the N6 construction, a well was identified *c.*100m SSW of the Red2 Route Option. It was deemed to be post medieval in date.
2003:554	C316, E3967	Terryland	Testing at Terryland Castle (AH 62/ BH 20), to the immediate north of the Red2 Route Option, revealed buried portions of remains associated with the structure of the castle as well as a number of features within the interior of the castle and a possible boundary ditch separating the bawn from the River Corrib.
N/a	Moore Group Website	Terryland	In 2013 a number of post medieval burials were identified *c.*75m east of Terryland Castle (AH 62/ BH 20) prior to the construction of a new ramp from the existing N6. Ten burials were identified most of which were thought to be 17th century in date. However, some were significantly older. In addition a large amount of prehistoric lithic tools were recovered during the excavation (late Mesolithic, Neolithic, early Bronze Age).
1993:114	93E0078	Rahoon	Nothing of archaeological significance was identified during a programme of testing *c.*200m SSE of the Red2 Route Option.
1997:215 2001:520	96E0018 97E0060 01E0498	Rahoon/ Knocknacarra	Nothing of archaeological significance was identified during monitoring associated with the Knocknacarra Main Drainage Scheme.

Detailed Assessment - Section 1

Tables 7.6.6.3 to 7.6.6.5 below list the impacts associated with the Red2 Route Option for Section 1.

Table 7.6.6.3 Designed Landscapes – Red2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
DL 1	Eagle Lodge and demesne	No	0m	Direct	Moderate negative

Table 7.6.6.4 Cultural Heritage – Red2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 91	Vernacular building, in ruins	No	53m west	Indirect	Slight negative
CH 92	Vernacular buildings	No	137m ENE	Indirect	Slight negative
CH 93	Vernacular buildings, in ruins	No	0m	Direct	Significant negative
CH 94	Vernacular building, in ruins	No	26m WSW	Indirect	Moderate negative
CH 95	Vernacular settlement, in ruins	No	184m WSW	Indirect	Slight negative
CH 96	Vernacular building	No	69m ENE	Indirect	Slight negative
CH 97	Vernacular building	No	80m ENE	Indirect	Slight negative
CH 98	Vernacular building	No	47m ENE	Indirect	Moderate negative
CH 99	Vernacular building	No	151m ESE	Indirect	Slight negative
CH 57	Ruinous vernacular settlement of Cloghscoltia	No	167m NW	Indirect	Slight negative

Table 7.6.6.5 Townland Boundaries – Red2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 30	Townland boundary	No	0m	Direct	Moderate negative
TB 31	Townland boundary	No	0m	Direct	Moderate negative
TB 7	Townland boundary	No	0m	Direct	Moderate negative

No recorded Built Heritage sites, AH sites or AAPs located within Red2 Route Option Corridor.

Detailed Assessment - Section 2

Tables 7.6.6.6 to 7.6.6.11 below list the impacts associated with the Yellow2 Route Option for Section 2.

Table 7.6.6.6 Archaeological Heritage – Red2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 35	*Fulacht fiadh*	**Yes**	131m north	Neutral	N/a
AH 64	Designed landscape feature	**Yes**	19m north	Indirect	Moderate negative
AH 56	House - indeterminate date (also BH 16)	**Yes**	44m north	Indirect	Moderate negative
AH 55	Ringfort - unclassified	**Yes**	150m south	Neutral	N/a
AH 57	Ritual site - holy well	**Yes**	73m north	Indirect	Slight negative
AH 58	Enclosure	**Yes**	0m	Direct	Significant negative
AH 59	Church, Graveyard, Ecclesiastical enclosure	**Yes**	0m	Direct	Profound negative
AH 60	Church	**Yes**	82m SSE	Indirect	Moderate negative
AH 61	18th/19th century house	**Yes**	0m	Direct	Profound negative
AH 62	Castle – unclassified, House - 17th century (also BH 20)	**Yes**	27m north	Neutral	N/a
AH 109	Dovecote	**Yes**	189m SSE	Neutral	N/a
AH 63	Bastioned fort	**Yes**	182m SE	Neutral	N/a
AH 48	Quarry	No	0m	Direct	Moderate negative
AH 49	Redundant record	No	0m	N/a	N/a
AH 50	Quarry	No	22m north-west	Indirect	Slight negative
AH 51	Quarry	No	50m north-west	Neutral	N/a
AH 30	Quarry	No	42m north	Neutral	N/a
AH 31	Redundant record	No	109m NNE	N/a	N/a
AH 33	Designed landscape feature	No	0m	Neutral	N/a
AH 32	Earthwork	No	51m SSE	Neutral	N/a
AH 25	Tower house (also BH 6)	**Yes**	244m NNW	Neutral	N/a

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 24	Settlement deserted - medieval	**Yes**	153m NNW	Neutral	N/a
AH 26	Enclosure	**Yes**	81m NNW	Neutral	N/a
AH 27	Ringfort – rath House - indeterminate date	**Yes**	72m NNW	Neutral	N/a

Table 7.6.6.7 Built Heritage – Red2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
BH 16	Rahoon House (also AH 56)	**Yes**	44m north	Indirect	Moderate negative
BH 17	Entrance to Rahoon House	**Yes**	132m north	Indirect	Slight negative
BH 18	Summerdale House	**Yes**	117m south	Indirect	Slight negative
BH 33	No. 49 (house)	**Yes**	37m west	Neutral	N/a
BH 35	College (former nunnery)	No	0m	Direct	Significant negative
BH 34	Former Franciscan College	**Yes**	To immediate east	Neutral	N/a
BH 19	Mill race	No	0m	Direct	Moderate negative
BH 37	NUIG Campus	**Yes**	111m north	Indirect	Imperceptible negative
BH 20	Castle – unclassified, House - 17th century (also AH 62)	**Yes**	27m north	Neutral	N/a
BH 21	Waterworks	**Yes**	40m north	Neutral	N/a
BH 6	Tower house (also AH 25)	**Yes**	240m NNW	Neutral	N/a

Table 7.6.6.8 Designed Landscapes – Red2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
DL 10	Menlo House demesne	House is in RSP[20]	195m south	Indirect	Imperceptible negative
DL 16	Kingston House demesne	No	173m south	Neutral	N/a

[20] Record of Protected Structures (RPS) (Galway City Development Plan 2011-2017/ Galway County Development Plan 2015-2021)

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
DL 15	Rahoon House demesne	No	0m	Neutral	N/a
DL 33	Vicar Croft and St Helen's (houses) demesnes	No	197m south	Neutral	N/a
DL 34	Taylor's Hill demesne	No	200m south	Neutral	N/a
DL 28	Shantallow House demesne	No	61m south	Neutral	N/a
DL 26	Newcastle House demesne	No	0m	Neutral	N/a
DL 12	Rock Lodge demesne	No	0m	Neutral	N/a
DL 11	Newcastle Cottage demesne	No	0m	Neutral	N/a
DL 21	Mervue House demesne	No	55m south-west	Neutral	N/a
DL 25	Ballybrit House demesne	No	0m	Neutral	N/a

Table 7.6.6.9 Cultural Heritage – Red2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 4	Possible enclosure	No	80m south	Indirect	Slight negative
CH 5	Vernacular buildings, in ruins	No	0m	Direct	Significant negative
CH 60	Vernacular buildings, in ruins	No	185m north	Indirect	Imperceptible negative
CH 14	Railway (site of)	No	0m	Neutral	N/a
CH 100	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 101	Vernacular settlement of Coolagh	No	40-100m NNE	Indirect	Moderate Negative
CH 135	Mass Rock?	No	10-200m SW	Indirect	Slight negative
CH 138	Two staddle stone circles	No	167m south	Indirect	Imperceptible negative
CH 142	Site of cashel	No	0m	Neutral	N/a

Table 7.6.6.10 Areas of Archaeological Potential – Red2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AAP 3	Stream (also TB 8)	No	0m	Direct	Moderate negative
AAP 11	Stream	No	0m	Direct	Moderate negative
AAP 13	Stream (also TB 32)	No	0m	Direct	Moderate negative
AAP 9	River Corrib & margins	No	0m	Direct	Significant negative
AAP 12	Terryland River (also TB 39)	No	0m	Direct	Significant negative

Table 7.6.6.11 Townland boundaries – Red2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 8	Townland boundary (also AAP 3)	No	0m	Direct	Moderate negative
TB 32	Townland boundary (also AAP 13)	No	0m	Direct	Moderate negative
TB 33-38	Townland boundaries, site of	No	0m	Neutral	N/a
TB 39	Townland boundary (also AAP 12)	No	0m	Direct	Moderate negative
TB 40	Townland boundary, site of	No	0m	Neutral	N/a
TB 62	Townland boundary, site of	No	0m	Neutral	N/a
TB 41	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 42	Townland & parish boundary	No	0m	Direct	Moderate negative

Detailed Assessment - Section 3

Tables 7.6.6.12 to **7.6.6.13** below list the impacts associated with the Red2 Route Option for Section 3.

There are no AH, BH, DL or AAPs sites within the receiving environment of Section 3.

Table 7.6.6.12 Cultural Heritage - Red2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 100	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 101	Vernacular settlement of Coolagh	No	40-100m NE	Indirect	Moderate Negative
CH 135	Mass Rock?	No	10-200m SW	Indirect (?)	Moderate negative
CH 138	Two staddle stone circles	No	167m south	Indirect	Imperceptible negative
CH 142	Site of cashel	No	0m	Neutral	N/a

Table 7.6.6.13 Townland Boundaries - Red2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 41	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 42	Townland & parish boundary	No	0m	Direct	Moderate negative

Orange2 Route Option

The Orange2 Route Option travels through the baronies, parishes and townlands listed in **Table 7.6.6.14** below.

Table 7.6.6.14 Baronies, Parishes and Townlands - Orange2 Route Option

Barony	Parish	Townland
Galway	Rahoon	Aille , Ballyburke, Ballynahown East, Cappagh, An Chloch Scoilte, Dangan Upper, Freeport, Keeraun, Lenarevagh, Letteragh, Mincloon, Newcastle, Rahoon, Trusky East
	St. Nicholas	Ballinfoyle Ballybane Beg, Ballybane More, Glenanail, Terryland
	Oranmore	Doughiska
Dunkellin		Garaun North, Coolagh

National Museum of Ireland: Topographical Files

Information from the NMI topographical files lists a polished stone axe (2009:223) and a quern stone (1970:22) recovered from the townland of Ballybaanmore.

A total of 14 entries indicate a variety of recovered artefacts from the townland of Newcastle. A number of these include sword fragments from a range of typologies, including 18 Bronze Age sword and dagger fragments of the 'rapier' style (4323:W116); a sword fragment of the La Tene style (E269:1); an iron sword of possible Viking date (E269:2) and a very fragmented iron sword of unclassified typology (E269:3). A small tanged iron knife was also recovered (E269:30). A number of spearheads have also been recovered from the townland, including six iron socketed spearheads (E269:12, E269:16, E269:17, E269:9, E269:95 and E269:96) and a looped and socketed bronze spearhead (E269:15).

Some 30 lithic artefacts including cores, flakes, amphorous worked objects and debitage were listed from the townland of Terryland. The artefacts were all collected from an active erosion scar beside the River Corrib. The artefacts include two cores (2005C1:803 and 2005C1:828), the latter of which was a chert multi-platform example, along with 18 flakes (2005C1:804-21) (three flint, one quartzite); five amphorous worked objects (2005C1:822-827) and five pieces of debitage (2005C1:829-832).

Summary of Previous Archaeological Fieldwork

A review of the Excavations Bulletin (1970-2014) has shown that the following programmes of fieldwork included in **Table 7.6.6.15** below have been carried out within the receiving environment of the Orange2 Route Option.

Table 7.6.6.15 Summary of Previous Archaeological Fieldwork - Orange2 Route Option

Excavations Bulletin Ref.:	Licence Ref.:	Townland:	Description:
2001:497	01E0992	Coolagh/ Castlegar/ Ballybrit/ Parkmore/ Cappanabornia/ Glenanail/ Ballybaan Beg,	Nothing of archaeological significance was identified during the course of monitoring 4.1km of pipeline construction.
2005:579 & 2006:779	Ministerial Dir.: A024/1.3 & A024/5 E2435	Coolagh	Archaeological testing and excavation were carried out prior to the development of the existing N6. A possible cashel (53m x 60m) was identified in the townland of Coolagh within the footprint of the scheme (although an associated annex wall was noted to the south of the CPO). A secure date for the site was not secured due to the lack of stratified finds. However, a red bead and fragments of lignite bracelet as well as two possible lime kilns were noted within the interior along with the oval foundations of a stone structure. It is possible the site represents an earlier medieval cashel. It has been included within this assessment as CH 142 as associated remains with the site are located to the south of

Excavations Bulletin Ref.:	Licence Ref.:	Townland:	Description:
			the N6 and to the immediate east of the end of the Orange2 Route Option..
2008:553	08E0618 & 08R212	Newcastle	Archaeological testing 175m south of the Orange2 Route Option (where it will be in tunnel) resulted in the discovery of a Bronze Age halberd. The copper blade measured 160mm in length by 110.5mm, had a central ridge tapering to a point along its blade and near the butt were two centrally placed circular perforations with evidence for three rivet holes along its back edge. The immediate area around the findspot was metal-detected. No further artefacts or features of archaeological significance were recovered. The halberd was considered an *ex situ* artefact.
1999:297	99E0012	Newcastle	Nothing of archaeological significance identified during works associated with the NUIG Campus.
2002:0749	02E0915	Newcastle	
2007:621	07E1116	Newcastle	
2008:551	08E0507	Newcastle	
2008:552	08E0508	Newcastle	
2009:399	09E0217	Newcastle	
2009:400	09E377	Newcastle	
2010:340	10E0369	Newcastle	
2010:341	09E0217ext	Newcastle	
2012:276	10E0369	Newcastle	
2000:0368	00E0144	Ballinfoyle, Glenanail, Castlegar	Monitoring of the Terryland drainage scheme in the landscape to the north of the proposed Orange2 Route Option failed to identify any features of archaeological significance.
2005:592 2006:790	A024/1.1 E2052	Doughiska	A series of burnt mounds were found during testing and then excavated *c.*250m south-west of the proposed Orange2 Route Option, although only one shallow pit was found with the remains. Presumed to be prehistoric in date.
2008:540	E3588	Doughiska	During monitoring as part of the N6 construction, a well was identified *c.*100m SSW of the proposed Orange2 Route Option. It was deemed to be post medieval in date.

Detailed Assessment -Section 1

Tables 7.6.6.16 to **7.6.6.18** below list the impacts associated with the Orange2 Route Option for Section 1

Table 7.6.6.16 Designed Landscapes - Orange2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
DL 1	Eagle Lodge demesne	No	0m	Direct	Moderate negative

Table 7.6.6.17 Cultural Heritage - Orange2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 91	Vernacular building, in ruins	No	53m west	Indirect	Slight negative
CH 92	Vernacular buildings	No	137m ENE	Indirect	Slight negative
CH 93	Vernacular buildings, in ruins	No	0m	Direct	Significant negative
CH 94	Vernacular building, in ruins	No	26m WSW	Indirect	Moderate negative
CH 95	Vernacular settlement, in ruins	No	184m WSW	Indirect	Slight negative
CH 96	Vernacular building	No	69m ENE	Indirect	Slight negative
CH 97	Vernacular building	No	80m ENE	Indirect	Slight negative
CH 98	Vernacular building	No	47m ENE	Indirect	Moderate negative
CH 99	Vernacular building	No	151m ESE	Indirect	Slight negative
CH 57	Ruinous vernacular settlement of Cloghscoltia	No	167m NW	Indirect	Slight negative

Table 7.6.6.18 Townland Boundaries - Orange2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 30	Townland boundary	No	0m	Direct	Moderate negative
TB 31	Townland boundary	No	0m	Direct	Moderate negative
TB 7	Townland boundary	No	0m	Direct	Moderate negative

No recorded Built Heritage sites, AH sites or AAPs located within Section 1 of this route option corridor.

Detailed Assessment - Section 2

Tables 7.6.6.19 to 7.6.6.24 below list the impacts associated with the Orange2 Route Option for Section 2

Table 7.6.6.19 Archaeological Heritage - Orange2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 36	Bullaun stone	**Yes**	154m NNW	Indirect	Imperceptible negative
AH 48	Quarry	No	0m	Direct	Moderate negative
AH 49	Redundant record	No	0m	N/a	N/a
AH 50	Quarry	No	22m north-west	Indirect	Slight negative
AH 51	Quarry	No	50m north-west	Neutral	N/a
AH 30	Quarry	No	42m north	Neutral	N/a
AH 31	Redundant record	No	109m NNE	N/a	N/a
AH 33	Designed landscape feature	No	0m	Neutral	N/a
AH 32	Earthwork	No	51m SSE	Neutral	N/a
AH 25	Tower house (also BH 6)	**Yes**	244m NNW	Neutral	N/a
AH 24	Settlement deserted - medieval	**Yes**	153m NNW	Neutral	N/a
AH 26	Enclosure	**Yes**	81m NNW	Neutral	N/a
AH 27	Ringfort – rath House - indeterminate date	**Yes**	72m NNW	Neutral	N/a

Table 7.6.6.20 Built Heritage - Orange2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
BH 11	Thatched Cottage	Yes	80m NNW	Indirect	Moderate negative
BH 12	Thatched Cottage	Yes	142m south-east	Indirect	Imperceptible negative
BH 4	Church	Yes	56m east	Indirect	Slight negative
BH 5	Bushypark House	Yes	78m north	Neutral	N/a
BH 69	Farmyard	No	15m north-west (link)	Indirect	Moderate negative
BH 6	Tower house (also AH 25)	Yes	240m NNW	Neutral	N/a

Table 7.6.6.21 Designed Landscapes - Orange2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
DL 6	Bushypark House demesne	**House is in the RSP[18]**	To immediate north	Neutral	N/a
DL 7	Lake View House demesne	No	158m ESE	Neutral	N/a
DL 21	Mervue House demesne	No	55m south-west	Neutral	N/a
DL 25	Ballybrit House demesne	No	0m	Neutral	N/a

Table 7.6.6.22 Cultural Heritage - Orange2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 4	Possible enclosure	No	35m south	Indirect	Moderate negative
CH 5	Vernacular buildings, in ruins	No	27m north	Indirect	Moderate negative
CH 58	Vernacular buildings	No	0m	Direct	Significant negative
CH 59	Vernacular buildings	No	138m NW	Indirect	Slight negative
CH 60	Vernacular buildings, in ruins	No	93m SE	Indirect	Slight negative
CH 61	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 62	Vernacular building, in ruins	No	21m SE	Indirect	Moderate negative
CH 63	Vernacular building, in ruins	No	63m SE	Indirect	Slight negative
CH 64	Vernacular buildings	No	29m NW	Indirect	Moderate negative
CH 65	Vernacular building, in ruins	No	0m	Direct	Significant negative
CH 66	Vernacular building	No	160m NW	Indirect	Slight negative
CH 68	Site of vernacular building	No	141m NNW	Indirect	Imperceptible negative
CH 102	Site of vernacular building	No	0m	Direct	Significant negative
CH 103	Vernacular farm	No	112m NW	Indirect	Imperceptible negative
CH 104	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 105	Site of vernacular buildings	No	0m	Direct	Significant negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 106	Leitriff House	No	197m NW	Indirect	Imperceptible negative
CH 107	Vernacular building	No	17m west	Indirect	Moderate negative
CH 108	Vernacular building	No	165m WNW	Indirect	Imperceptible negative
CH 120	Vernacular building	No	159m WNW	Indirect	Imperceptible negative
CH 109	Vernacular buildings, derelict	No	0m	Direct	Significant negative
CH 39	Lake View House	No	169m ESE	Neutral	N/a
CH 110	Vernacular buildings	No	24m south	Indirect	Moderate negative
CH 111	Post medieval settlement & buildings	No	0m	Direct	Significant negative
CH 112	Vernacular building	No	32m north	Indirect	Moderate negative

Table 7.6.6.23 Areas of Archaeological Potential - Orange2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AAP 3	Stream (also TB 8)	No	0m	Direct	Moderate negative
AAP 13	Stream (also TB 32)	No	0m	Direct	Moderate negative
AAP 4	Stream	No	0m	Direct	Moderate negative
AAP 12	Terryland River	No	0m	Direct	Significant negative

Table 7.6.6.24 Townland Boundaries - Orange2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 8	Townland boundary (also AAP 3)	No	0m	Direct	Moderate negative
TB 32	Townland boundary (also AAP 13)	No	0m	Direct	Moderate negative
TB 8	Townland boundary (also AAP 3)	No	0m	Direct	Moderate negative
TB 9	Townland boundary	No	0m	Direct	Moderate negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 10	Townland boundary	No	0m	Direct	Moderate negative
TB 11	Townland boundary, site of	No	0m	Direct	Moderate negative
TB 43	Townland boundary	No	0m	Direct	Moderate negative
TB 44	Townland boundary	No	0m	Direct	Moderate negative
TB 45	Townland boundary	No	0m	Direct	Moderate negative
TB 46	Townland boundary	No	0m	Direct	Moderate negative
TB 54	Townland boundary	No	0m	Direct	Moderate negative
TB 48	Townland boundary	No	0m	Direct	Moderate negative
TB 49	Townland boundary	No	0m	Direct	Moderate negative
TB 39	Townland boundary (also AAP 12)	No	0m	Direct	Moderate negative
TB 40	Townland boundary, site of	No	0m	Neutral	N/a

Detailed Assessment - Section 3

Tables 7.6.6.25 to 7.6.6.26 below list the impacts associated with the Orange2 Route Option for Section 3.

There are no AH, BH, DL or AAPs sites within the receiving environment of Section 3.

Table 7.6.6.25 Cultural Heritage - Orange2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 100	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 101	Vernacular settlement of Coolagh	No	40-100m NE	Indirect	Moderate Negative
CH 135	Mass Rock?[21]	No	10-200m SW	Indirect	Slight negative
CH 138	Two staddle stone circles	No	167m south	Indirect	Imperceptible negative
CH 142	Site of cashel	No	0m	Neutral	N/a

[21] Identified during Public Consultation but exact location unknown.

Table 7.6.6.26 Townland Boundaries - Orange2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 41	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 42	Townland & parish boundary	No	0m	Direct	Moderate negative

Yellow2 Route

The Yellow2 route travels through the following baronies, parishes and townlands:

Table 7.6.6.27 Baronies, Parishes and Townlands - Yellow2 Route Option

Barony	Parish	Townland
Galway	Rahoon	Na Foraí Maola Thoir, Freeport, Keeraun, Lacklea, Knocknacarra, Letteragh, Mincloon, An Baile Nua, Rahoon, Trusky East, Ballyburke, Ballynahown East, Bamacranny, Cappagh, Dangan Lower, Dangan Upper, Ahaglugger, Aille, Ballard East, Ballard West, Ballagh, An Chloch Scoilte, Ballybaan Beg, Ballyhown, Na Foraí Maola Thiar,Keeraun, Lenabower, An Baile Nua, Trusky West
	St. Nicholas	Ballinfoyle, Ballybrit, Castlegar, Glenanail, Parkmore
	Oranmore	Doughiska, Menlough, Ballindooley, Cappagh, Mincloon
Dunkellin		Coolagh

National Museum of Ireland: Topographical Files

Information from the NMI topographical files listed a stone ard fragment (1987:184) and an iron axehead (1983:61) recovered from the townland of Dangan Lower. A number of lithic artefacts are listed under the townland of Menlough, including seven stone axeheads of 'Shannon type' (KK131129, 2005C1:802, 1638:W307, 1637:W306, 1636:W305, 1635:W304, 1634:W303); a collection of twenty blades of various geologies (1280:W5) and a chert blade (2005C1:801). A 'beehive' type quern top and base (2011:252) have also been recovered from the townland of Castlegar. A log boat (2014:263) was recovered from the townland of Freeport, but no further details were included within the file.

Summary of Previous Archaeological Fieldwork

A review of the Excavations Bulletin (1970-2014) has shown that the following programmes of fieldwork included in **Table 7.6.6.28** below have been carried out within the receiving environment of the Yellow2 Route Option.

Table 7.6.6.28 Summary of Previous Archaeological Fieldwork - Yellow2 Route Option

Excavations Bulletin Ref.:	Licence Ref.:	Townland:	Description:
2001:497	01E0992	Coolagh/ Castlegar/ Ballybrit/ Parkmore/ Cappanabornia/ Glenanail/ Ballybaan Beg,	Nothing of archaeological significance was identified during the course of monitoring 4.1km of pipeline construction.
2002:0724	02E1327	Dangan Lower	Archaeological testing adjacent to a recorded ring barrow (AH 42) revealed no features of archaeological significance.
2008:545	08E0558	Dangan Lower	Archaeological testing *c.*200m SE of this route option as part of a park and ride development revealed no features of archaeological significance.
2005:579 & 2006:779	Ministerial Dir.: A024/1.3 & A024/5 E2435	Coolagh	Archaeological testing and excavation were carried out prior to the development of the existing N6. A possible cashel (53m x 60m) was identified in the townland of Coolagh within the footprint of the scheme (although an associated annex wall was noted to the south of the CPO). A secure date for the site was not secured due to the lack of stratified finds. However, a red bead and fragments of lignite bracelet as well as two possible lime kilns were noted within the interior along with the oval foundations of a stone structure. It is possible the site represents an earlier medieval cashel. It has been included within this assessment as CH 142 as associated remains with the site are located to the south of the N6 and to the immediate east of the end of the Yellow2 Route Option.
2000:0368	00E0144	Ballinfoyle, Glenanail, Castlegar	Monitoring of the Terryland drainage scheme in the landscape to the north of the existing N6 failed to identify any features of archaeological significance.
2005:592 2006:790	A024/1.1 E2052	Doughiska	A series of burnt mounds were found during testing and then excavated *c.*250m south-west of the Yellow2 Route Option, although only one shallow pit was found with the remains. Presumed to be prehistoric in date.
2008:540	E3588	Doughiska	During monitoring as part of the N6 construction, a well was identified *c.*100m SSW of the Yellow2 Route Option. It was deemed to be post medieval in date.
2012:279	12E0055	Aille, Cappagh	Nothing of archaeological significance discovered during monitoring associated with an 110kv electricity line.

Detailed Assessment - Section 1

Tables **7.6.6.29** to **7.6.6.32** below list the impacts associated with the Yellow2 Route Option for Section 1.

Table 7.6.6.29 Archaeological Heritage - Yellow2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 1	Redundant record	No	11m east	N/a	N/a

Table 7.6.6.30 Cultural Heritage - Yellow2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 51	Vernacular buildings, in ruins	No	47m west	Indirect	Slight negative
CH 52	Vernacular building	No	134m east	Indirect	Imperceptible negative
CH 136	Vernacular buildings	No	78m east	Indirect	Slight negative
CH 1	Enclosure (2006 EIS)	No	11m east	Indirect	Moderate Negative
CH 53	Vernacular buildings	No	34m NNW	Indirect	Moderate negative
CH 129	Vernacular building, in ruins	No	62m SE	Indirect	Slight negative
CH 130	Vernacular building	No	62m ESE	Indirect	Slight negative
CH 131	Vernacular building	No	200m ESE	Indirect	Imperceptible negative
CH 54	Site of PM sheep fold	No	69m NW	Indirect	Imperceptible negative
CH 55	Vernacular farm	No	42m SE	Indirect	Slight negative
CH 56	Vernacular buildings	No	180m north	Indirect	Imperceptible negative
CH 99	Vernacular building	No	42m NNW	Indirect	Moderate negative

Table 7.6.6.31 Areas of Archaeological Potential - Yellow2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AAP 2	Stream (also TB 5)	No	0m	Direct	Moderate negative

Table 7.6.6.32 Townland Boundaries - Yellow2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 2	Townland boundary	No	0m	Direct	Moderate negative
TB 3	Townland boundary	No	0m	Direct	Moderate negative
TB 4	Townland boundary	No	0m	Direct	Moderate negative
TB 5	Former townland boundary (19th C) (also AAP 2)	No	0m	Direct	Moderate negative
TB 6	Townland boundary	No	0m	Direct	Moderate negative
TB 31	Townland boundary	No	0m	Direct	Moderate negative

No recorded Built Heritage sites or Designed Landscapes located within the Yellow2 Route Option Corridor.

Detailed Assessment - Section 2

Tables 7.6.6.33 to 7.6.6.38 below list the impacts associated with the Yellow2 Route Option for Section 2.

Table 7.6.6.33 Archaeological Heritage - Yellow2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 36	Bullaun stone	**Yes**	0m	Direct	Significant negative
AH 65	Glenlo Abbey (also BH 1)	**Yes**	179m NE	Indirect	Imperceptible negative
AH 37	Redundant record	No	64m south-east	N/a	N/a
AH 42	Barrow - unclassified	**Yes**	140m south	Neutral	N/a
AH 40	Designed landscape feature	**Yes**	0m	Direct	Profound negative
AH 39	Designed landscape feature	**Yes**	41m SSE	Neutral	N/a
AH 44	Ringfort (Also BH 14)	**Yes**	154m south	Indirect	Slight negative
AH 41	Summer house (Also BH 13)	**Yes**	31m north-west	Indirect	Moderate negative
AH 11	Menlo Castle (also BH 2)	**Yes**	289m NW	Indirect	Slight negative
AH 29	Redundant record	No	0m	N/a	N/a

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 51	Quarry	No	50m north-west	Neutral	N/a
AH 30	Quarry	No	42m north	Neutral	N/a
AH 31	Redundant record	No	109m NNE	N/a	N/a
AH 33	Designed landscape feature	No	0m	Neutral	N/a
AH 32	Earthwork	No	51m SSE	Neutral	N/a
AH 25	Tower castle (also BH 6)	**Yes**	244m NNW	Neutral	N/a
AH 24	Settlement deserted - medieval	**Yes**	153m NNW	Neutral	N/a
AH 26	Enclosure	**Yes**	81m NNW	Neutral	N/a
AH 27	Ringfort – rath, House - indeterminate date	**Yes**	72m NNW	Neutral	N/a

Table 7.6.6.34 Built Heritage - Yellow2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
BH 11	Thatched Cottage	**Yes**	59m NNW	Indirect	Moderate negative
BH 12	Thatched Cottage	**Yes**	166m SE	Indirect	Slight negative
BH 30	Heffernans cottage	**Yes**	58m ENE	Indirect	Slight negative
BH 1	Glenlo Abbey (also AH 65)	No	179m NE	Indirect	Imperceptible negative
BH 8	Gate pillars	**Yes**	183n NE	Indirect	Imperceptible negative
BH 13	Summer house (Also AH 41)	**Yes**	31m NW	Indirect	Moderate negative
BH 2	Menlo Castle (also AH 11)	**Yes**	289m NW	Indirect	Slight negative
BH 6	Tower house (also AH 25)	**Yes**	240m NNW	Neutral	N/a

Table 7.6.6.35 Designed Landscapes - Yellow2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
DL 5	Glenlo Abbey demesne	No	To immediate north	Indirect	Imperceptible negative
DL 3	River View house & demesne	No	105m NW	Indirect	Imperceptible negative
DL 9	Ashley Park demesne	No	22m south-east	No impact	N/a
DL 8	Dangan Cottage, Dangan House, Dangan Nunnery, Mary Ville demesnes	No	0m	Direct	Moderate negative
DL 10	Menlo Castle demesne	**House is in the RSP[18]**	0m	Direct	Significant negative
DL 21	Merview House demesne	No	55m south-west	Neutral	N/a
DL 25	Ballybrit House demesne	No	0m	Neutral	N/a

Table 7.6.6.36 Cultural Heritage - Yellow2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 4	Possible enclosure	No	30m SSW	Indirect	Moderate negative
CH 5	Vernacular buildings, in ruins	No	6m north	Indirect	Moderate negative
CH 58	Vernacular buildings	No	12m south	Indirect	Significant negative
CH 59	Vernacular buildings	No	101m NNW	Indirect	Slight negative
CH 60	Vernacular buildings, in ruins	No	95m SE	Indirect	Slight negative
CH 61	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 133	Vernacular building, in ruins	No	54m NNW	Indirect	Moderate negative
CH 62	Vernacular building, in ruins	No	5m SE	Indirect	Significant negative
CH 63	Vernacular building, in ruins	No	63m SE	Indirect	Slight negative
CH 64	Vernacular buildings	No	29m NW	Indirect	Moderate negative
CH 65	Vernacular building, in ruins	No	0m	Direct	Significant negative
CH 66	Vernacular building	No	160m NW	Indirect	Slight negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 68	Site of vernacular building	No	141m NNW	Indirect	Imperceptible negative
CH 103	Vernacular farm	No	73m NW	Indirect	Slight negative
CH 104	Site of vernacular buildings	No	32m SE	Indirect	Imperceptible negative
CH 105	Site of vernacular buildings	No	141m SE	Indirect	Slight negative
CH 118	Site of vernacular buildings	No	To immediate SE	Indirect	Slight negative
CH 119	Vernacular buildings	No	184m NW	Indirect	Imperceptible negative
CH 106	Leitriff House	No	60m SE	Indirect	Moderate negative
CH 107	Vernacular building	No	17m west	Indirect	Moderate negative
CH 108	Vernacular building, derelict	No	165m WNW	Indirect	Imperceptible negative
CH 120	Vernacular building	No	159m WNW	Indirect	Imperceptible negative
CH 109	Vernacular buildings, derelict	No	0m	Direct	Significant negative
CH 121	Vernacular building, in ruins	No	90m east	Indirect	Slight negative
CH 122	Site of vernacular buildings	No	26m WNW	Indirect	Slight negative
CH 41	Site of Dangan Cottage	No	0m	Direct	Moderate negative
CH 42	Mary Ville	No	73m SSE	Indirect	Slight negative
CH 40	Dangan House	No	20m SSE	Indirect	Significant negative
CH 14	Railway track, site of (disused)	No	0m	Direct	Moderate negative
CH 21	Vernacular animal shelter (2006 EIS)	No	91m WNW	Indirect	Slight negative
CH 22	Possible prehistoric tomb (2006 EIS)	No	9m SE	Indirect	Profound negative
CH 23	Circular feature? (2006 EIS)	No	24m north	Indirect	Slight negative
CH 24	Small boulder (2006 EIS)	No	154m north	Indirect	Imperceptible negative
CH 139	Possible mass path	No	0m	Direct	Significant negative
CH 123	Possible enclosure	No	0m	Direct	Profound negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 132	Post medieval settlement of Ballinfoyle	No	0m	Direct	Significant negative
CH 100	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 101	Vernacular settlement of Coolagh	No	40-100m NNE	Indirect	Moderate Negative
CH 135	Mass Rock?	No	10-200m SW	Indirect (?)	Moderate negative
CH 138	Two staddle stone circles	No	167m south	Indirect	Imperceptible negative
CH 142	Site of cashel	No	0m	Neutral	N/a

Table 7.6.6.37 Areas of Archaeological Potential - Yellow2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AAP 3	Stream (also TB 8)	No	0m	Direct	Moderate negative
AAP 13	Stream (also TB 32)	No	0m	Direct	Moderate negative
AAP 4	Stream	No	0m	Direct	Moderate negative
AAP 9	River Corrib & margins	No	0m	Direct	Significant negative
AAP 16	Former wetland (containing TB 66)	No	0m	Direct	Significant negative
AAP 12	Terryland River (also TB 39)	No	0m	Direct	Significant negative

Table 7.6.6.38 Townland boundaries - Yellow2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 8	Townland boundary (also AAP 3)	No	0m	Direct	Moderate negative
TB 63	Townland boundary	No	0m	Direct	Moderate negative
TB 64	Townland boundary	No	0m	Direct	Moderate negative
TB 32	Townland boundary (also AAP 13)	No	0m	Direct	Moderate negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 9	Townland boundary	No	0m	Direct	Moderate negative
TB 10	Townland boundary	No	0m	Direct	Moderate negative
TB 11	Townland boundary, site of	No	0m	Direct	Moderate negative
TB 43	Townland boundary	No	0m	Direct	Moderate negative
TB 44	Townland boundary	No	0m	Direct	Moderate negative
TB 45	Townland boundary	No	0m	Direct	Moderate negative
TB 46	Townland boundary	No	0m	Direct	Moderate negative
TB 54	Townland boundary	No	0m	Direct	Moderate negative
TB 48	Townland boundary	No	0m	Direct	Moderate negative
TB 15	Townland boundary	No	0m	Direct	Moderate negative
TB 55	Townland boundary	No	0m	Direct	Moderate negative
TB 56	Townland boundary	No	0m	Direct	Moderate negative
TB 66	Townland & parish boundary (within AAP 16)	No	0m	Direct	Moderate negative
TB 67	Townland boundary	No	0m	Direct	Moderate negative
TB 39	Townland boundary (also AAP 12)	No	0m	Direct	Moderate negative
TB 40	Townland boundary, site of	No	0m	Neutral	N/a
TB 62	Townland boundary, site of	No	0m	Neutral	N/a
TB 41	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 42	Townland & parish boundary	No	0m	Direct	Moderate negative

Detailed Assessment - Section 3

Tables 7.6.6.39 to **7.6.6.40** below list the impacts associated with the Yellow2 Route Option for Section 3.

There are no AH, BH, DL or AAPs sites within the receiving environment of Section 3.

Table 7.6.6.39 Cultural Heritage - Yellow2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 100	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 101	Vernacular settlement of Coolagh	No	40-100m NE	Indirect	Moderate Negative
CH 135	Mass Rock?	No	10-200m SW	Indirect (?)	Moderate negative
CH 138	Two staddle stone circles	No	167m south	Indirect	Imperceptible negative
CH 142	Site of cashel	No	0m	Neutral	N/a

Table 7.6.6.40 Townland Boundaries - Yellow2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 41	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 42	Townland & parish boundary	No	0m	Direct	Moderate negative

Blue2 Route Option

The Blue2 Route Option travels through the baronies, parishes and townlands listed below in **Table 7.6.6.41**

Table 7.6.6.41 Baronies, Parishes and Townlands - Blue2 Route Option

Barony	Parish	Townland
Galway	Rahoon	Na Foraí Maola Thior, Freeport, Keeraun, Lacklea, Lenarevagh, Letteragh, Mincloon, An Baile Nua, Trusky East, Ballyburke, Rahoon, Ballynahown East, Bamacranny, Cappagh, Dangan Lower, Dangan Upper, Ahaglugger, Aille, Ballard East, Ballard West, Ballagh, An Chloch Scoilte
	St. Nicholas	Castlegar, Ballybrit, Parkmore
	Oranmore	Doughiska, Menlough, Ballindooley
Dunkellin		Coolagh

National Museum of Ireland: Topographical Files

Information from the NMI topographical files listed a stone ard fragment (1987:184) and an iron axehead (1983:61) recovered from the townland of Dangan Lower. A number of lithic artefacts are listed under the townland of Menlough, including seven stone axeheads of 'Shannon type' (KK131129, 2005C1:802, 1638:W307, 1637:W306, 1636:W305, 1635:W304, 1634:W303); a collection of twenty blades of various geologies (1280:W5) and a chert blade (2005C1:801). A 'beehive' type quern top and base (2011:252) have also been recovered from the townland of Castlegar. A log boat (2014:263) was recovered from the townland of Freeport, but no further details were included within the file.

Summary of Previous Archaeological Fieldwork

A review of the Excavations Bulletin (1970-2014) has shown that the programmes of fieldwork included in **Table 7.6.6.42** below have been carried out within the receiving environment of the Blue2 Route Option.

Table 7.6.6.42 Summary of Previous Archaeological Fieldwork - Blue2 Route Option

Excavations Bulletin Ref.:	Licence Ref.:	Townland:	Description:
2001:497	01E0992	Coolagh/ Castlegar/ Ballybrit/ Parkmore/ Cappanabornia/ Glenanail/ Ballybaan Beg,	Nothing of archaeological significance was identified during the course of monitoring 4.1km of pipeline construction.
2002:0724	02E1327	Dangan Lower	Archaeological testing adjacent to a recorded ring barrow (AH 42) revealed no features of archaeological significance.
2008:545	08E0558	Dangan Lower	Archaeological testing *c.*200m SE of the proposed route option as part of a park and ride development revealed no features of archaeological significance.
2005:579 & 2006:779	Ministerial Dir.: A024/1.3 & A024/5 E2435	Coolagh	Archaeological testing and excavation were carried out prior to the development of the existing N6. A possible cashel (53m x 60m) was identified in the townland of Coolagh within the footprint of the scheme (although an associated annex wall was noted to the south of the CPO). A secure date for the site was not secured due to the lack of stratified finds. However, a red bead and fragments of lignite bracelet as well as two possible lime kilns were noted within the interior along with the oval foundations of a stone structure. It is possible the site represents an earlier medieval cashel. It has been included within this assessment as CH 142 as associated remains with the site are located to the south of the N6 and to the immediate east of the end of the Blue2 Route Option.

Excavations Bulletin Ref.:	Licence Ref.:	Townland:	Description:
2000:0368	00E0144	Ballinfoyle, Glenanail, Castlegar	Monitoring of the Terryland drainage scheme in the landscape to the north of the existing N6 failed to identify any features of archaeological significance.
2005:592 2006:790	A024/1.1 E2052	Doughiska	A series of burnt mounds were found during testing and then excavated *c*250m south-west of the proposed Orange2 Route Option, although only one shallow pit was found with the remains. Presumed to be prehistoric in date.
2008:540	E3588	Doughiska	During monitoring as part of the N6 construction, a well was identified *c.*100m SSW of the proposed Blue2 Route Option. It was deemed to be post medieval in date.
2012:279	12E0055	Aille, Cappagh	Nothing of archaeological significance discovered during monitoring associated with an 110kv electricity line.
1997:194	97E0341	Castlegar	Archaeological testing to the immediate west of AH 74/ BH 72 failed to identify any features of archaeological significance.
1998:237	98E0498	Castlegar	Archaeological testing was carried out at the site of a souterrain identified in 1967 *c.*100m south of the proposed route option. Reports of the time also indicated the discovery of a number of skeletons. However, testing in the area failed to identify any archaeology – it is possible any remains were removed during land clearance.
2000:0369	00E0745	Ballybrit	Pre-development testing at Galway Racecourse (to the south of the proposed route option and adjacent to AH 27) failed to identify any features of archaeological significance.

Geophysical Survey

A detailed geophysical survey was carried out in 2014 in the centre and to the immediate south of Galway Racecourse, Ballybrit as part of the initial constraints study, (Refer **Appendix A.4.5**). This was undertaken in order to gain a more thorough understanding of the key archaeological constraints located within the Galway Racecourse. These consist of a deserted medieval settlement (AH 24), tower house (AH 25), enclosure (AH 26), ringfort and an undated house (AH 27). All of the sites are recorded monuments and further protected with Preservation Orders. The centre of the Galway Racecourse will be crossed by the Blue2 Route Option. The results of the geophysical survey are summarised in **Section 4.11** of this report.

Detailed Assessment - Section 1

Tables 7.6.6.43 to **7.6.6.47** below list the impacts associated with the Blue2 Route Option for Section 1.

Table 7.6.6.43 Archaeological Heritage - Blue2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 66	Ringfort - cashel	No	42m NNW	Indirect	Imperceptible negative
AH 68	Church	**Yes**	136m south-west	Neutral	N/a
AH 69	Settlement cluster	No	142m NNW	Indirect	Slight positive
AH 67	Field system	No	43m NNW	Neutral	N/a

Table 7.6.6.44 Designed Landscapes - Blue2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
DL 1	Eagle Lodge and demesne	No	To immediate west	Neutral	N/a

Table 7.6.6.45 Cultural Heritage - Blue2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 113	Vernacular building	No	84m SE	Indirect	Slight negative
CH 114	Vernacular settlement (part of Bearna)	No	62m south	Indirect	Imperceptible negative
CH 91	Vernacular building, in ruins	No	0m	Direct	Significant negative
CH 92	Vernacular buildings	No	190m NE	Indirect	Imperceptible negative
CH 115	Vernacular building	No	29m east	Indirect	Moderate negative
CH 95	Vernacular settlement, in ruins	No	0m	Direct	Significant negative
CH 94	Vernacular building, in ruins	No	140m east	Indirect	Imperceptible negative
CH 98	Vernacular building	No	189m ENE	Indirect	Imperceptible negative
CH 57	Ruinous vernacular settlement of An Chloch Scoilte	No	0m	Direct	Significant negative
CH 56	Vernacular buildings	No	172m NW	Indirect	Slight negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 116	Vernacular building, in ruins	No	157m NW	Indirect	Slight negative
CH 117	Vernacular buildings	No	102m north	Indirect	Imperceptible negative

Table 7.6.6.46 Areas of Archaeological Potential - Blue2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AAP 14	Stream	No	0m	Direct	Moderate negative
AAP 15	Stream	No	0m	Direct	Moderate negative

Table 7.6.6.47 Townland Boundaries - Blue2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 50	Townland boundary	No	0m	Direct	Moderate negative
TB 51	Townland boundary, site of	No	0m	Neutral	N/a
TB 52	Townland boundary	No	0m	Direct	Moderate negative
TB 6	Townland boundary	No	0m	Direct	Moderate negative
TB 7	Townland boundary	No	0m	Direct	Moderate negative

Detailed Assessment - Section 2

Tables 7.6.6.48 to **7.6.6.53** below list the impacts associated with the Blue2 Route Option for Section 2.

Table 7.6.6.48 Archaeological Heritage - Blue2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 36	Bullaun stone	Yes	0m	Direct	Significant negative
AH 65	Glenlo Abbey (also BH 1)	Yes	124m NE	Indirect	Imperceptible negative
AH 37	Redundant record	No	64m south-east	N/a	N/a

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 42	Barrow - unclassified	Yes	140m south	Neutral	N/a
AH 40	Designed landscape feature	Yes	0m	Direct	Profound negative
AH 39	Designed landscape feature	Yes	41m SSE	Neutral	N/a
AH 44	Ringfort (Also BH 14)	Yes	154m south	Indirect	Slight negative
AH 41	Summer house (Also BH 13)	Yes	31m north-west	Indirect	Moderate negative
AH 11	Menlo Castle (also BH 2)	Yes	289m NW	Indirect	Slight negative
AH 18	Enclosure	No	67m south-east	No impact	N/a
AH 19	Ringfort - unclassified	No	10m SSE	No impact	N/a
AH 20	Quarry	No	177m north	Indirect	Imperceptible negative
AH 74	Tower House (also BH 72)	Yes	193m south	Indirect	Imperceptible negative
AH 148	Redundant record	No	45m north	N/a	N/a
AH 146	Children's Burial ground	Yes	139m SSW	Indirect	Slight negative
AH 147	Quarry	No	102m SSW	No impact	N/a
AH 32	Earthwork	No	91m WSW	Neutral	N/a
AH 33	Designed landscape feature	No	140m south	Neutral	N/a
AH 27	Ringfort – rath House - indeterminate date	Yes	24m west	Indirect	Slight negative
AH 24	Settlement deserted - medieval	Yes	28m SW	Neutral	N/a
AH 25	Tower castle (also BH 6)	Yes	89m SW	Neutral	N/a
AH 26	Enclosure	Yes	147m SW	Neutral	N/a

Table 7.6.6.49 Built Heritage - Blue2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
BH 11	Thatched Cottage	Yes	59m NNW	Indirect	Moderate negative
BH 12	Thatched Cottage	Yes	183m SE	Indirect	Imperceptible negative
BH 30	Heffernans cottage	Yes	38m ENE	Indirect	Moderate negative
BH 1	Glenlo Abbey (also AH 65)	No	124m NE	Indirect	Imperceptible negative
BH 8	Gate pillars	Yes	183n NE	Indirect	Imperceptible negative
BH 13	Summer house (Also AH 41)	Yes	31m NW	Indirect	Moderate negative
BH 2	Menlo Castle (also AH 11)	Yes	289m NW	Indirect	Slight negative
BH 73	House	No	2m north	Indirect	Significant negative
BH 72	Tower House (also AH 74)	Yes	193m south	Indirect	Imperceptible negative

Table 7.6.6.50 Designed Landscapes - Blue2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
DL 5	Glenlo Abbey demesne	No	0m	Direct	Slight negative
DL 3	River View house & demesne	No	0m	Direct	Slight negative
DL 9	Ashley Park demesne	No	22m south-east	No impact	N/a
DL 8	Dangan Cottage, Dangan House, Dangan Nunnery, Mary Ville demesnes	No	0m	Direct	Moderate negative
DL 10	Menlo Castle demesne	House is in the RSP[18]	0m	Direct	Significant negative
DL 25	Ballybrit House demesne	No	0m	Neutral	N/a

Table 7.6.6.51 Cultural Heritage - Blue2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 117	Vernacular buildings	No	102m north	Indirect	Imperceptible negative
CH 58	Vernacular buildings	No	12m south	Indirect	Significant negative
CH 59	Vernacular buildings	No	101m NNW	Indirect	Slight negative
CH 60	Vernacular buildings, in ruins	No	95m SE	Indirect	Slight negative
CH 133	Vernacular building, in ruins	No	54m NNW	Indirect	Moderate negative
CH 61	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 62	Vernacular building, in ruins	No	5m SE	Indirect	Significant negative
CH 63	Vernacular building, in ruins	No	63m SE	Indirect	Slight negative
CH 64	Vernacular buildings	No	29m NW	Indirect	Moderate negative
CH 65	Vernacular building, in ruins	No	0m	Direct	Significant negative
CH 66	Vernacular building	No	160m NW	Indirect	Slight negative
CH 68	Site of vernacular building	No	141m NNW	Indirect	Imperceptible negative
CH 103	Vernacular farm	No	73m NW	Indirect	Slight negative
CH 104	Site of vernacular buildings	No	32m SE	Indirect	Imperceptible negative
CH 105	Site of vernacular buildings	No	141m SE	Indirect	Slight negative
CH 118	Site of vernacular buildings	No	To immediate SE	Indirect	Slight negative
CH 119	Vernacular buildings	No	184m NW	Indirect	Imperceptible negative
CH 106	Leitriff House	No	60m SE	Indirect	Moderate negative
CH 107	Vernacular building	No	17m west	Indirect	Moderate negative
CH 108	Vernacular building, derelict	No	165m WNW	Indirect	Imperceptible negative
CH 120	Vernacular building	No	159m WNW	Indirect	Imperceptible negative
CH 109	Vernacular buildings, derelict	No	0m	Direct	Significant negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 121	Vernacular building, in ruins	No	56m ENE	Indirect	Slight negative
CH 134	Possible famine path	No	0m	Direct	Moderate negative
CH 122	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 41	Site of Dangan Cottage	No	0m	Direct	Moderate negative
CH 42	Mary Ville	No	73m SSE	Indirect	Slight negative
CH 40	Dangan House	No	20m SSE	Indirect	Significant negative
CH 14	Railway track, site of (disused)	No	0m	Direct	Moderate negative
CH 21	Vernacular animal shelter (2006 EIS)	No	91m WNW	Indirect	Slight negative
CH 22	Possible prehistoric tomb (2006 EIS)	No	9m SE	Indirect	Moderate negative
CH 123	Possible enclosure	No	0m	Direct	Profound negative
CH 23	Circular feature? (2006 EIS)	No	23m south-east	Indirect	Moderate negative
CH 24	Small boulder (2006 EIS)	No	0m	Direct	Significant negative
CH 25	Possible cairn (2006 EIS)	No	83m NNW	No impact	N/a
CH 124	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 125	Site of PM settlement of Castlegar	No	0m	Direct	Significant negative
CH 126	Vernacular buildings, in ruin	No	10m west	Indirect	Moderate negative
CH 127	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 128	Vernacular building	No	161m NNE	Indirect	Slight negative

Table 7.6.6.52 Areas of Archaeological Potential - Blue2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AAP 3	Stream (also TB 8)	No	0m	Direct	Moderate negative
AAP 4	Stream	No	0m	Direct	Moderate negative
AAP 9	River Corrib & margins	No	0m	Direct	Significant negative

Table 7.6.6.53 Townland boundaries – Blue2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 8	Townland boundary (also AAP 3)	No	0m	Direct	Moderate negative
TB 9	Townland boundary	No	0m	Direct	Moderate negative
TB 10	Townland boundary	No	0m	Direct	Moderate negative
TB 11	Townland boundary, site of	No	0m	Direct	Moderate negative
TB 43	Townland boundary	No	0m	Direct	Moderate negative
TB 44	Townland boundary	No	0m	Direct	Moderate negative
TB 53	Townland boundary, site of	No	0m	Direct	Moderate negative
TB 46	Townland boundary	No	0m	Direct	Moderate negative
TB 45	Townland boundary	No	0m	Direct	Moderate negative
TB 15	Townland boundary	No	0m	Direct	Moderate negative
TB 16	Townland boundary	No	0m	Direct	Moderate negative
TB 54	Townland boundary	No	0m	Direct	Moderate negative
TB 55	Townland boundary	No	0m	Direct	Moderate negative
TB 56	Townland boundary	No	0m	Direct	Moderate negative
TB 57	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 22	Townland & parish boundary	No	0m	Direct	Moderate negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 58	Townland boundary	No	0m	Direct	Moderate negative
TB 59	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 60	Townland boundary	No	0m	Direct	Moderate negative
TB 61	Townland boundary, site of	No	0m	Direct	Moderate negative
TB 62	Townland boundary, site of	No	0m	Neutral	N/a

Detailed Assessment - Section 3

Tables 7.6.6.54 to 7.6.6.55 below list the impacts associated with the Blue2 Route Option for Section 3.

There are no AH, BH, DL or AAPs sites within the receiving environment of Section 3.

Table 7.6.6.54 Cultural Heritage - Blue2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 100	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 101	Vernacular settlement of Coolagh	No	40-100m NE	Indirect	Moderate Negative
CH 135	Mass Rock? [2]	No	10-200m SW	Indirect (?)	Moderate negative
CH 138	Two staddle stone circles	No	167m south	Indirect	Imperceptible negative
CH 142	Site of cashel	No	0m	Neutral	N/a

Table 7.6.6.55 Townland Boundaries - Blue2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 41	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 42	Townland & parish boundary	No	0m	Direct	Moderate negative

Pink2 Route Option

The Pink2 Route Option travels through the baronies, parishes and townlands listed in **Table 7.6.6.48** below.

Table 7.6.6.56 Baronies, Parishes and Townlands - Pink2 Route Option

Barony	Parish	Townland
Galway	Rahoon	Na Foraí Maola Thoir, Freeport, Keeraun, Lacklea, Knocknacarra, Letteragh, Mincloon, An Baile Nua, Rahoon, Trusky East, Ballyburke, Ballynahown East, Bamacranny, Cappagh, Dangan Lower, Dangan Upper, Ahaglugger, Aille, Ballard East, Ballard West, Ballagh, An Chloch Scoilte
	St. Nicholas	Castlegar, Ballybrit, Parkmore
	Oranmore	Doughiska, Menlough, Ballindooley
Dunkellin		Coolagh

National Museum of Ireland: Topographical Files

Information from the NMI topographical files listed a stone ard fragment (1987:184) and an iron axehead (1983:61) recovered from the townland of Dangan Lower. A number of lithic artefacts are listed under the townland of Menlough, including seven stone axeheads of 'Shannon type' (KK131129, 2005C1:802, 1638:W307, 1637:W306, 1636:W305, 1635:W304, 1634:W303); a collection of twenty blades of various geologies (1280:W5) and a chert blade (2005C1:801). A 'beehive' type quern top and base (2011:252) have also been recovered from the townland of Castlegar. A log boat (2014:263) was recovered from the townland of Freeport, but no further details were included within the file.

Summary of Previous Archaeological Fieldwork

A review of the Excavations Bulletin (1970-2014) has shown that the following programmes of fieldwork included in **Table 7.6.6.57** below have been carried out within the receiving environment of the Pink2 Route Option.

Table 7.6.6.57 Summary of Previous Archaeological Fieldwork - Pink2 Route Option

Excavations Bulletin Ref.:	Licence Ref.:	Townland:	Description:
2001:497	01E0992	Coolagh/ Castlegar/ Ballybrit/ Parkmore/ Cappanabornia/ Glenanail/ Ballybane Beg,	Nothing of archaeological significance was identified during the course of monitoring 4.1km of pipeline construction.
2002:0724	02E1327	Dangan Lower	Archaeological testing adjacent to a recorded ring barrow (AH 42) revealed no features of archaeological significance.
2008:545	08E0558	Dangan Lower	Archaeological testing *c.*200m SE of this route option as part of a park and ride development revealed no features of archaeological significance.
2005:579 & 2006:779	Ministerial Dir.: A024/1.3 & A024/5 E2435	Coolagh	Archaeological testing and excavation were carried out prior to the development of the existing N6. A possible cashel (53m x 60m) was identified in the townland of Coolagh within the footprint of the scheme (although an associated annex wall was noted to the south of the CPO). A secure date for the site was not secured due to the lack of stratified finds. However, a red bead and fragments of lignite bracelet as well as two possible lime kilns were noted within the interior along with the oval foundations of a stone structure. It is possible the site represents an earlier medieval cashel. It has been included within this assessment as CH 142 as associated remains with the site are located to the south of the N6 and to the immediate east of the end of the Pink2 Route Option.

Excavations Bulletin Ref.:	Licence Ref.:	Townland:	Description:
2000:0368	00E0144	Ballinfoyle, Glenanail, Castlegar	Monitoring of the Terryland drainage scheme in the landscape to the north of the existing N6 failed to identify any features of archaeological significance.
2005:592 2006:790	A024/1.1 E2052	Doughiska	A series of burnt mounds were found during testing and then excavated immediately adjacent to the Pink2 Route Option (AH 28), although only one shallow pit was found with the remains. Presumed to be prehistoric in date.
2008:540	E3588	Doughiska	During monitoring as part of the N6 construction, a well was identified *c.*100m SSW of the Pink2 Route Option. It was deemed to be post medieval in date.
2012:279	12E0055	Aille, Cappagh	Nothing of archaeological significance discovered during monitoring associated with an 110kv electricity line.
1997:194	97E0341	Castlegar	Archaeological testing to the immediate west of AH 74/ BH 72 failed to identify any features of archaeological significance.
1998:237	98E0498	Castlegar	Archaeological testing was carried out at the site of a souterrain identified in 1967 *c.*100m south of this route option. Reports of the time also indicated the discovery of a number of skeletons. However, testing in the area failed to identify any archaeology – it is possible any remains were removed during land clearance.

Detailed Assessment - Section 1

Tables 7.6.6.58 to **7.6.6.62** below list the impacts associated with the Green2 Route Option for Section 1.

Table 7.6.6.58 Archaeological Heritage - Pink2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 66	Ringfort - cashel	No	42m NNW	Indirect	Imperceptible negative
AH 68	Church	Yes	136m south-west	Neutral	N/a
AH 69	Settlement cluster	No	142m NNW	Indirect	Slight positive
AH 67	Field system	No	43m NNW	Neutral	N/a

Table 7.6.6.59 Designed Landscapes - Pink2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
DL 1	Eagle Lodge and demesne	No	To immediate west	Neutral	N/a

Table 7.6.6.60 Cultural Heritage - Pink2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 113	Vernacular building	No	84m SE	Indirect	Slight negative
CH 114	Vernacular settlement (part of Bearna)	No	62m south	Indirect	Imperceptible negative
CH 91	Vernacular building, in ruins	No	0m	Direct	Significant negative
CH 92	Vernacular buildings	No	190m NE	Indirect	Imperceptible negative
CH 115	Vernacular building	No	29m east	Indirect	Moderate negative
CH 95	Vernacular settlement, in ruins	No	0m	Direct	Significant negative
CH 94	Vernacular building, in ruins	No	180m east	Indirect	Imperceptible negative
CH 98	Vernacular building	No	48m ESE	Indirect	Moderate negative
CH 99	Vernacular building	No	59m NW	Indirect	Slight negative

Table 7.6.6.61 Areas of Archaeological Potential - Pink2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AAP 14	Stream	No	0m	Direct	Moderate negative
AAP 15	Stream	No	0m	Direct	Moderate negative

Table 7.6.6.62 Townland boundaries – Pink2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 50	Townland boundary	No	0m	Direct	Moderate negative
TB 51	Townland boundary, site of	No	0m	Neutral	N/a

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 52	Townland boundary	No	0m	Direct	Moderate negative
TB 31	Townland boundary	No	0m	Direct	Moderate negative

Detailed Assessment - Section 2

Tables 7.6.6.63 to **7.6.6.68** below list the impacts associated with the Pink2 Route Option for Section 2.

Table 7.6.6.63 Archaeological Heritage - Pink2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 36	Bullaun stone	**Yes**	0m	Direct	Significant negative
AH 65	Glenlo Abbey (also BH 1)	**Yes**	179m NE	Indirect	Imperceptible negative
AH 37	Redundant record	No	83m south-east	N/a	N/a
AH 40	Designed landscape feature	**Yes**	147m SSE	Indirect	Slight negative
AH 41	Summer house (Also BH 13)	**Yes**	68m north-west	Indirect	Moderate negative
AH 34	18th/19th Century House	**Yes**	106m NNW	Indirect	Slight negative
AH 11	Menlo Castle (also BH 2)	**Yes**	169m NW	Indirect	Slight negative
AH 18	Enclosure	No	67m south-east	No impact	N/a
AH 19	Ringfort - unclassified	No	10m SSE	No impact	N/a
AH 20	Quarry	No	147m north	Indirect	Imperceptible negative
AH 146	Children's Burial ground	Yes	200m SSW	Indirect	Imperceptible negative
AH 147	Quarry	No	59m WNW	Indirect	Imperceptible negative
AH 74	Tower House (also BH 72)	**Yes**	193m south	Indirect	Imperceptible negative
AH 148	Redundant record	No	45m north	N/a	N/a
AH 32	Earthwork	No	73m east	Neutral	N/a
AH 33	Designed landscape feature	No	55m south	Neutral	N/a

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 24	Settlement deserted - medieval	**Yes**	100m west	Neutral	N/a
AH 151	Anomalous stone group	**Yes**	136m SW	Neutral	N/a
AH 152	Ringfort – cashel, souterrain, children's burial ground (Also BH 74)	**Yes**	106m SW	Indirect	Slight negative

Table 7.6.6.64 Built Heritage - Pink2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
BH 11	Thatched Cottage	**Yes**	59m NNW	Indirect	Moderate negative
BH 12	Thatched Cottage	**Yes**	183m SE	Indirect	Imperceptible negative
BH 30	Heffernans cottage	**Yes**	58m ENE	Indirect	Slight negative
BH 1	Glenlo Abbey (also AH 65)	No	179m NE	Indirect	Imperceptible negative
BH 8	Gate pillars	**Yes**	177m NE	Indirect	Imperceptible negative
BH 13	Summer house (Also AH 41)	**Yes**	68m SSE	Indirect	Moderate negative
BH 2	Menlo Castle (also AH 11)	**Yes**	169m NW	Indirect	Slight negative
BH 73	House	No	2m north	Indirect	Significant negative
BH 72	Tower House (also AH 74)	**Yes**	193m south	Indirect	Imperceptible negative
BH 74	Ringfort – cashel, souterrain, children's burial ground (Also AH 152)	**Yes**	106m SW	Indirect	Slight negative

Table 7.6.6.65 Designed Landscapes - Pink2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
DL 5	Glenlo Abbey demesne	No	To immediate north	Indirect	Imperceptible negative
DL 3	River View house demesne	No	105m NW	Indirect	Imperceptible negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
DL 9	Ashley Park demesne	No	81m south-east	No impact	N/a
DL 8	Dangan Cottage, Dangan House, Dangan Nunnery, Mary Ville demesnes	No	0m	Direct	Moderate negative
DL 10	Menlo Castle demesne	**House is in the RSP[18]**	0m	Direct	Significant negative

Table 7.6.6.66 Cultural Heritage - Pink2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 4	Possible enclosure	No	30m SSW	Indirect	Moderate negative
CH 5	Vernacular buildings, in ruins	No	6m north	Indirect	Moderate negative
CH 58	Vernacular buildings	No	12m south	Indirect	Significant negative
CH 59	Vernacular buildings	No	101m NNW	Indirect	Slight negative
CH 60	Vernacular buildings, in ruins	No	95m SE	Indirect	Slight negative
CH 61	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 133	Vernacular building, in ruins	No	54m NNW	Indirect	Moderate negative
CH 62	Vernacular building, in ruins	No	5m SE	Indirect	Significant negative
CH 63	Vernacular building, in ruins	No	63m SE	Indirect	Slight negative
CH 64	Vernacular buildings	No	29m NW	Indirect	Moderate negative
CH 65	Vernacular building, in ruins	No	0m	Direct	Significant negative
CH 66	Vernacular building	No	160m NW	Indirect	Slight negative
CH 68	Site of vernacular building	No	141m NNW	Indirect	Imperceptible negative
CH 103	Vernacular farm	No	73m NW	Indirect	Slight negative
CH 104	Site of vernacular buildings	No	32m SE	Indirect	Imperceptible negative
CH 105	Site of vernacular buildings	No	141m SE	Indirect	Slight negative
CH 118	Site of vernacular buildings	No	To immediate SE	Indirect	Slight negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 119	Vernacular buildings	No	184m NW	Indirect	Imperceptible negative
CH 106	Leitriff House	No	60m SE	Indirect	Moderate negative
CH 107	Vernacular building	No	17m west	Indirect	Moderate negative
CH 108	Vernacular building, derelict	No	165m WNW	Indirect	Imperceptible negative
CH 120	Vernacular building	No	159m WNW	Indirect	Imperceptible negative
CH 109	Vernacular buildings, derelict	No	10m east	Indirect	Significant negative
CH 121	Vernacular building, in ruins	No	90m east	Indirect	Slight negative
CH 122	Site of vernacular buildings	No	26m WNW	Indirect	Slight negative
CH 134	Possible famine path	No	0m	Direct	Moderate negative
CH 41	Site of Dangan Cottage	No	0m	Direct	Moderate negative
CH 14	Railway track, site of (disused)	No	0m	Direct	Moderate negative
CH 21	Vernacular animal shelter (2006 EIS)	No	91m WNW	Indirect	Slight negative
CH 22	Possible prehistoric tomb (2006 EIS)	No	9m SE	Indirect	Moderate negative
CH 123	Possible enclosure	No	0m	Direct	Significant negative
CH 23	Circular feature? (2006 EIS)	No	23m south-east	Indirect	Moderate negative
CH 24	Small boulder (2006 EIS)	No	0m	Direct	Significant negative
CH 25	Possible cairn (2006 EIS)	No	83m NNW	No impact	N/a
CH 124	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 125	Site of PM settlement of Castlegar	No	0m	Direct	Significant negative
CH 126	Vernacular buildings, in ruin	No	10m west	Indirect	Moderate negative
CH 127	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 128	Vernacular building	No	120m NNE	Indirect	Slight negative

Table 7.6.6.67 Areas of Archaeological Potential - Pink2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AAP 3	Stream (also TB 8)	No	0m	Direct	Moderate negative
AAP 13	Stream (also TB 32)	No	0m	Direct	Moderate negative
AAP 4	Stream	No	0m	Direct	Moderate negative
AAP 9	River Corrib & margins	No	0m	Direct	Significant negative

Table 7.6.6.68 Townland boundaries - Pink2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 8	Townland boundary (also AAP 3)	No	0m	Direct	Moderate negative
TB 63	Townland boundary	No	0m	Direct	Moderate negative
TB 64	Townland boundary	No	0m	Direct	Moderate negative
TB 32	Townland boundary (also AAP 13)	No	0m	Direct	Moderate negative
TB 9	Townland boundary	No	0m	Direct	Moderate negative
TB 10	Townland boundary	No	0m	Direct	Moderate negative
TB 11	Townland boundary, site of	No	0m	Direct	Moderate negative
TB 43	Townland boundary	No	0m	Direct	Moderate negative
TB 44	Townland boundary	No	0m	Direct	Moderate negative
TB 53	Townland boundary, site of	No	0m	Direct	Moderate negative
TB 46	Townland boundary	No	0m	Direct	Moderate negative
TB 45	Townland boundary	No	0m	Direct	Moderate negative
TB 15	Townland boundary	No	0m	Direct	Moderate negative
TB 54	Townland boundary	No	0m	Direct	Moderate negative
TB 55	Townland boundary	No	0m	Direct	Moderate negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 56	Townland boundary	No	0m	Direct	Moderate negative
TB 57	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 22	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 58	Townland boundary	No	0m	Direct	Moderate negative
TB 25	Townland boundary, site of	No	0m	Neutral	N/a
TB 65	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 41	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 42	Townland & parish boundary	No	0m	Direct	Moderate negative

Detailed Assessment - Section 3

Tables 7.6.6.69 to 7.6.6.71 below list the impacts associated with the Pink2 Route Option for Section 3.

There are no BH, DL or AAPs sites within the receiving environment of Section 3.

Table 7.6.6.69 Archaeological Heritage - Pink2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 28	*Fulachta fiadh* (excavated)	No	0m	No impact	N/a
AH 144	Road	**Yes**	0m	Direct	Significant negative

Table 7.6.6.70 Cultural Heritage - Pink2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 100	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 135	Mass Rock?	No	10-200m SW	Indirect (?)	Moderate negative
CH 142	Site of cashel	No	0m	Neutral	N/a

Table 7.6.6.71 Townland Boundaries - Pink2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 41	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 42	Townland & parish boundary	No	0m	Direct	Moderate negative

Green2 Route Option

The Green2 Route Option travels through the baronies, parishes and townlands listed in **Table 7.6.6.72** below.

Table 7.6.6.72 Baronies, Parishes and Townlands - Green2 Route Option

Barony	Parish	Townland
Galway	Rahoon	Aille, Ballagh, Ballyburke, Ballynahown East, Bushypark, Cappagh, An Chloch Scoilte, Clybaun, Dangan Lower, Na Foraí Maola Thior, Na Foraí Maola Thiar, Glenrevagh, Gortacleva, Kentfield, Lenabower, Mincloon, An Baile Nua, Rahoon, Tonabrocky, Trusky East, Trusky West
Galway	Oranmore	Ballindooley, Carrowbrowne, Ballygarraun, Brockagh, Killoughter, Menlough, Pollkeen
Dunkellin		Ballintemple, Breanloughaun, Coolagh

National Museum of Ireland: Topographical Files

Information from the NMI topographical files lists a stone ard fragment (1987:184) and an iron axehead (1983:61) recovered from the townland of Dangan Lower. A number of lithic artefacts are listed under the townland of Menlough, including seven stone axeheads of 'Shannon type' (KK131129, 2005C1:802, 1638:W307, 1637:W306, 1636:W305, 1635:W304, 1634:W303), a collection of 20 blades of various geologies (1280:W5) and a chert blade (2005C1:801).

Summary of Previous Archaeological Fieldwork

A review of the Excavations Bulletin (1970-2014) has shown that the programmes of fieldwork included in **Table 7.6.6.73** below have been carried out within the receiving environment of the Green2 Route Option.

Table 7.6.6.73 Baronies, Parishes and Townlands - Green2 Route Option

Excavations Bulletin Ref.:	Licence Ref.:	Townland:	Description:
2001:497	01E0992	Coolagh/ Castlegar/ Ballybrit/ Parkmore/ Cappanabornia/ Glenanail/ Ballybaan Beg,	Nothing of archaeological significance was identified during the course of monitoring 4.1km of pipeline construction.

Excavations Bulletin Ref.:	Licence Ref.:	Townland:	Description:
2005:579 & 2006:779	Ministerial Dir.: A024/1.3 & A024/5 E2435	Coolagh	Archaeological testing and excavation were carried out prior to the development of the existing N6. A possible cashel (53m x 60m) was identified in the townland of Coolagh within the footprint of the scheme (although an associated annex wall was noted to the south of the CPO). A secure date for the site was not secured due to the lack of stratified finds. However, a red bead and fragments of lignite bracelet as well as two possible lime kilns were noted within the interior along with the oval foundations of a stone structure. It is possible the site represents an earlier medieval cashel. It has been included within this assessment as CH 142 as associated remains with the site are located to the south of the N6 and the Green2 Route Junction alignment.

Detailed Assessment - Section 1

Tables 7.6.6.74 to **7.6.6.77** below list the impacts associated with the Green2 Route Option for Section 1.

Table 7.6.6.74 Archaeological Heritage - Green2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 1	Redundant record (also AH 1)	No	40m east	N/a	N/a

Table 7.6.6.75 Cultural Heritage - Green2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 51	Vernacular buildings, in ruins	No	0m	Direct	Significant negative
CH 52	Vernacular building	No	191m east	Indirect	Imperceptible negative
CH 1	Enclosure (2006 EIS) (also AH 1)	No	40m east	Indirect	Moderate Negative
CH 136	Vernacular buildings	No	107m east	Indirect	Slight negative
CH 53	Vernacular buildings	No	149m SE	Indirect	Slight negative
CH 140	Possible famine bridge	No	186m NNW	Indirect	Imperceptible negative
CH 54	Site of PMsheep fold	No	0m	Direct	Significant negative
CH 55	Vernacular farmstead	No	8m SE	Indirect	Significant negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 56	Vernacular buildings	No	153m NW	Indirect	Imperceptible negative
CH 57	Ruinous vernacular settlement of Cloghscoltia	No	53m NW	Indirect	Moderate negative

Table 7.6.6.76 Areas of Archaeological Potential - Green2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AAP 1	Stream (also TB 1)	No	0m	Direct	Moderate negative
AAP 2	Stream (also TB 5)	No	0m	Direct	Moderate negative

Table 7.6.6.77 Townland Boundaries - Green2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 1	Townland & parish boundary (also AAP 1)	No	0m	Direct	Moderate negative
TB 2	Townland boundary	No	0m	Direct	Moderate negative
TB 3	Townland boundary	No	0m	Direct	Moderate negative
TB 4	Townland boundary	No	0m	Direct	Moderate negative
TB 5	Former townland boundary (19th C) (also AAP 2)	No	0m	Direct	Moderate negative
TB 6	Townland boundary	No	0m	Direct	Moderate negative
TB 7	Townland boundary	No	0m	Direct	Moderate negative

No recorded Built Heritage sites or Designed Landscapes located within Section 1 of the Green2 Route Option Corridor.

Detailed Assessment - Section 2

Tables 7.6.6.78 to **7.6.6.83** below list the impacts associated with the Green2 Route Option for Section 2.

Table 7.6.6.78 Archaeological Heritage - Green2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AH 17	Redundant record	No	25m south	N/a	N/a
AH 6	Burial ground	**Yes**	40m north-west	Indirect	Moderate negative
AH 7	Designed landscape feature	No	0m	Direct	Significant negative
AH 8	Designed landscape feature	No	0m	Direct	Profound negative
AH 9	Gate house (Also BH 3)	**Yes**	34m south-east	Indirect	Moderate negative
AH 116	Pillar stone	**Yes**	30m north-west	Indirect	Moderate negative
AH 117	Settlement cluster & Redundant record	No	0m	Direct	Significant negative
AH 160	Hut site	**Yes**	124m south-east	Indirect	Slight negative
AH 159	Enclosure	**Yes**	145m south-east	Indirect	Slight negative
AH 161	Ringfort	**Yes**	88m north-east	Indirect	Moderate negative
AH 162	Redundant record	No	68m north-east	N/a	N/a
AH 12	Castle - tower house (also BH 36)	**Yes**	65m south	Indirect	Moderate negative
AH 150	Redundant record	No	194m ESE	N/a	N/a
AH 163	Castle, 17th C house, inscribed stone	**Yes**	50m WNW	Indirect	Moderate negative
AH 20	Quarry	No	143m east	Indirect	Imperceptible negative
AH 121	Redundant record	No	97m west	N/a	N/a
AH 49	Crannog (also BH 70)	**Yes**	200m south	Indirect	Slight negative
AH 151	Anomalous stone group	**Yes**	97m south-west	Indirect	Slight negative
AH 152	Ringfort – cashel, souterrain, children's burial ground (Also BH 74)	**Yes**	115m south-west	Indirect	Slight negative

Table 7.6.6.79 Built Heritage - Green2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
BH 11	Thatched Cottage	**Yes**	105m ESE	Indirect	Moderate negative
BH 5	Bushypark House	**Yes**	147m south	Indirect	Moderate negative
BH 3	Gate house	**Yes**	34m south-east	Indirect	Moderate negative
BH 9	Thatched cottage	**Yes**	0m	Direct	Profound negative
BH 31	x3 houses at Menlough	**Yes**	66m north-west	Indirect	Moderate negative
BH 10	Thatched cottage	**Yes**	140m ESE	Indirect	Slight negative
BH 36	Castle - tower house (also AH 12)	**Yes**	65m south	Indirect	Moderate negative
BH 70	Crannog (also AH 149)	**Yes**	200m south	Indirect	Slight negative
BH 74	Ringfort – cashel, souterrain, children's burial ground (Also AH 152)	**Yes**	115m SW	Indirect	Slight negative

Table 7.6.6.80 Designed Landscapes - Green2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
DL 5	Glenlo Abbey demesne, including extant demesne wall	No	0m	Direct	Significant negative
DL 6	Bushypark House demesne	**House is in the RSP[18]**	0m	Direct	Significant negative
DL 10	Menlo Castle demesne	**House is in the RSP[18]**	0m	Direct	Significant negative

Table 7.6.6.81 Cultural Heritage - Green2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 58	Vernacular buildings	No	0m	Direct	Significant negative
CH 59	Vernacular buildings	No	150m NW	Indirect	Slight negative
CH 60	Vernacular buildings, in ruins	No	93m SE	Indirect	Slight negative
CH 61	Site of vernacular buildings	No	0m	Direct	Significant negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 62	Vernacular building, in ruins	No	21m SE	Indirect	Moderate negative
CH 63	Vernacular building, in ruins	No	63m SE	Indirect	Slight negative
CH 64	Vernacular buildings	No	74m NW	Indirect	Slight negative
CH 65	Vernacular building, in ruins	No	5m NW	Indirect	Significant negative
CH 66	Vernacular building	No	142m NW	Indirect	Slight negative
CH 67	Vernacular buildings	No	197m NW	Indirect	Imperceptible negative
CH 68	Site of vernacular building	No	0m	Direct	Significant negative
CH 69	Vernacular buildings	No	40m east	Indirect	Moderate negative
CH 70	Site of vernacular building	No	0m	Direct	Significant negative
CH 71	Vernacular buildings	No	90m EME	Indirect	Slight negative
CH 72	Vernacular settlement of Tonabrocky	No	0-150m WNW	Direct	Significant negative
CH 73	Vernacular building, in ruins	No	76m east	Indirect	Slight negative
CH 137	Possible mass rock	No	0m	Direct	Significant negative
CH 74	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 75	Site of vernacular building	No	0m	Direct	Significant negative
CH 14	Railway track (disused)	No	0m	Direct	Moderate negative
CH 17	Medieval field system? (2006 EIS)	No	To immediate north	Indirect	Slight negative
CH 18	Regular rectangular cut feature & Possible standing stone (2006 EIS)	No	41m SSE	Indirect	Moderate negative
CH 19	Vernacular structure, in ruins (2006 EIS)	No	189m SE	Indirect	Slight negative
CH 76	Site of limekiln	No	To immediate SE	Indirect	Moderate negative
CH 141	Vernacular settlement of Menlough	No	0m	Direct	Significant negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 77	Vernacular buildings (site of & upstanding)	No	0m	Direct	Significant negative
CH 78	Vernacular buildings	No	172m NW	Indirect	Slight negative
CH 79	Site of sheep fold	No	0m	Direct	Significant negative
CH 80	Vernacular building, in ruins	No	73m NE	Indirect	Slight negative
CH 27	Possible corn/turf drying stand, possible ringfort, possible cairn, possible consumption wall, three possible structures (2006 EIS)	No	59m SW	Indirect	Slight negative
CH 28	Possible *fulacht fiadh* (2006 EIS)	No	34m north	Indirect	Moderate negative
CH 29	Possible ringfort (2006 EIS)	No	30m NNE	Indirect	Moderate negative
CH 30	Rectangular feature (2006 EIS)	No	103m SE	Indirect	Slight negative
CH 31	Vernacular buildings, in ruins (2006 EIS)	No	20m NNW	Indirect	Moderate negative
CH 87	Vernacular buildings	No	126m N & ESE	Indirect	Moderate negative
CH 80	Vernacular buildings	No	85m NW	Indirect	Moderate negative
CH 81	Vernacular buildings	No	0m	Direct	Significant negative
CH 82	Vernacular settlement of Ballindooley	No	100-120m ESE	Indirect	Moderate negative
CH 83	Vernacular buildings	No	43m WNW	Indirect	Moderate negative
CH 84	Vernacular building, in ruins	No	To immediate east	Indirect	Moderate negative
CH 85	Vernacular building, in ruins	No	13m east	Indirect	Moderate negative
CH 86	Vernacular buildings	No	149m south	Indirect	Slight negative
CH 49	Burnt mound and ditches? (Geophysical survey 2005)	No	0m	Direct	Significant negative

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 88	Site of vernacular buildings	No	0m	Direct	Significant negative
CH 89	Vernacular settlement at Ballygarraun	No	161m south	Indirect	Slight negative
CH 34	Possible standing stone, isolated boulder, three raised areas of archaeological potential, possible cairn (2006 EIS)	No	154m north	Indirect	Slight negative
CH 35	Raised stone circular area (2006 EIS)	No	139m north	Indirect	Imperceptible negative
CH 36	Vernacular settlement at Ballintemple	No	0m	Direct	Profound negative
CH90	Vernacular buildings	No	62m SSW	Indirect	Moderate negative

Table 7.6.6.82 Areas of Archaeological Potential - Green2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
AAP 3	Stream (also TB 8)	No	0m	Direct	Moderate negative
AAP 4	Stream	No	0m	Direct	Moderate negative
AAP 5	Site of Lough Nacreeva	No	0m	Direct	Significant negative
AAP 6	Stream (also TB 13)	No	0m	Direct	Moderate negative
AAP 7	Lough Nabrocky (original extent)	No	0m	Direct	Significant negative
AAP 8	Loughaunnafraska (original extent)	No	0m	Direct	Significant negative
AAP 9	River Corrib & margins	No	0m	Direct	Significant negative
AAP 10	Lough	No	47m SE	Indirect	Slight negative

Table 7.6.6.83 Townland boundaries - Green2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 8	Townland boundary (also AAP 3)	No	0m	Direct	Moderate negative
TB 9	Townland boundary	No	0m	Direct	Moderate negative
TB 10	Townland boundary	No	0m	Direct	Moderate negative
TB 11	Townland boundary, site of	No	0m	Direct	Moderate negative
TB 12	Townland boundary, site of	No	0m	Direct	Moderate negative
TB 13	Townland boundary (also AAP 6)	No	0m	Direct	Moderate negative
TB 14	Townland boundary	No	0m	Direct	Moderate negative
TB 15	Townland boundary	No	0m	Direct	Moderate negative
TB 16	Townland boundary	No	0m	Direct	Moderate negative
TB 17	Townland boundary	No	0m	Direct	Moderate negative
TB 18	Townland & parish boundary (also AAP 9)	No	0m	Direct	Moderate negative
TB 19	Townland boundary	No	0m	Direct	Moderate negative
TB 20	Townland boundary	No	0m	Direct	Moderate negative
TB 21	Townland boundary	No	0m	Direct	Moderate negative
TB 22	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 23	Townland boundary	No	0m	Direct	Moderate negative
TB 24	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 25	Townland boundary, site of	No	0m	Direct	Moderate negative
TB 26	Townland & parish boundary	No	0m	Direct	Moderate negative
TB 27	Townland boundary	No	0m	Direct	Moderate negative

Detailed Assessment – Section 3

Tables 7.6.6.84 to **7.6.6.85** below list the impacts associated with the Green2 Route Option for Section 3.

There are no AH, BH or DL sites within the receiving environment of Section 3.

Table 7.6.6.84 Cultural Heritage - Green2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
CH 37	**Possible stone dump with boulders and trees (2006 EIS)**	**No**	**52m SW**	**Indirect**	**Slight negative**
CH 46	Burnt mound? (Geophysical survey 2005)	No	0m	Direct	Profound negative
CH 47	Two Burnt mounds? (Geophysical survey 2005)	No	0m	Direct	Significant negative
CH 142	Site of cashel	No	0m	Neutral	N/a

Table 7.6.6.85 Townland boundaries – Green2 Route Option

ID No.:	Classification:	Statutory Protection:	Dist. from route:	Impact type:	Impact level:
TB 28	**Townland boundary**	**No**	**0m**	**Direct**	**Moderate negative**
TB 29	Townland boundary	No	0m	Direct	Moderate negative

There are no AAPs within the receiving environment of Section 3.

7.6.6.6 Assessment Summary

Table 7.6.6.86 summaries the impacts for each of the route options.

Table 7.6.6.86 Summary of impacts

Impact Level	Red2 Route Option	Orange2 Route Option	Yellow2 Route Option	Blue2 Route Option	Pink2 Route Option	Green2 Route Option
Profound Negative	AH 59 (Church, graveyard, ecclesiasti-cal enclosure) AH 61 (18/19th C house)	CH 58 (V[22]. buildings)	AH 40 (DLF) CH 123 (Possible enclosure) CH 22 (Poss. Prehistoric tomb)	AH 40 (DLF) CH 123 (Possible enclosure)		AH 8 (DLF[23]) BH 9 (Cottage) CH 36 (Ballintemple) CH 46 (Burnt mound)
Significant Negative	AH 58 (Enclosure) BH 35 (College) CH 93 (V. buildings) CH 5 (V. buildings) CH 100 (V. building site) AAP 9 (River Corrib) AAP 12 (Terryland River)	CH 93 (V. buildings) CH 61 (V. buildings site) CH 65 (V. buildings) CH 102 (V. buildings site) CH 104 (V. buildings site) CH 105 (V. buildings site) CH 109 (V. buildings, derelict)	AH 36 (Bullaun stone) DL 10 (Menlo Castle demesne) CH 58 (V. buildings) CH 61 (V. building site) CH 62 (V. building) CH 65 (V. buildings) CH 109 (V. buildings) CH 40 (Dangan Ho.)	AH 36 (Bullaun stone) BH 73 (House) CH 91 (V. building) CH 57 (Cloghscoltia) CH 58 (V. buildings) CH 61 (V. building site) CH 62 (V. building) CH 65 (V. buildings) CH 109 (V. buildings)	AH 36 (Bullaun stone) BH 73 (House) CH 91 (V. building) CH 95 (V. settlement) CH 58 (V. buildings) CH 61 (V. building site) CH 62 (V. building) CH 65 (V. buildings) CH 109 (V. buildings)	AH 117 (Settlement cluster) DL 6 (Bushypark Ho. Demesne) DL 10 (Menlo Castle demesne) DL 5 (Glenlo Abbey demesne) CH 51 (V. building) CH 54 (Sheep fold)

[22] Vernacular
[23] Designed Landscape Feature

Impact Level	Red2 Route Option	Orange2 Route Option	Yellow2 Route Option	Blue2 Route Option	Pink2 Route Option	Green2 Route Option
		CH 111 (Post Med. settlement etc) CH 100 (V. buildings site) AAP 12 (Terryland River)	CH 100 (V. building site) CH 132 (Ballinfoyle) CH 139 (Poss. mass path) AAP 9 (River Corrib) AAP 12 (Terryland River) AAP 16 (Former wetland)	CH 122 (V. building site) CH 40 (Dangan Ho.) CH 24 (Small boulder) CH 124 (V. building site) CH 125 (Castlegar) CH 127 (V. building site) CH 100 (V. building site) DL 10 (Menlo Castle demesne) AAP 9 (River Corrib)	CH 40 (Dangan Ho.) CH 24 (Small boulder) CH 124 (V. building site) CH 125 (Castlegar) CH 127 (V. building site) CH 100 (V. building site) CH 123 (Possible enclosure) CH 135 (Mass Rock?) DL 10 (Menlo Castle demesne) AAP 9 (River Corrib)	CH 55 (V. farm) CH 58 (V buildings) CH 61 (V. buildings site) CH 65 (V. buildings) CH 68 (V. buildings site) CH 70 (V. buildings site) CH 72 (Tonabrocky) CH 137 (Poss. mass rock) CH 74 (V. buildings site) CH 75 (V. buildings site) CH 141 (Menlo settlement) CH 77 (V. buildings) CH 79 (Sheep fold site) CH 81 (V. buildings) CH 49 (Burnt mound & ditches) CH 88 (V. buildings site) CH 47 (Two burnt mounds)

Impact Level	Red2 Route Option	Orange2 Route Option	Yellow2 Route Option	Blue2 Route Option	Pink2 Route Option	Green2 Route Option
						AAP 5 (Lough Nacreeva) AAP 7 (Lough Nabrocky) AAP 8 (Loughaunna-fraska) AAP 9 (River Corrib)
Moderate Negative	AH 64 (DLF) AH 56/ BH 16 (Rahoon Ho.) AH 60 (Church) AH 48 (Quarry) BH 19 (Mill race) DL 1 (Eagle Lodge demesne) CH 94 (V. buildings) CH 98 (V. buildings) CH 101 (Coolagh) AAP 3 (Stream) AAP 11 (Stream) AAP 13 (Stream) 8 townland boundaries	AH 48 (Quarry) BH 11 (Cottage) BH 69 (Farm yard) DL 1 (Eagle Lodge demesne) CH 94 (V. buildings) CH 98 (V. buildings) CH 4 (Possible encl.) CH 5 (V. buildings) CH 62 (V. buildings) CH 64 (V. buildings) CH 107 (V. buildings) CH 110 (V. buildings) CH 112 (V. building) CH 101 (Coolagh) AAP 3 (Stream)	AH 41/ BH 13 (Summer house) BH 11 (Cottage) DL 8 (Dangan Cottage & additional demesnes) CH 1 (Enclosure) CH 53 (V. buildings) CH 99 (V. buildings) CH 4 (Possible encl.) CH 5 (V. buildings) CH 64 (V. buildings) CH 133 (V. building) CH 106 (Leitriff Ho.) CH 107 (V. building) CH 41 (Dangan Cottage site)	AH 41/ BH 13 (Summer house) BH 11 (Cottage) BH 30 (Cottage) DL 8 (Dangan Cottage & additional demesnes) CH 115 (V. building) CH 95 (V. settlement) CH 64 (V. buildings) CH 133 (V. building) CH 106 (Leitriff Ho.) CH 107 (V. building) CH 41 (Dangan Cottage site) CH 134 (Poss. famine path)	AH 41/ BH 13 (Summer house) BH 11 (Cottage) DL 8 (Dangan Cottage & additional demesnes) CH 115 (V. building) CH 98 (V. building) CH 4 (Possible encl.) CH 5 (V. buildings) CH 64 (V. buildings) CH 133 (V. building) CH 106 (Leitriff Ho.) CH 107 (V. building) CH 41 (Dangan Cottage site) CH 134 (Poss. famine path)	AH 6 (Burial ground) AH 7 (DLF) AH 9/ BH 3 (Gate House) AH 161 (Ringfort) AH 116 (Pillar Stone) AH 12/ BH 36) Castle AH 163 (Castle, 17th C house) BH 11 (Cottage) BH 5 (Bushypark Ho.) BH 31 (x3 Menlo houses) CH 1 (Encl.**) CH 57 (Cloghscoltia) CH 62 (V. buildings) CH 69 (V. buildings) CH 14 (Railway)

Impact Level	Red2 Route Option	Orange2 Route Option	Yellow2 Route Option	Blue2 Route Option	Pink2 Route Option	Green2 Route Option
		AAP 13 (Stream) AAP 4 (Stream) 19 townland boundaries	CH 14 (Railway) CH 101 (Coolagh) CH 135 (Mass Rock?) AAP 2 (Stream) AAP 3 (Stream) AAP 13 (Stream) AAP 4 (Stream) 27 townland bouns	CH 14 (Railway) CH 22 (Poss. Prehistoric tomb) CH 23 (Circular feature) CH 126 (V. buildings) CH 101 (Coolagh) CH 135 (Mass Rock?) AAP 14 (Stream) AAP 15 (Stream) AAP 4 (Stream) AAP 3 (Stream) 26 townland boundaries	CH 14 (Railway) CH 22 (Poss. Prehistoric tomb) CH 23 (Circular feature) CH 126 (V. buildings) AAP 14 (Stream) AAP 15 (Stream) AAP 3 (Stream) AAP 13 (Stream) AAP 4 (Stream) 27 townland boundaries	CH 18 (x3 possible features) CH 76 (Lime kiln site) CH 28 (Possible fulacht fiadh) CH 29 (Possible ringfort) CH 31 (V. buildings) CH 87 (V. buildings) CH 80 (V. buildings) CH 82 (Ballindooley) CH 83 (V. buildings) CH 84 (V. buildings) CH 85 (V. buildings) CH 90 (V. buildings) AAP 1 (Stream) AAP 2 (Stream) AAP 3 (Stream) AAP 4 (Stream) AAP 6 (Stream) 29 townland boundaries
Slight Negative	AH 57 (Holy well) AH 50 (Quarry)	AH 50 (Quarry) BH 4 (Church)	AH 44/ BH 14 (Ringfort)	AH 146 (Children's burial ground) AH 27 (Ringfort)	AH 11 /BH 2) Menlo Castle AH 40 (DLF)	AH 160 (Hut site) AH 159 (Encl.)

Impact Level	Red2 Route Option	Orange2 Route Option	Yellow2 Route Option	Blue2 Route Option	Pink2 Route Option	Green2 Route Option
	BH 17 (Entrance) BH 18 (Summerdale Ho.) CH 91 (V. buildings) CH 92 (V. buildings) CH 95 (V. settlement) CH 96 (V. building) CH 97 (V. building) CH 99 (V. building) CH 57 (Cloghscoltia) CH 4 (Possible encl.) CH 138 Two staddle stone circles)	CH 91 (V. buildings) CH 92 (V. buildings) CH 95 (V. settlement) CH 96 (V. building) CH 97 (V. building) CH 99 (V. building) CH 57 (Cloghscoltia) CH 59 (V. buildings) CH 60 (V. buildings) CH 63 (V. buildings) CH 66 (V. building) CH 135 (Mass Rock?)	AH 11 /BH 2) Menlo Castle BH 12 (Cottage) BH 30 (Cottage) CH 51 (V. buildings) CH 136 (V. buildings) CH 129 (V. buildings) CH 130 (V. building) CH 55 (V. farm) CH 59 (V. buildings) CH 60 (V. buildings) CH 63 (V. building) CH 66 (V. building) CH 103 (V. farm) CH 105 (V. building site) CH 118 (V. building site) CH 121 (V. building) CH 122 (V. building site) CH 42 (Mary Ville) CH 21 (V. animal shelter)	AH 11 /BH 2) Menlo Castle AH 44/ BH 14 (Ringfort) DL 5 (Glenlo Abbey demesne) DL 3 (River View house demesne) CH 113 (V. building) CH 56 (V. buildings) CH 116 (V. building) CH 59 (V. buildings) CH 60 (V. buildings) CH 63 (V. building) CH 66 (V. building) CH 103 (V. farm) CH 121 (V. building) CH 42 (Mary Ville) CH 21 (V. animal shelter) CH 128 (V. building)	AH 152/ BH 74 (Cashel etc) AH 34 (18^{th}/19^{th} C house) BH 30 (Cottage) CH 113 (V. building) CH 99 (V. building) CH 66 (V. building) CH 103 (V. farm) CH 105 (V. building site) CH 118 (V. building site) CH 121 (V. building) CH 122 (V. building site) CH 21 (V. animal shelter) CH 128 (V. building)	AH 49/ BH 70 (Crannog) AH 151 (Stone group) AH 152/ BH 74 (Ringfort etc) BH 10 (Cottage) CH 53 (V. buildings) CH 136 (V. buildings) CH 59 (V. buildings) CH 60 (V. buildings) CH 63 (V. buildings) CH 64 (V. buildings) CH 66 (V. building) CH 71 (V. buildings) CH 73 (V. buildings) CH 17 (Med. field system) CH 19 (V. building) CH 78 (V. buildings) CH 80 (V. building) CH 27 (x7 possible features) CH 30 (Rect. feature) CH 86 (V. buildings) CH 89 (Ballygarraun)

Impact Level	Red2 Route Option	Orange2 Route Option	Yellow2 Route Option	Blue2 Route Option	Pink2 Route Option	Green2 Route Option
			CH 23 (Circular feature)			CH 34 (x6 possible features) CH 37 (Stone dump trees) AAP 10 (Lough)
Imperceptible Negative	DL 2 (Bearna Ho. Demesne) CH 60 (V. buildings) CH 138 Two staddle stone circles)	AH 36 (Bullaun stone) BH 12 (Cottage) CH 68 (V. buildings site) CH 103 (V. farm) CH 106 (Leitriff Ho.) CH 108 (V. building) CH 120 (V. building) CH 138 Two staddle stone circles)	AH 65/ BH 1 (Glenlo Abbey) BH 8 (Gate pillars) BH 37 (NUIG Campus) DL 5 (Glenlo Abbey demesne) DL 3 (River View Ho. Demesne) CH 52 (V. building) CH 131 (V. building) CH 54 (Sheep fold site) CH 56 (V. buildings) CH 68 (V. building site) CH 104 (V. building site) CH 119 (V. buildings)	AH 66 (Cashel) AH 65/ BH 1 (Glenlo Abbey) AH 20 (Quarry) AH 74/ BH 72 (Tower house) BH 12 (Cottage) BH 8 (Gate pillars) CH 114 (V. settlement) CH 92 (V. buildings) CH 94 (V. building) CH 98 (V. building) CH 117 (V. buildings) CH 117 (V. buildings) CH 68 (V. building site) CH 104 (V. building site) CH 119 (V. buildings)	AH 66 (Cashel) AH 65/ BH 1 (Glenlo Abbey) AH 20 (Quarry) AH 74/ BH 72 (Tower house) AH 146 (Children's burial ground) AH 147 (Quarry) BH 12 (Cottage) BH 8 (Gate pillars) DL 5 (Glenlo Abbey demesne) DL 3 (River View Ho. Demesne) CH 114 (V. settlement) CH 92 (V. buildings) CH 94 (V. building)	AH 20 (Quarry) CH 140 (Poss. famine bridge) CH 52 (V. building) CH 56 (V. Buildings) CH 67 (V. buildings) CH 35 (Raised circular area)

Impact Level	Red2 Route Option	Orange2 Route Option	Yellow2 Route Option	Blue2 Route Option	Pink2 Route Option	Green2 Route Option
			CH 108 (V. building) CH 120 (V. building) CH 24 (Small boulder) CH 138 Two staddle stone circles)	CH 108 (V. building) CH 120 (V. building) CH 138 Two staddle stone circles)	CH 68 (V. building site) CH 104 (V. building site) CH 119 (V. buildings) CH 108 (V. building) CH 120 (V. building)	
Neutral	AH 35 (*fulacht fiadh*) AH 55 (Ringfort) AH 62/ BH 20 (Castle) AH 109 (Dovecote) AH 63 (Fort) AH 51 (Quarry) AH 30 (Quarry) AH 33 (DLF) AH 32 (Earthwork) AH 25/ BH 6 (Tower house AH 24 (DMS) AH 26 (Encl.) AH 27 (Ringfort & house) BH 33 (N0. 49) BH 34 (Former College)	AH 51 (Quarry) AH 30 (Quarry) AH 33 (DLF) AH 32 (Earthwork) AH 25/ BH 6 (Tower house AH 24 (DMS) AH 26 (Encl.) AH 27 (Ringfort & house) BH 5 (Bushypark House) DL 6 (Bushypark House demesne) DL 7 (Lake View House demesne)	AH 42 (Barrow) AH 51 (Quarry) AH 30 (Quarry) AH 32 (Earthwork) AH 33 (DLF) AH 25/ BH 6 (Tower house) AH 24 (DMS) AH 26 (Encl.) AH 27 (Ringfort & house) DL 21 (Merview House demesne) DL 25 (Ballybrit House demesne) CH 142 (Site of cashel)	AH 68 (Church) AH 67 (Field system) AH 42 (Barrow) AH 32 (Earthwork) AH 33 (DLF) AH 24 (DMS) AH 25/ BH 6 (Tower house) AH 26 (Enclosure) AH 39 (DLF) DL 1 (Eagle Lodge demesne) DL 25 (Ballybrit House demesne) CH 142 (Site of cashel)	AH 68 (Church) AH 67 (Field system) AH 151 (Stone group) AH 32 (Earthwork) AH 33 (DLF) AH 24 (Deserted settlement) DL 1 (Eagle Lodge demesne) CH 142 (Site of cashel) TB 51, 25	CH 142 (Site of cashel)

Impact Level	Red2 Route Option	Orange2 Route Option	Yellow2 Route Option	Blue2 Route Option	Pink2 Route Option	Green2 Route Option
	BH 21 (Waterworks) DL 16 (Kingston Ho. Demesne) DL 15 (Rahoon Ho. Demesne) DL 33 (Vicar Croft/ St. Helen's demesne) DL 34 (Taylor's Hill demesne) DL 28 (Shantallow Ho. Demesne) DL 26 (Newcastle Ho. Demesne) DL 12 (Rock Lodge demesne) DL 11 (Newcastle Cottage demesne) DL 21 (Merview House demesne) DL 25 (Ballybrit House demesne) CH 14 (Railway) CH 142 (Site of cashel) TB 33-38, 40, 62	DL 21 (Merview House demesne) DL 25 (Ballybrit House demesne) CH 39 (Lake View Ho.) CH 142 (Site of cashel) TB 40	TB 40, 62	TB 51		

Impact Level	Red2 Route Option	Orange2 Route Option	Yellow2 Route Option	Blue2 Route Option	Pink2 Route Option	Green2 Route Option
Positive				AH 69 (Settlement cluster – slight)	AH 69 (Settlement cluster – slight)	N/a
No impact			DL 9 (Ashley Park demesne)	AH 18 (Enclosure) AH 19 (Ringfort) AH 147 (Quarry) DL 9 (Ashley Park demesne) CH 25 (Possible cairn)	AH 18 (Enclosure) AH 19 (Ringfort) AH 28 (Fulachta fiadh) DL 9 (Ashley Park demesne) CH 25 (Possible cairn)	N/a

Route Selection Preference

The Archaeology, Architectural and Cultural Heritage ranking of the route options is presented in **Table 7.6.6.87** below.

Table 7.6.6.87 Summary of Archaeology, Architectural and Cultural Heritage rankings of Route Options

Route Option	Section 1	Section 2	Section 3
Red2	P	LP	P
Orange2	P	P	P
Yellow2	I	I	P
Blue2	I	I	P
Pink2	I	I	LP
Green2	I	LP	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred

The Red2 and Orange2 Route Options are preferred for Section 1 with the remaining four options all ranked as intermediate. The order of preference for Section 2 is outlined below.

Least Preferred (Green2 and Red2 Route Options):
The least preferred route options for Section 2 are considered to be the Green2 and Red2 Route Options. Whilst they are the least preferred, they possess very different characteristics.

The Red2, Orange2, Yellow2 and Blue2 Rotue Options are preferred for Section 3 with the remaining two options all ranked as least preferred.

Green2 Route Option

The Green2 Route Option is the longest of all the route options and would result in the highest amount of direct impacts on both the recorded and previously unrecorded archaeological, architectural and cultural heritage resource. One recorded archaeological heritage site would be profoundly impacted upon, which consists of a designed landscape feature (AH 8). This is likely to be post medieval in date, but may represent an earlier circular enclosure that was utilised in the later post medieval demesne associated with Menlo Castle. In addition, a protected structure in the form of a vernacular cottage (BH 9), would also be profoundly impacted upon by this route option. The building is located in Menlough Village. The Green2 Route Option would also have a profound impact on the post medieval vernacular settlement at Ballintemple (CH 36) along with a possible burnt mound identified during previous geophysical survey work (CH 46).

This route option would also have a significant direct impact on a large number of sites. These include the village of Menlough (AH 117) and three demesne landscapes. These are associated with Bushypark House (DL 6), Menlo Castle (DL

10) and Glenlo Abbey (DL 5). It should be noted that both Menlo Castle and Bushypark House are protected structures. It can therefore be assumed that the curtilage of the structures is formed by the demesne landscape.
A further 17 Cultural Heritage sites would be significantly impacted upon by the Green2 Route Option. These consist of a mixture of vernacular structures (extant, derelict, ruined or the sites of) and potential archaeological features identified during the geophysical survey that was carried out in association with the 2006 GCOB scheme. Four areas of archaeological potential (AAPs) would also be significantly impacted upon. These consist of three former loughs or bodies of water along with the River Corrib and its margins. A further five AAPs and 29 townland boundaries will be directly impacted upon by this route option but the impact level has been defined as moderate.

A large number of potential indirect impacts have been identified as a result of the Green2 Route Option assessment. A total of 25 recorded and previously unrecorded sites will be slightly negatively impacted upon, whilst five will be subject to a potential imperceptible negative impact. No neutral or positive impacts were identified associated with the Green2 Route Option during the assessment.

Red2 Route Option

The Red2 Route Option consists, for the most part, of an on-line option through the northern environs of Galway City. Although it is travelling through an area that has, for the most part, been subject to development, it does possess some large scale impacts on the archaeological resource. This route option would profoundly impact upon a recorded church site, graveyard and ecclesiastical enclosure (AH 59) within the former demesne of Rahoon House. In addition, the site of a 18th or 19th century house would also be profoundly impacted upon adjacent to the River Corrib (AH 61). This route option would significantly impact upon a recorded enclosure site (AH 58) and a college building (BH 35). Three other significant impacts have been identified upon Cultural Heritage sites – all of which are represented by vernacular structures. Two areas of potential would also be impacted on, which are represented by the River Corrib and the Terryland River. A further three AAPs and eight townland boundaries will be directly impacted upon by the Red2 Route Option but the impact level has been defined as moderate.

A total of 23 indirect impacts have been identified during the assessment of the Red2 Route Option. Of these, nine are deemed to be moderate, 12 slight and three imperceptible. Due to the fact that the Red2 Route Option is for the most part on-line, there are a large amount of sites where the result of its construction would not affect the receiving environment, resulting in a neutral effect on a total of 27 recorded and previously unrecorded sites of archaeological, architectural and cultural heritage significance.

Fourth Preference (Blue2 Route Option)

The Blue2 Route Option represents the fourth preference for Section 2 and whilst similar in form to the Pink2 Route Option, does possess a greater number of direct impacts upon the recorded and previously unrecorded archaeological, architectural

and cultural heritage resource. This route option will have a profound negative impact on a designed landscape feature (AH 40) at Dangan Lower, as well as resulting in a profound impact on the site of a potential enclosure at Menlough (CH 123).

A number of direct significant impacts have also been identified, including the recorded site of a bullaun stone (AH 36) and 14 other previously unrecorded cultural heritage sites. These mostly consist of vernacular structures, either extant, in ruin or the sites of. This route option will also have a significant impact on the demesne associated with Menlo Castle (DH 10) and the River Corrib and its environs (AAP 9). A significant indirect impact has been identified as part of this assessment on BH 73, which is a protected structure located in Castlegar. The building, which consists of a thatched cottage, is located to the immediate north of a proposed link road into Castlegar.

A further four AAPs (streams), 26 townland boundaries and one demesne will be directly impacted upon by the Blue2 Route Option but the impact level has been defined as moderate.

A large number of potential indirect impacts have been identified as a result of the Blue2 Route Option assessment. A total of 14 recorded and previously unrecorded sites will be moderately negatively impacted upon, whilst 18 will be subject to a potential slight negative impact. A total of 17 will be subject to an imperceptible negative impact and at 11 sites the impact is defined as neutral. No impact is predicted as a result of this route option on a further five sites and one slightly positive impact has been identified. This consist of the positive impact on the settlement at Bearna as a result of the removal of through traffic (AH 69).

Third Preference (Pink2 Route Option)

The Pink2 route is very similar to the Blue2 Route Option, but does have less of an impact of the archaeological, architectural and cultural heritage resource. This route option will not have any profound impacts upon the cultural heritage resource.

A number of direct significant impacts have been identified though, including the recorded site of a bullaun stone (AH 36) and 15 other previously unrecorded cultural heritage sites (rather than the 14 associated with the Blue2 Route Option). These mostly consist of vernacular structures, either extant, in ruin or the sites of. CH 123 does consist of a possible enclosure site identified during aerial photographic analysis. This route option will also have a significant impact on the demesne associated with Menlo Castle (DH 10) and the River Corrib and its environs (AAP 9). A significant indirect impact has been identified as part of this assessment on BH 73, which is a protected structure located in Castlegar. The building, which consists of a thatched cottage, is located to the immediate north of a proposed link road into Castlegar.

A further five AAPs (streams), 27 townland boundaries and one demesne will be directly impacted upon by the route option but the impact level has been defined as moderate.

A large number of potential indirect impacts have been identified as a result of the Pink2 Route Option assessment. A total of 17 recorded and previously unrecorded sites will be moderately negatively impacted upon, whilst 15 will be subject to a potential slight negative impact. A total of 18 will be subject to an imperceptible negative impact and at ten sites the impact is defined as neutral. No impact is predicted as a result of this route option on a further five sites and one slightly positive impact has been identified. This consist of the positive impact on the settlement at Bearna as a result of the removal of through traffic (AH 69).

Second Preference (Yellow2 Route Option)

A number of direct impacts have been identified along the Yellow2 Route Option; however, it possess the fewest direct impacts upon the recorded archaeological and built heritage resource, with the exception of the Orange2 Route Option. This route option will have a profound negative impact on a designed landscape feature (AH 40) at Dangan Lower, as well as resulting in a profound impact on the site of a potential enclosure at Menlough (CH 123).

A number of direct significant impacts have also been identified, including the recorded site of a bullaun stone (AH 36) and eight other previously unrecorded cultural heritage sites. These mostly consist of vernacular structures, either extant, in ruin or the sites of. This route option will also have a significant impact on the demesne associated with Menlo Castle (DH 10), the River Corrib and its environs (AAP 9), the Terryland River and its environs (AAP 12) and an area of former wetland (AAP 16). A further four AAPs (streams), 27 townland boundaries and one demesne will be directly impacted upon by this route option but the impact level has been defined as moderate.

A number of potential indirect impacts have been identified as a result of the Yellow2 Route Option assessment. A total of 13 recorded and previously unrecorded sites will be moderately negatively impacted upon, whilst 20 will be subject to a potential slight negative impact. A total of 14 will be subject to an imperceptible negative impact and at 11 sites the impact is defined as neutral. No impact is predicted as a result of this route option on one further site. No positive impacts have been identified as part of the route option assessment.

Preferred Option (Orange2 Route Option)

The Orange2 Route Option is the preferred route option from an archaeological, architectural and cultural heritage perspective. No profound direct impact upon the archaeological or built heritage resource have been identified. Of the ten direct significant impacts identified, all of the sites consist of vernacular structures, none of which are subject to statutory protection and some of which are already in ruins or derelict. This route option will also have a significant impact on the Terryland River and its environs (AAP 12). No impact on the River Corrib has been identified as this route option will pass beneath the river via a tunnel. In addition, no impact in anticipated on the landscape surrounding Menlo Castle, as this route option will be underground. A further three AAPs (streams), 19 townland boundaries and one

demesne will be directly impacted upon by this route option but the impact level has been defined as moderate.

A number of potential indirect impacts have been identified as a result of the Orange2 Route Option assessment. A total of 13 recorded and previously unrecorded sites will be moderately negatively impacted upon, whilst 13 will be subject to a potential slight negative impact. A total of seven will be subject to an imperceptible negative impact and at 14 sites the impact is defined as neutral.

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7.6.7 Material Assets – Agriculture

7.6.7.1 Introduction

This section details the Stage 2 assessment of the route options with respect to the agricultural constraints identified in **Section 4.12 Material Assets - Agriculture** of this report. The route options as described in **Section 7.1** with the agricultural constraints are presented in **Figure 7.6.7.1** and **7.6.7.2**. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options.

Section 7.6.7.2 outlines the methodology that was used to carry out the study and **Section 7.6.7.3** details the options assessment. A summary is presented in **Section 7.6.7.4** and references are listed in **Section 7.6.7.5.**

The constraints study identified three main agricultural constraints:

Good quality agricultural land;

Farm yards[24]; and

Equine Enterprises.

Each of the route options was assessed for potential impacts on agricultural land (including good agricultural land) farm yards and equine enterprises. The route options are assessed in three sections. Section 1 is from the R336 to Galway City boundary, Section 2 is from the Galway City boundary to the N6 and Section 3 is the N6 Junction at Coolagh. The assessment is mindful that these route options could be realigned within their corridors and therefore the overall impact of the route corridor is also assessed to identify possible impacts within 150m of the route options.

7.6.7.2 Methodology

The impact on agricultural land is assessed by:

- Measuring the area of agricultural land within the footprint of the route option. The agricultural land includes grass land, rough grazing and cut over bog. This land is mapped using aerial photography;
- Measuring the area of good agricultural land within the footprint of the route option. Good agricultural land is good quality grass land. It is mapped using aerial photography, visual assessment from road side surveys and referring to EPA mapping data;
- Measuring area of land registry land parcels which consist of mainly agricultural land. The land registry land parcels are landownership boundary parcels provided from the Property Registration Authority of Ireland database. This information only provides an indication of landownership and farming practices, for example, several land parcels may be part of the same farm;
- Counting the number of farm yards and agricultural structures within the footprint of each route option and counting the number of high sensitive farm

[24] Included in the "Farm yards" category are yards without sheds e.g. silage pits, single sheds, cattle holding pens and accommodation roads.

yards (i.e. equine farms). These are mapped using aerial photography and visual assessment from roadside surveys.

7.6.7.3 Option Assessment

Section 1

Table 7.6.7.1 below identifies the potential agricultural impacts for Section 1 of the Route Selection Stage 2 assessment. Land area is in hectares (HA).

Table 7.6.7.1 Potential Agricultural Impacts in Section 1

Route Option	Agricultural land (HA)	Good quality agricultural land (HA)	Area of land parcels (HA)	No of farm yards / farm structures	No of Equine enterprises	Order of Preference
Red2	9.5	0	76	0	0	P
Orange2	9.5	0	76	0	0	P
Yellow2	14	0	169	0	0	I
Blue2	12	0	94	1	0	I
Pink2	12	0	116	1	0	I
Green2	16.5	0	105	1	0	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

- The Red2 and Orange2 Route Options are preferred. They have the lowest area of agricultural land (9.5 HA) and potentially affect the lowest number and area of agricultural land parcels (76HA). The Red2 and Orange2 Route Options do not affect farm yards/farm structures or equine enterprises;
- The Yellow2, Blue2, Pink2 and Green2 Route Options are second preference. The Blue2 and Pink2 Route Options have the second lowest area of agricultural land (12HA) and affect one farm yard/farm structure (along with Green2 Route Option;
- The Yellow2 Route Option has the second highest area of agricultural land (14HA). It potentially affects the highest area of agricultural land parcels (169HA) and does not affect farm yards/farm structures. No equine enterprises will be impacted by the Blue2, Pink2 and Yellow2 Route Options; and
- The Green2 Route Option has the highest area of agricultural land (16.5HA) and potentially affects the third highest area of agricultural land parcels (105HA). It affects one farm yard/farm structure (along with Pink2 and Blue2 Route Options). No equine enterprises will be impacted by the Green2 Route Option.

Section 2

Table 7.6.7.2 below identifies the potential agricultural impacts for Section 2 of the Route Selection Stage 2 assessment.

Table 7.6.7.2 Potential Agricultural Impacts in Section 2

Route Option	Agricultural land (HA)	Good quality agricultural land (HA)	Area of land parcels (HA)	No of farm yards / farm structures	No of Equine enterprises	Order of Preference
Red2	9	3	47	0	0	P
Orange2	44	6	214	9	0	I
Yellow2	51	8	273	7	0	I
Blue2	55	18	332	10	0	LP
Pink2	55	14.5	316	8	0	LP
Green2	66	28	428	5	1	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred

- The Red2 Route Option is preferred. It has the lowest area of agricultural land (9HA) and potentially affects the lowest area of agricultural land parcels (47HA). No farm yards/farm structures or equine enterprises will be impacted;
- The Orange2 Route Option has the second lowest area of agricultural land (44HA), and potentially affects the second lowest area of agricultural land parcels (214HA). It affects the second highest number of farm yards / farm structures (total 9) and no equine enterprises. Overall it has a similar ranking score to the Yellow2 Route Option but due to the lower area of agricultural land it is second preference;
- The Yellow2Route Option is third preference. It has the third lowest area of agricultural land (51HA) (marginally lower than Pink2 and blue2 Route Options), and potentially affects the third highest area of agricultural land parcels (273HA). It affects the third lowest number of farm yards/farm structures (total 7 - after the Red2 and Green2 Route Option) and no equine enterprises;
- The Pink2 and Blue2 Route Options have the second highest areas of agricultural land (55HA for each route option) and potentially affect the second highest area of agricultural land parcels (316 & 332HA respectively). The Pink2 Route Option affects the third highest number of farm yards/farm structures (total 8). The Blue2 Route Option affects the highest number of farm yards/farm structures (total 10). The Pink2 and Blue2 Route Options do not affect equine enterprises; and
- The Green2 Route Option is least preferred. It has the highest area of agricultural land (66HA) and potentially affects the highest area of agricultural land parcels (428HA). It affects the second lowest number of farm yards/farm structures, however it affects one significant equine enterprise.

Section 3

Table 7.6.7.3 below identifies the potential agricultural impacts for Section 3 of the Route Selection Stage 2 assessment.

Table 7.6.7.3 Potential Agricultural Impacts in Section 3

Route Option	Agricultural land (HA)	Good quality agricultural land (HA)	Area of land parcels (HA)	No of farm yards / farm structures	No of Equine enterprises	Order of Preference
Red2	15.5	11.5	59	1	0	P
Orange2	15.5	11.5	59	1	0	P
Yellow2	15.5	11.5	59	1	0	P
Blue2	21.5	20	80	1	0	LP
Pink2	17.5	25.5	147	1	0	LP
Green2	26	25	134	3	0	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred

- The Red2, Orange2 and Yellow2 Route Options are preferred. They have the lowest area of agricultural land (15.5HA) and potentially affect the lowest area of agricultural land parcels (59HA). They affect the lowest number of farm yards/farm structures (along with the Blue2 Route and Pink2 Options);
- The Pink2 Route Option is second preference. Although it potentially affects the highest area of agricultural land parcels (147HA) it has the second lowest area of agricultural land (17.5HA). It affects the lowest number of farm yards/farm structures (along with Red2, Orange2, Yellow2 and Blue2 Route Options);
- The Blue2 Route Option has the second highest area of agricultural land (21.5HA), and potentially affects the second lowest area of agricultural land parcels (80HA). It affects the lowest number of farm yards/farm structures (along with Red2, Orange2, Yellow2 and Pink2 Route Options);
- The Green2 Route Option has the highest area of agricultural land (26HA) and potentially affects the second highest area of agricultural land parcels (134HA). It affects the highest number of farm yards/farm structures; and
- No equine enterprises are impacted but any of the route options.

7.6.7.5 Summary

The ranking preferences for the route options in Section 1, 2 and 3 are shown in **Table 7.6.7.4** below.

Table 7.6.7.4 Summary of Material Assets – Agricultural ranking of Route Options

Route Option	Section 1	Section 2	Section 3
Red2	P	P	P
Orange2	P	I	P
Yellow2	I	I	P
Blue2	I	LP	LP
Pink2	I	LP	LP
Green2	LP	LP	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred.

Within Section 1 Red2 and Orange2 Route Options are preferred. While the Green2 Route Option has the highest impact score it is acceptable along with the other route options because all route options are located on low sensitivity agricultural environment.

Within Section 2 the agricultural environment is low – medium sensitivity. The Red2 Route Option is preferred and while the Green2 Route Option has the highest negative impact, the Blue2, Pink2 and Green2 Route Options are least preferred.

Within Section 3 the agricultural environment is low – medium sensitivity. The Red2, Orange2 and Yellow2 Route Options are preferred and Green2 is least preferred.

7.6.7.6 References

None.

7.6.8 Material Assets – Non-Agriculture

7.6.8.1 Introduction

This section details the Stage 2 assessment of the route options with respect to the material assets non-agriculture constraints identified in **Section 4.13 Material Assets -Agriculture** of this report. The route options as described in **Section 7.1** with the material assets non-agriculture constraints are presented in **Figure 7.6.8.1** to **7.6.8.10**. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options.

Section 7.6.8.2 outlines the methodology that was used to carry out the study and **Section 7.6.8.3** details the options assessment. A summary is presented in **Section 7.6.8.4** and references are listed in **Section 7.6.8.5**.

7.6.8.2 Methodology

The assessment material assets non-agricultural is based on the constraints identified in **Section 4.12.**

For Stage 2 assessment, the route options are assessed in three sections. The location of the breakline between Section 1 & Section 2 has been moved eastwards towards the Galway City boundary. Section 1 extends from the R336 to the Galway City boundary and Section 2 extends from the Galway City boundary to the existing N6 in the east of the city. An additional break down at the N6 tie-in at Coolagh has been incorporated in order to compare the junction layouts at the N6 tie-in for the Stage 2 assessment. This section is referred to as Section 3.

For this assessment two types of properties were examined:

- Residential properties; and
- Commercial and industrial properties.

The impact on the infrastructure of public and private utilities/service providers is also assessed.

Material assets non-agriculture excluding utilities and services assessment methodology

For the purposes of assessing direct impacts on properties, the footprint for each of the route options was considered to include all lands required to construct the proposed road. This included the design and a buffer of 5 m from the edge of the earthworks associated with the design apart from the following exception:

Along the Western Distributor Road from Cappagh Road to Bothar Stiofáin on the Red2 Route Option, there is an existing retaining wall, set back from the edge of the existing carriageway, in place. This existing wall was taken as the extents of the footprint of the Red2 Route Option at this location;

On the Red2 Route Option from where the design crosses the Rahoon Road to the River Corrib a 2m buffer from the back of verge for the proposed road was used for the extents of the footprint at this location;

For the proposed viaduct at Terryland associated with the Red2 Route Option a 2m buffer from the back of verge for the proposed road was used for the extents of the footprint at this location, however the footprint for the new junction and link roads at Terryland includes a 5m buffer; and

On the Red2 Route Option where the cutting begins to the eastern end of the Terryland viaduct along the route of the existing N6 to the Briarhill Junction a 2m buffer from the back of verge for the proposed road was used for the extents of the footprint at this location. This same 2m buffer was used for the sections of the Orange2 and Yellow2 Route Option which also re-use with existing N6 in this area.

Level of Impact

The impact of the route options on non-agricultural properties is assessed as per the assessment criteria described in **Section 6.5.8** for the Stage 1 assessment.

The assessment of the number of affected properties and a synopsis of the impacts are presented in **Section 7.6.8.3** below.

Utilities and services assessment methodology

This assessment has been carried out as per the methodology described in **Section 6.5.8** for the Stage 1 utlitilies and services assessment. The assessment of the number of conflicts for utilities and services, for each route option is presented in **Section 7.6.8.3** below. Option Assessment

Section 1 - Material assets non-agriculture excluding utilities and services

The assessment for the number of properties directly impacted for each route option in Section 1 is presented below in **Table 7.6.8.1**.

Table 7.6.8.1 Property Assessment - Section 1

Route Option	Residential Acquisitions	Residential Partial Landtake	Residential Properties within the corridor *	Order of Preference
Red2	14	4	10	LP
Orange2	14	4	9	LP
Yellow2	2	3	14	P
Blue2	6	40	28	I
Pink2	3	42	27	I
Green2	17	5	15	LP

**These are properties outside of the footprint of the route option but within close proximity and within the route option corridor.*

Note: P = Preferred, I = Intermediate, LP = Least Preferred

There are no direct impacts on commercial properties in Section 1. The high number of one-off rural housing along the Green2 Route Option means that this route option has the greatest number of significant impacts on residential properties with the full acquisition of 17 properties and is the least preferred route option. The Yellow2 and Pink2 Route Options have the lowest number of full acquisitions with 2 and 3 respectively. There is partial landtake from a large number of residential properties

on the Blue2 and Pink2 Route Option with 40 and 42 respectively. As such the Yellow2 Route Option is the preferred route option.

Section 1- Utilities and Services

The assessment for the number of conflicts with utilities and services for each route option within Section 1 is presented in **Table 7.6.8.2** below. These impacts range from crossing of the road footprint to diversions of kilometres of service ducts and pipelines. There are no conflicts with E-Net, Gas Networks Ireland (Bord Gáis), ESB HV underground, UPC, Galway City and County Council watermains, surface drainage, foul sewer or trunk sewers or SSE Airtricity and as such they are excluded from **Table 7.6.8.2** below. There are also no waste facility impacts in Section 1 for any of the route options.

Table 7.6.8.2 No. of Utilities and Services Conflicts - Section 1

Utility	Red2 Route Option	Orange2 Route Option	Yellow2 Route Option	Blue2 Route Option	Pink2 Route Option	Green2 Route Option
ESB HV OH	1	1	1	1	1	1
ESB MV OH	2	2	3	6	5	6
ESB MV/LV UG	1	1	0	3	3	0
Eircom	3	3	4	6	6	6
Total no. of conflicts	7	7	8	16	15	13
Order of Preference	P	P	I	LP	LP	I

The total number of utility impacts are quantified in the table above. These impacts range from crossing of the road footprint to diversions of kilometres of service ducts and pipelines. As all of the route options in Section 1 are in a rural setting the number of conflicts is low. The Red2 and Orange2 Route Options are the shortest and consequently have the least number of conflicts. The Blue2 and Pink2 Route Options come closest to Bearna Village and as such, have the highest number of conflicts and are the least preferred in terms of conflicts with utilities. ***Section 1 – Overview.***

In the overall ranking of the route options for Section 1 in terms of material assets non-agriculture the number of property acquisitions are taken more into consideration than conflicts with utlities as these utlities can be diverted as part of the works. **Table 7.6.8.3** below summarises the order of ranking for the route options in Section 1.

Table 7.6.8.3 Ranking of Route Options – Section 1

Route Option	Order of Preference
Red2	LP
Orange2	LP
Yellow2	P
Blue2	I
Pink2	I
Green2	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred

Section 2 - Material assets non-agriculture excluding utilities and services

The assessment for the number of properties directly impacted for each route option in Section 2 is presented below in **Table 7.6.8.4**.

Table 7.6.8.4 Property Assessment - Section 2

Route Option	Residential Acquisitions	Residential Partial Landtake	Residential Properties within the corridor*	Commercial Acquisitions	Commercial Partial Landtake	Commercial Properties within the corridor*	Planning Permissions	Order or Preference
Red2	73	12	26	19	11	0	2	LP
Orange2	32	14	22	9	10	0	1	P
Yellow2	97**	14	67	11	11	3	1	LP
Blue2	42	24	35	6	5	3	1	I
Pink2	42	17	42	6	2	12	0	P
Green2	54	26	57	10	8	5	1	I

**These are properties outside of the footprint of the route option but within close proximity and within the route option corridor.*
***An apartment block accounts for 37 residential acquisitions*

AS

The Yellow2 Route Option has the greatest number of acquisitions and is the least preferred route option as it has the greatest number of significant impacts. This route option will require the full acquisition of 97 residential properties, including an apartment building (37 residential untis), and 11 commercial properties. This route option also requires partial landtake from 14 residential and 11 commercial properties which are moderate impacts.

The Red2 Route Option has the second largest number of commercial and residential acquisitions and is also least preferred route option, again due to the significant impacts. A combined total of 92 properties would be acquired, 19 of which are commercial properties. This route option traverses the more urbanised area of Galway City and as a result has the largest direct impact on commercial properties. This route option also requires partial landtake from 12 residential and 11 commercial properties which are moderate impacts.

The Green2 Route Option will require the acquisition of 10 commercial properties and 54 residential properties. This is a total of 64 significant impacts. Additionally there are a significantly higher number of properties lying within the 150m wide corridor on the Green2 Route Option which could potential require landtake should the design be modified. This route option also requires partial landtake from 26 residential and 8 commercial properties, which are moderate impacts.

The numbers of acquisitions on the Blue2 Route Options is 6 commercial properties and 42 residential properties. This route option also requires partial landtake from 24 residential and 5 commercial properties.

The numbers of acquisitions on the Pink2 Route Options is 6 commercial properties and 42 residential properties and is the preferred route option. This is a total of 48 significant impacts. This route option also requires partial landtake from 17 residential and 2 commercial properties, which are moderate impacts.

Although the Orange2 Route Option travels through a densely residential area, the large tunnel section on this route option means that it would have a total 41 property acquisitions which are significant impacts, 32 of which are residential properties and 9 commercial properties. This route option also requires partial landtake from 14 residential and 10 commercial properties which are moderate impacts. It also ranks as a preferable option.

Section 2- Utilities and Services

The assessment for the number of conflicts with utilities and services for each route option within Section 2 is presented in **Table 7.6.8.5** below. These impacts range from crossing of the road footprint to diversions of kilometres of service ducts and pipelines.

Table 7.6.8.5 No. of Utilities and Services Conflicts - Section 2

Utility	Red2 Route Option	Orange2 Route Option	Yellow2 Route Option	Blue2 Route Option	Pink2 Route Option	Green2 Route Option
E-Net	10	3	4	3	3	3
ESB HV OH	4	7	13	12	10	6
ESB HV UG	6	5	5	2	1	1
ESB MV OH	2	8	14	15	15	16
ESB MV/LV UG	24	7	9	5	6	6
Eircom	38	18	28	19	21	18
Gas	14	3	3	1	1	2
UPC	29	4	9	2	3	1
Water - 300mm	4	4	4	2	2	2
Water - 450mm	4	1	0	0	0	0
Water - 500mm	1	1	1	1	1	1
Foul Pipes	1	1	2	2	2	1
Surface Drainage	3	0	1	1	2	1
Trunk Sewer	25	11	8	2	5	2
SSE	1	3	5	4	4	1
Waste facilities	1	0	0	0	0	0
Section 2 Total	167	76	106	71	76	61
Order of Preference	LP	I	LP	I	I	P

Note: P = Preferred, I = Intermediate, LP = Least Preferred

The Red2 Route Option is closest to the city centre and consequently has the highest number of utility conflicts. The sections of cut following the alignment of the existing roads, along the Red2 Route Option at Rahoon, Terryland, Ballybrit and Briarhill will have a high impacts on utilities with large scale diversions required. Some utility services run parallel to the Red2 Route Option. Along Seamus Quirke Road, Gas Networks Ireland (Bord Gáis), ESB and UPC services run within the footprint and parallel to the existing road. Similarly at Western Distributor Road and along the existing N6 from Ballybrit to the N17 Tuam Road, Eircom, ESB and Gas Networks Ireland services run parallel to the road. Eircom, E-Net, ESB and Gas Networks Ireland all run along the existing N6. There is also a large number of trunk sewer crossings on the Red2 Route Option, this is considered to be a major constraint. The Red2 Route Option impacts on a single waste facility in Section 2,

the bring bank facility which is located along Western Distributor Road and is within the footprint of the Red2 Route Option.

The Yellow2 Route Option has 106 utility conflicts; the major impacts on the Yellow2 Route Option will be the five crossings of the new 110kV SSE Airtricity line from Moycullen.

The tunnel section on the Orange2 Route Option would not have significant impact on utilities, at full depth, however there remains a high number crossing points when this route option merges with the existing N6 at Terryland.

The Blue2 and Pink2 Route Options have a similar number of conflicts with utilities.

The Green2 Route Option has the least number of conflicts with utilities as it is the most northern route option and the services are more dispersed. A summary of the rankings for Section 2 in terms of utilities is provided in **Table 7.6.8.7** below.

Section 2 - Overview

In the overall ranking of the route options for Section 2 in terms of material assets non-agriculture the number of property acquisitions are taken more into consideration than conflicts with utilities as these utilities can be diverted as part of the works. **Table 7.6.8.6** below summarises the order of ranking for the route options in Section 2.

Table 7.6.8.6 Ranking of Route Options – Section 2

Route Option	Order of Preference
Red2	LP
Orange2	P
Yellow2	LP
Blue2	I
Pink2	P
Green2	I

Section 3 - Material assets non-agriculture excluding utilities and services

The assessment for the number of properties directly impacted for each route option in Section 3 is presented below in **Table 7.6.8.7.**

Table 7.6.8.7 Property Assessment - Section 3

Route Option	Residential Acquisitions	Commercial Acquisitions	Commercial Partial Landtake	Commercial Properties within the corridor*	Total	Order of Preference
Red2	7	0	1	0	8	LP
Orange2	7	0	1	0	8	LP
Yellow2	7	0	1	0	8	LP
Blue2	6	0	0	1	7	I
Pink2	1	0	1	0	2	P
Green2	5	0	0	0	5	I

Section 3 - Utilities and Services

The assessment for the number of the utilities and services directly impacted for each route option in Section 3 is presented below in **Table 7.6.8.8.** There are no conflicts with Gas Networks Ireland (Bord Gáis), Galway City and County Council watermains, foul sewer or SSE Airtricity and as such they are excluded from **Table 7.6.8.9** below. There are also no waste facility impacts in Section 3 for any of the route options.

Table 7.6.8.8 Utilities Assessment - Section 3

Utility	Red2 Route Option	Orange2 Route Option	Yellow2 Route Option	Blue2 Route Option	Pink2 Route Option	Green2 Route Option
E-Net	2	2	2	0	1	1
ESB HV OH	3	3	3	3	6	0
ESB HV UG	1	1	1	3	0	0
ESB MV OH	0	0	0	0	0	3
ESB MV/LV UG	3	3	3	1	0	0
Eircom	2	2	2	0	1	2
UPC	2	2	2	1	0	0
Surface Drainage	1	1	1	1	0	0
Trunk Sewer	0	0	0	0	1	0
Total Number of Conflicts	14	14	14	9	9	6
Overall Ranking	LP	LP	LP	I	I	P

Note: P = Preferred, I = Intermediate, LP = Least Preferred

The total number of utility impacts are quantified in the table above. These impacts range from crossing of the road footprint to diversions of kilometres of service ducts and pipelines. As all of the route options in Section 3 are of a short length the number of conflicts is low. The Red2, Orange2 and Yellow2 Route Options are the online options at Section 3 and consequently have the greatest number of conflicts. The Blue2 and Pink2 Route Options are ranked as intermediate in terms of conflicts with utilities and services. The Green2 Route Option has the least number of conflicts with utilities and services than the other route options as it has a more rural setting. The Green2 Route Option is the preffered route option in terms of utilities and services in Section 3.

Section 3 - Overview

In the overall ranking of the route options for Section 3 in terms of material assets non-agriculture the number of property acquisitions are taken more into consideration than conflicts with utlities as these utlities can be diverted as part of the works. **Table 7.6.8.9** below summarises the order of ranking for the route options in Section 3.

Table 7.6.8.9 Ranking of Route Options – Section 3

Route Option	Order of Preference
Red2	LP
Orange2	LP
Yellow2	LP
Blue2	I
Pink2	P
Green2	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

7.6.8.3 Summary

The overall ranking preferences for the route options in Section 1 and 2, in terms of material assets non-agriculture are shown in **Table 7.6.8.10** below.

Table 7.6.8.10 Summary of rankings for Material Assets Non-agriculture

Route Option	Section 1	Section 2	Section 3
Red2	LP	LP	LP
Orange2	LP	P	LP
Yellow2	P	LP	LP
Blue2	I	I	I
Pink2	I	P	P
Green2	LP	I	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

7.6.8.4 References

None

7.6.9 Air Quality and Climate

7.6.9.1 Introduction

This section details the Stage 2 assessment of the route options with respect to the air quality and climate constraints identified in **Section 4.14 Air Quality and Climate** of this report. The route options as described in **Section 7.1** with the air quality and climate constraints are presented in **Figure 7.6.9.1** and **7.6.9.2**. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options.

Section 7.6.9.2 outlines the methodology that was used to carry out the study and **Section 7.6.9.3** details the options assessment. A summary is presented in **Section 7.6.9.4** and references are listed in **Section 7.6.9.5**.

7.6.9.2 Methodology

The air quality and climate Stage 2 assessment has been completed in accordance with the National Roads Authority (NRA) document *'Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes'*, 2011. In accordance with these NRA guidelines, the following are considered as part of a Stage 2 assessment:

- Changes to baseline air quality conditions since Stage 1;
- Calculation of the index for overall change in exposure;
- Calculation of local-scale pollutant concentrations; and
- Impacts on sensitive ecosystems.

7.6.9.3 Option Assessment

Changes to baseline air quality conditions since Stage 1

Table 4.14.2, in **Chapter 4** of this report, contains baseline data for Zone C, published by the EPA for the years 2011, 2012 and 2013. No more recent data has been published by the EPA and as a result no changes to the baseline assessment prepared for Stage 1 is required.

Calculation of the index for overall change in exposure

The calculation of the index for overall change in exposure considers the number of sensitive receptor locations within 50m of the carriageway of all road links that would experience a significant change in traffic for each of the route options. A significant change is defined to be an increase or decrease in traffic emissions of 10% or more. The assessment of the calculation of the index for overall change in exposure is completed using the UK DMRB spreadsheet for regional assessment.

The results of the index of overall change in exposure is provided in **Tables 7.6.91 to 7.6.9.6** below for each route option for nitrogen oxides and in **Tables 7.6.9.7 to 7.6.9.12** for particulate matter. Total values are provided for Section 1 (between the R336 and the assessment breakline) and Section 2 (between the assessment breakline and the existing N6 at Coolagh), refer to **Figure 7.6.9.1** and **7.6.9.2** for sensitive receptor locations and road links.

Table 7.6.9.1 Red2 Route Option NO_x index

Link location	Properties within 50m	Link length	NO_x (kg/yr)			% change in emissions	Change in NO_x emission rate (kg/km/yr)	NO_x index
			Do-min	Do-som	Change in emissions			
RL1	27	2.4	0	2,197	2,197	>+10	915	24,716
Total Section 1				***2,197***			***915***	***24,716***
RL2	307	1.9	5,291	7,989	2,698	>+10	1,420	435,940
RL3	214	1.55	2,288	5,438	3,150	>+10	2,032	434,903
RL4	176	1.31	2,004	6,492	4,488	>+10	3,426	602,968
RL5	264	1.36	0	2,182	2,182	>+10	1,604	423,565
RL6	15	1.08	0	6,174	6,174	>+10	5,717	85,750
RL7	36	1.53	6,293	14,376	8,083	>+10	5,283	190,188
RL8	49	0.53	2,738	3,801	1,063	>+10	2,006	98,277
RL9	119	1.86	0	16,356	16,356	>+10	8,794	1,046,432
RL10	36	1.58	2,066	10,121	8,055	>+10	5,098	183,532
Total Section 2			***20,680***	***72,929***			***35,380***	***3,501,555***
Total			**20,680**	**75,126**			**35,295**	**3,526,272**

Table 7.6.9.2 Orange2 Route Option NO_x index

Link name	Properties within 50m	Link length	NO_x (kg/yr)			% change in emissions	Change in NO_x emission rate (kg/km/yr)	NO_x index
			Do-min	Do-som	Change in emissions			
OL1	30	2.4	0	1,562	1,562		651	19,525
OL2	4	0.33	0	215	215	>+10	651	2,603
Total Section 1			***0***	***1,777***			***1,302***	***22,129***
OL3	20	3.2	0	4,658	4,658	>+10	1,706	58,012
OL4	4	0.54	0	1,345	1,345	>+10	2,491	9,963
OL5	12	1.35	0	1,435	1,435	>+10	1,063	12,754
OL6	386	3.84	0	17,320	17,320	>+10	4,511	1,741,068
OL7	47	1.32	0	12,122	12,122	>+10	9,183	431,609
OL8	49	0.53	0	3,783	3,783	>+10	7,137	349,707
OL9	129	1.85	0	15,797	15,797	>+10	8,539	1,101,492
OL10	36	1.58	0	9,250	9,250	>+10	5,855	210,765
Total Section 2				***65,710***			***40,484***	***3,915,372***
Overall total			**0**	**67,486**			**41,785**	**3,937,500**

Table 7.6.9.3 Yellow2 Route Option NO_x index

Link name	Properties within 50m	Link length	NO_x (kg/yr)			% change in emissions	Change in NO_x emission rate (kg/km/yr)	NO_x index
			Do-min	Do-som	Change in emissions			
YL1	37	4.27	0	5,464	5,464		1,280	47,346
Total Section 1			***0***	***5,464***			***1,280***	***47,346***
YL2	24	1.24	0	5,932	5,932		4,784	114,813
YL3	13	1.08	0	2,492	2,492		2,307	29,996
YL4	14	1.62	0	2,364	2,364		1,459	20,430
YL5	104	4.42	0	21,525	21,525		4,870	506,471
YL6	45	1.24	0	3,705	3,705		2,988	134,456
YL7	49	0.54	0	2,248	2,248		4,163	203,985
YL8	148	2.19	0	14,728	14,728		6,725	995,317
YL9	17	1.24	0	5,932	5,932		4,784	81,326
Total Section 2			***0***	***60,590***			**29,366**	***2,021,651***
Total				**66,054**			**30,646**	**2,068,997**

Table 7.6.9.4 Blue2 Route Option NO_x index

Link name	Properties within 50m	Link length	NOx (kg/yr)			% change in emissions	Change in NO_x emission rate (kg/km/yr)	NO_x index
			Do-min	Do-som	Change in emissions			
BL1	124	1.82	0	2,988	2,988	>+10	1,642	203,578
BL2	31	1		644	644		1,199	
BL3	8	1.43	0	1,714	1,714	>+10	1,642	
Total Section 1				***5,346***			***4,482***	***253,869***
BL4	12	3.4	0	2,190	2,190		644	7,729
BL5	43	3.25	0	4,187	4,187	>+10	1,288	55,397
BL6	13	1.07	0	2,622	2,622	>+10	2,450	31,856
BL7	26	1.93	0	2,943	2,943	>+10	1,525	39,647
BL8	112	4.98	0	22,074	22,074	>+10	4,433	496,443
BL9	81	1.29	0	8,064	8,064	>+10	6,251	506,344
BL10	34	1.82	0	6,670	6,670	>+10	3,665	124,604
BL11	34	1.62	0	7,002	7,002	>+10	4,322	146,956
Total Section 2				***55,752***	***55,752***		***25,223***	***1,428,941***
Total				**61,098**			**29,705**	**1,682,810**

Table 7.6.9.5 Pink2 Route Option NO_x index

Link name	Properties within 50m	Link length	NO_x (kg/yr)			% change in emissions	Change in NO_x emission rate (kg/km/yr)	NO_x index
			Do-min	Do-som	Change in emissions			
PL1	128	1.82	0	2,396	2,396	>+10	1,317	163,274
PL2	2	1.4	0	1,498	1,498	>+10	1,047	8,380
PL3	12	1	0	642	642		642	7,704
Total Section 1				***4,536***	***4,536***		***3,006***	***179,358***
PL4	0	0.34	0	218	218		641	0
PL5	47	3.26	0	4,341	4,341	>+10	1,284	55,226
PL6	13	1.07	0	2,666	2,666	>+10	2,492	32,391
PL7	14	1.62	0	2,415	2,415	>+10	1,491	20,870
PL8	50	4.48	0	20,231	20,231	>+10	4,516	225,792
PL9	118	1.78	0	11,362	11,362	>+10	6,383	753,211
PL10	66	2.63	0	9,189	9,189	>+10	3,494	230,598
PL11	1	0.71	0	2,936	2,936	>+10	4,135	4,135
Total Section 2				***53,358***	***53,358***		***24,436***	***1,322,224***
Total			**0**	**57,894**	**57,894**	**0**	**27,442**	**1,501,582**

Table 7.6.9.6 Green2 Route Option NO_x index

Link name	Properties within 50m	Link length (km)	NO_x (kg/yr)			% change in emissions	Change in NO_x emission rate (kg/km/yr)	NO_x index
			Do-min	Do-som	Change in emissions			
GL1	106	3.5	0	2,277	2,277	>+10	651	68,961
GL2	4	0.6	0	390	390		650	2,600
Total Section 1				***2,667***			***1,301***	***71,561***
GL3	49	2.1	0	4,346	5,514	>+10	2,070	109,685
GL4	82	2.4	0	9,234	9,234	>+10	3,848	315,495
GL5	125	6.5	0	25,991	25,991	>+10	3,999	499,827
GL6	3	1.4	0	3,658	3,658	>+10	2,613	7,839
GL7	74	2.3	0	13,865	13,865	>+10	6,028	446,091
GL8	129	2.5	0	11,237	11,237	>+10	4,495	579,829
GL9	40	1.8	0	8,338	8,338	>+10	4,632	185,289
Total Section 2				***76,669***			***27,684***	***2,144,055***
Overall Total			**0**	**79,336**			**75,343**	**6,745,834**

Table 7.6.9.7 Red2 Route Option PM_{10} index

Link name	Properties within 50m	Link length	PM_{10} (kg/yr)			% change in emissions	Change in PM_{10} emission rate (kg/km/yr)	PM_{10} index
			Do-min	Do-som	Change in emissions			
RL1	27	2.4	0	112	112	>+10	47	1,260
Total Section 1			***0***	***112***	***112***	***>+10***	***47***	***1,260***
RL2	307	1.9	272	407	135	>+10	71	21,813
RL3	214	1.55	117	277	160	>+10	103	22,090
RL4	176	1.31	91	311	220	>+10	168	29,557
RL5	264	1.36	0	101	101	>+10	74	19,606
RL6	15	1.08	0	284	284	>+10	263	3,944
RL7	36	1.53	281	661	380	>+10	248	8,941
RL8	49	0.53	121	173	52	>+10	98	4,808
RL9	119	1.86	0	717	717	>+10	385	45,873
RL10	36	1.58	92	472	380	>+10	241	8,658
Total Section 2			***974***	***3403***			***1,652***	***164,031***
Total			**0**	**3,515**			**1,699**	**165,291**

Table 7.6.9.8 Orange2 Route Option PM_{10} index

Link name	Properties within 50m	Link length	PM_{10} (kg/yr)			% change in emissions	Change in PM_{10} emission rate (kg/km/yr)	PM_{10} index
			Do-min	Do-som	Change in emissions			
OL1	30	2.4	0	80	80	>+10	33	1,000
OL2	4	0.33	0	11	11	>+10	33	133
Total Section 1			***0***	***91***			***67***	***1,133***
OL3	20	3.2	0	237	237	>+10	87	2,952
OL4	4	0.54	0	62	62	>+10	115	459
OL5	12	1.35	0	67	67	>+10	50	596
OL6	386	3.84	0	818	818	>+10	213	82,226
OL7	47	1.32	0	561	561	>+10	425	19,975
OL8	49	0.53	0	174	174	>+10	328	16,087
OL9	129	1.85	0	700	700	>+10	378	48,811
OL10	36	1.58	0	437	437	>+10	277	9,957
Total Section 2				***3056***			***1,873***	***181,062***
Overall total			**0**	**3,147**			**1,939**	**182,195**

Table 7.6.9.9 Yellow2 Route Option PM_{10} index

Link name	Properties within 50m	Link length	PM_{10} (kg/yr)			% change in emissions	Change in PM_{10} emission rate (kg/km/yr)	PM_{10} index
			Do-min	Do-som	Change in emissions			
YL1	37	3.45	0	274	274		80	2,943
Total Section 1			***0***	***274***	***274***	***>+10***	***80***	***2,943***
YL2	24	4.36	0	387	387		89	2,130
YL3	13	1.08	0	120	120		111	1,444
YL4	14	1.62	0	110	110		68	951
YL5	104	4.42	0	1,037	1,037		235	24,400
YL6	45	1.24	0	176	176		142	6,387
YL7	49	0.54	0	106	106		196	9,619
YL8	148	2.19	0	653	653		298	44,130
YL9	17	1.24	0	275	275		222	3,770
Total Section 2			***0***	***2,864***	***2,864***	***0***	***1,361***	***92,831***
Total			**0**	**3,138**			**1,440**	**95,773**

Table 7.6.9.10 Blue2 Route Option PM_{10} index

Link name	Properties within 50m	Link length	PM_{10} (kg/yr)			% change in emissions	Change in PM_{10} emission rate (kg/km/yr)	PM_{10} index
			Do-min	Do-som	Change in emissions			
BL1	124	1.82	0	154	154	>+10	85	10,492
BL2	8	1.43	0	87	87	>+10	61	487
BL3	31	1	0	33	33	>+10	33	1023
Total Section 1				***274***			***202***	***11,669***
BL4	12	3.4		112	112	>+10	61	487
BL5	43	3.25	0	213	213	>+10	66	2,818
BL6	13	1.07	0	123	123	>+10	115	1,494
BL7	26	1.93	0	138	138	>+10	72	1,859
BL8	112	4.98	0	1,035	1,035	>+10	208	23,277
BL9	81	1.29	0	388	388	>+10	301	24,363
BL10	34	1.82	0	328	328	>+10	180	6,127
BL11	34	1.62	0	328	328	>+10	202	6,884
Total Section 2				***2,665***	***2,665***		***1,237***	***67,705***
Total			**0**	**2,939**			**1,237**	**72,490**

Table 7.6.9.11 Pink2 Route Option PM_{10} index

Link name	Properties within 50m	Link length	PM_{10} (kg/yr)			% change in emissions	Change in PM_{10} emission rate (kg/km/yr)	PM_{10} index
			Do-min	Do-som	Change in emissions			
PL1	128	1.82	0	122	122	>+10	67	8,319
PL2	2	1.4	0	76	76	>+10	53	427
PL3	12	1		33	33		33	396
Total Section 1				***198***			***167***	***9,252***
PL4	0	0.34	0	11	11		32	0
PL5	47	3.26	0	221	221	>+10	65	2,812
PL6	13	1.07	0	124	124	>+10	116	1,507
PL7	14	1.62	0	113	113	>+10	70	977
PL8	50	4.48	0	949	949	>+10	212	10,592
PL9	118	1.78	0	543	543	>+10	305	35,997
PL10	66	2.63	0	443	443	>+10	168	11,117
PL11	1	0.71	0	135	135	>+10	190	190
Total Section 2				***2539***			***1,159***	***63,190***
Total			**0**	**2,770**			**1,326**	**72,442**

Table 7.6.9.12 Green2 Route Option PM_{10} index

Link name	Properties within 50m	Link length	PM_{10} (kg/yr)			% change in emissions	Change in PM_{10} emission rate (kg/km/yr)	PM_{10} index
			Do-min	Do-som	Change in emissions			
GL1	106	3.5	0	114	114	>+10	33	3,453
GL2	4	0.6	0	20	20	>+10	33	33
Total Section 1			**0**	**134**			**66**	**3,486**
GL3	49	2.1	0	281	281	>+10	105	5,589
GL4	82	2.4	0	457	457	>+10	190	15,619
GL5	125	6.5	0	1,235	1,235	>+10	190	23,750
GL6	3	1.4	0	180	180	>+10	128	385
GL7	74	2.3	0	682	682	>+10	296	21,930
GL8	129	2.5	0	549	549	>+10	219	28,307
GL9	40	1.8	0	407	407	>+10	226	9,046
Total Section 2				**3,731**			***1,356***	***104,626***
Total			**0**	**3,865**	**3,865**	**0**	**3,671**	**326,823**

Table 7.6.9.13 below summarises the outputs of the assessments above.

Table 7.6.9.13 Index of overall change in exposure for Sections 1 and 2

Route Option	NO_x Index	Better or worse?	PM_{10} index	Better or worse?
Section 1				
Red2	24,716	worse	1,260	worse
Orange2	22,129	worse	1,113	worse
Yellow2	47,346	worse	1,361	worse
Blue2	253,869	worse	11,669	worse
Pink2	179,358	worse	9,252	worse
Green2	71,561	worse	3,486	worse
Section 2				
Red2	3,478,979	worse	165,291	worse
Orange2	3,915,372,	worse	181,062	worse
Yellow2	2,021,651	worse	92,831	worse
Blue2	1,428,941	worse	67,705	worse
Pink2	1,322,224	worse	63,190	worse
Green2	2,144,055	worse	104,626	worse

Calculation of local-scale pollutant concentrations

The NRA guidelines states that if there are sensitive receptors within close proximity to one or more route options, i.e. within 10m of the edge of the road, it is necessary to predict pollutant concentration at Stage 2. The guidance advises that in these circumstances, concentrations of both nitrogen dioxide and PM10 at a small number of 'worst-case' receptors be calculated for the opening year. These predictions should be carried out using the screening model method described in the UK DMRB. Predicted values should then be added to future background levels and compared to air quality standards, refer to **Table 4.14.2**, in **Chapter 4** of this report for background levels. Future background levels are calculated based on NRA Guidance, where a factor is applied to determine concentrations in future years. 'Worst-case' receptors have been selected at locations where receptors are located in proximity to the proposed road, these locations are assumed to be 20m from the centre of the corridor for each route option. Predicted concentrations are added to background values to determine the cumulative impact. These total levels are compared to the air quality standards. The background levels used for the Design Year of 2034 are outlined in **Table 7.6.9. 14** below.

Table 7.6.9. 14 Predicted background annual average levels of NO_2, NO_x and PM_{10} for Design Year of 2034

Pollutant	Average of 2011 to 2013 values ($\mu g/m^3$)	Predicted values Design Year, 2034 ($\mu g/m^3$)	Air quality standard ($\mu g/m^3$)
NO_2	7.9	5.5	40
NOx	13.3	9.1	30
PM_{10}	18.8	17.9	40

Total predicted levels of nitrogen dioxide and PM_{10} for each route option including background concentrations are provided in **Table 7.6.9. 15** below.

Table 7.6.9.15 Predicted pollutant concentrations including background values for 2034 for NO_2 and PM_{10}

Pollutant	Route Option /Section	Predicted concentration ($\mu g/m^3$)	Total including background concentration ($\mu g/m^3$)	Percentage of AQS (%)
NO_2	**Red2 Route Option**			
	RL1. RL2	1.8	7.3	18.3
	RL3	2.3	7.8	19.5
	RL4	2.8	8.3	20.8
	RL5	1.6	7.1	17.8
	RL6	3	8.5	21.3
	RL7	3.7	9.2	23.0
	RL8	3.3	8.8	22.0
	RL9	3.7	9.2	23.0
	RL10	3.1	8.6	21.5
	Orange2 Route Option			
	OL1, OL2	1.78	7.3	18.2
	OL3	1.99	7.5	18.7
	OL4	1.56	7.1	17.7
	OL5	0.77	6.3	15.7
	OL6	2.11	7.6	19.0
	OL7	2.65	8.2	20.4
	OL8	2.38	7.9	19.7
	OL9	2.63	8.1	20.3
	OL10	2.16	7.7	19.2
	Yellow2 Route Option			
	YL1	1.2	6.7	16.8
	YL2	1.7	7.2	18.0
	YL3	1.9	7.4	18.5
	YL4	1.4	6.9	17.3
	YL5	2.5	8.0	20.0
	YL6	2.1	7.6	19.0
	YL7	2.4	7.9	19.8
	YL8	3.1	8.6	21.5
	YL9	2.6	8.1	20.3

Pollutant	Route Option /Section	Predicted concentration (µg/m^3)	Total including background concentration (µg/m^3)	Percentage of AQS (%)
	Blue2 Route Option			
	BL1	1.8	7.3	18.3
	BL2	1.3	6.8.	17.0
	BL3, BL4	1.4	6.9	17.3
	BL5	1.4	6.9	17.3
	BL6	2.3	7.8	19.5
	BL7	1.7	7.2	18.0
	BL8	2.9	8.4	21.0
	BL9	3.3	8.8	22.0
	BL10	2.6	8.1	20.3
	BL11	2.9	8.4	21.0
	Pink2 Route Option			
	PL1	1.5	7.0	17.5
	PL2	1.3	6.8	17.0
	PL3, PL4	1.4	6.9	17.3
	PL5	1.4	6.9	17.3
	PL6	2.4	7.9	19.8
	PL7	1.6	7.1	17.8
	PL8	3.0	8.5	21.3
	PL9	3.4	8.9	22.3
	PL10	2.6	8.1	20.3
	PL11	2.9	8.4	21.0
	Green2 Route Option			
	GL1	1.47	7.0	17.4
	GL2, GL3	2.09	7.6	19.0
	GL4	2.74	8.2	20.6
	GL5	2.87	8.4	20.9
	GL6	2.36	7.9	19.7
	GL7	3.28	8.8	22.0
	GL8	2.93	8.4	21.1
	GL9	2.93	8.4	21.1
PM_{10}	**Red2 Route Option**			
	RL1. RL2	1.3	19.2	48

Pollutant	Route Option /Section	Predicted concentration (µg/m^3)	Total including background concentration (µg/m^3)	Percentage of AQS (%)
	RL3	1.7	19.6	49
	RL4	1.9	19.8	49.5
	RL5	1.1	19	47.5
	RL6	2.0	19.9	49.75
	RL7	2.4	20.3	50.75
	RL8	2.1	20	50
	RL9	2.3	20.2	50.5
	RL10	2.1	20	50
	Orange2 Route Option			
	OL1, OL2	0.9	18.8	47.0
	OL3	1.1	19.0	47.5
	OL4	1.4	19.3	48.3
	OL5	0.7	18.6	46.5
	OL6	1.8	19.7	49.3
	OL7	2.4	20.3	50.8
	OL8	2.1	20.0	50.0
	OL9	2.3	20.2	50.5
	OL10	2.0	19.9	49.8
	Yellow2 Route Option			
	YL1	0.9	18.8	47.0
	YL2	1.3	19.2	48.0
	YL3	1.4	19.3	48.3
	YL4	1.0	18.9	47.3
	YL5	1.9	19.8	49.5
	YL6	1.5	19.4	48.5
	YL7	1.7	19.6	49.0
	YL8	2.1	20.0	50.0
	YL9	1.8	19.7	49.3
	Blue2 Route Option			
	BL1	1.2	19.1	47.8
	BL2	0.9	18.8	47.0
	BL3, BL4	0.9	18.8	47.0
	BL5	0.9	18.8	47.0

Pollutant	Route Option /Section	Predicted concentration (µg/m^3)	Total including background concentration (µg/m^3)	Percentage of AQS (%)
	BL6	1.4	19.3	48.3
	BL7	1.0	18.9	47.3
	BL8	1.8	19.7	49.3
	BL9	2.1	20.0	50.0
	BL10	1.7	19.6	49.0
	BL11	1.8	19.7	49.3
	Pink2 Route Option			
	PL1	1.0	18.9	47.3
	PL2	0.9	18.8	47.0
	PL3, PL4	0.9	18.8	47.0
	PL5	0.9	18.8	47.0
	PL6	1.4	19.3	48.3
	PL7	1.0	18.9	47.3
	PPL8	1.8	19.7	49.3
	PL9	2.1	20.0	50.0
	PL10	1.6	19.5	48.8
	PL11	1.7	19.6	49.0
	Green2 Route Option			
	GL1	0.9	18.8	47.0
	GL2, GL3	1.3	19.2	48.0
	GL4	1.7	19.6	49.0
	GL5	1.7	19.6	49.0
	GL6	1.5	19.4	48.5
	GL7	2.0	19.9	49.8
	GL8	1.8	19.7	49.3
	GL9	1.8	19.7	49.3

All predicted results are in compliance with the air quality standards for NO_2 and PM_{10}.

Impacts on sensitive ecosystems

The NRA guidance states that an assessment of air quality impacts on ecosystems should be carried out with a focus on NOx concentrations. All designated sites within 200m of any road that could be affected by the proposed scheme should be considered. The guidance states that it is only necessary to consider routes where a change in traffic flow of 5% or greater occurs. Predicted concentrations of nitrogen

oxides are calculated and compared to the standard for the protection of vegetation. For the purposes of this assessment it is assumed that each section of each route option passes within 20m of sensitive ecosystems; results are provided in **Table 7.6.9.16** below.

Table 7.6.9.16 Predicted pollutant concentrations including background values for 2034 for NO_x

Route Option /Section of road	NOx predictions at ecosystem	Total including background concentration (µg/m^3)	Percentage of AQS (%)
Red2 Route Option			
RL1. RL2	7.6	16.7	55.7
RL3	9.8	18.9	63.0
RL4	11.8	20.9.	69.7
RL5	6.9	16.0	53.3
RL6	12.9	22.0	73.3
RL7	15.7	24.8	82.7
RL8	14.2	23.3	77.7
RL9	15.8	24.9	83.0
RL10	13.3	22.4	74.7
Orange2 Route Option			
OL1, OL2	5.6	14.7	49.0
OL3	6.2	15.3	51.0
OL4	9.2	18.3	61.0
OL5	4.6	13.7	45.7
OL6	12.4	21.5	71.7
OL7	15.6	24.7	82.3
OL8	14.0	23.1	77.0
OL9	15.5	24.6	82.0
OL10	12.7	21.8	72.7
Yellow2 Route Option			
YL1	5.6	14.7	49.0
YL2	7.9	17.0	56.7
YL3	8.6	17.7	59.0
YL4	6.2	15.3	51.0
YL5	11.6	20.7	69.0
YL6	9.7	18.8	62.7
YL7	11.1	20.2	67.3
YL8	14.1	23.2	77.3

Route Option /Section of road	NOx predictions at ecosystem	Total including background concentration (µg/m^3)	Percentage of AQS (%)
YL9	11.9	21.0	70.0
Blue2 Route Option			
BL1	7.0	16.1	53.7
BL2	5.1	14.2	47.3
BL3, BL4	5.5	14.6	48.7
BL5	5.5	14.6	48.7
BL6	9.0	18.1	60.3
BL7	6.5	15.6	52.0
BL8	11.4	20.5	68.3
BL9	12.9	22.0	73.3
BL10	10.2	19.3	64.3
BL11	11.3	20.4	68.0
Pink2 Route Option			
PL1	5.7	14.8	49.3
PL2	5.1	14.2	47.3
PL3, PL4	5.5	14.6	48.7
PL5	5.5	14.6	48.7
PL6	9.1	18.2	60.7
PL7	6.4	15.5	51.7
PPL8	11.5	20.6	68.7
PL9	13.0	22.1	73.7
PL10	10.2	19.3	64.3
PL11	11.3	20.4	68.0
Green2 Route Option			
GL1	5.6	14.7	49.0
GL2, GL3	7.9	17.0	56.7
GL4	10.4	19.5	65.0
GL5	10.9	20.0	66.7
GL6	9.0	18.1	60.3
GL7	12.4	21.5	71.7
GL8	11.1	20.2	67.3
GL9	11.1	20.2	67.3

All predicted results are in compliance with the air quality standards for NO_x for the protection of vegetation.

Construction Impacts

The NRA guidance states that dust emissions generated during the construction phase of a road scheme can lead to elevated PM_{10} and $PM_{2.5}$ concentrations and may also cause dust soiling. The guidelines advise that impacts of dust emissions should be assessed by estimating the area over which there is a risk of significant impacts. Thisis considered in terms of the scale of the works and the proximity and number of sensitive receptors to the works. As identified in **Tables 7.6.9.1** to **7.6.9.12**, the route option with the greatest number of sensitive receptors located within 50m of the route is the Red2 Route Option with over 1,200 properties within 50m. The second highest is the Orange2 Route Option with over 700 properties in proximity. On this basis, the Red2 Route Option is considered the least preferable when construction impacts are considered.

7.6.9.4 Summary

Table 7.6.9. 17 below summarises the ranking of the route options from an air quality and climate perspective. From an air and climate perspective, the preferred route option is the option with the lowest NO_x and PM_{10} index presented in **Tables 7.6.9.1** to **Table 7.6.9.12**. The least preferred route option is the option with the highest NO_x and PM_{10} index presented in **Tables 7.6.9.1** to **Table 7.6.9.12**. The route options are also presented in terms of preferred (P), intermediate (I) and least preferred (LP). All route options are considered as acceptable as all air quality standards are predicted to be complied with.

Table 7.6.9.2.17 Summary of Air quality and climate ranking of Route Options

Route Option	Section 1	Section 2	Section 3
Red2	P	LP	LP
Orange2	P	LP	LP
Yellow2	P	P	LP
Blue2	LP	P	LP
Pink2	LP	P	I
Green2	I	I	P

Note: P = Preferred, I = Intermediate, LP = Least Preferred

For Section 1, the preferred route option from an air quality and climate perspective are the Red2, Orange2 and Yellow2 Route Options. For Section 2, the preferred route option from an air quality and climate perspective are the Yellow2, Blue2 and Pink2 Route Options. It should be noted that there is very little variation between the NO_x and PM_{10} index for the Orange2, Red2 and Yellow2 Route Options for Section 1. Also, there is very little variation between the NO_x and PM_{10} index for the Pink2, Blue2 and Yellow2 Route Options for Section 2.

7.6.9.6 References

National Roads Authority. (2011) *Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes*.

United Kingdom Design Manual for Roads and Bridges. (2007) *Volume 11 Environmental Assessment Section 3 Environmental Assessment Techniques Part 1 Ha 207/07 Air Quality*.

Environmental Protection Agency. (2014) *Air Quality in Ireland 2013, Key Indicators of Ambient Air Quality.*

Environmental Protection Agency. (2013) *Air Quality in Ireland (2012) Key Indicators of Ambient Air Quality.*

Environmental Protection Agency. (2012) *Air Quality in Ireland (2011) Key Indicators of Ambient Air Quality.*

7.6.10 Noise and Vibration

7.6.10.1 Introduction

This section details the Stage 2 assessment of the route options with respect to the noise and vibration constraints identified in **Section 4.15 Noise and Vibration** of this report. The route options as described in **Section 7.1.** The noise and vibration contours are presented in **Figure 7.6.10.1** to **7.6.10.6**. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options.

Section 7.6.10.2 outlines the methodology that was used to carry out the study and **Section 7.6.10.3** details the options assessment. A summary is presented in **Section 7.6.10.4** and references are listed in **Section 7.6.10.5**.

This section assesses the six route options associated with the N6 Galway City Transport Project with respect to their potential noise and vibration impact. The assessment has ranked the routes in order of preference taking into account their potential impacts to noise and vibration on the surrounding environment through which they pass.

This section of the report assesses the potential noise and vibration impacts associated with the revised 6 route options in order to feed into the environmental assessment matrix for the selection of the emerging preferred route corridor.

7.6.10.2 Methodology

Stage 1 of the route options assessment has undertaken a review of the Potential Impact Rating (PIR) relating to each of the route options in addition to assessing a high level noise footprint assessment. The assessment is largely based on ranking the route options in terms of their potential noise impact through assessing the number of noise sensitive properties which are likely to require noise mitigation as a result of its operational phase. Consideration was also given to potential noise and vibration impacts during the construction phase of each.

For Stage 2 assessment, the route options are assessed in three sections. The location of the breakline between Section 1 & Section 2 has been moved eastwards towards the Galway City boundary. Section 1 extends from the R336 to the Galway City boundary and Section 2 extends from the Galway City boundary to the existing N6 in the east of the city. An additional break down at the N6 tie in at Coolagh has been incorporated in order to compare the junction layouts at the N6 tie in for the Stage 2 assessment. This section is referred to as Section 3.

As noted previously in **Chapter 6** of this report, the design goal used for new road schemes in Ireland is set out in the NRA's documents "Guidelines for the Treatment of Noise and Vibration in National Road Schemes" (2004) and "Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes" (2014) provide guidelines for the assessment of route options and for operational preferred routes.

In terms of operational noise, the National Road's Authority considers it appropriate to set the design goal for Ireland as follows:

- day-evening-night 60dB L_{den} (free field)

Both documents acknowledge that it may not always be sustainable to achieve this design goal. In such circumstances, nevertheless, a structured approach should be taken in order to ameliorate as far as practicable road traffic noise through the consideration of mitigation measures.

In terms of vibration, road traffic along normal well maintained surfaces, in line with this proposed development, generate very low levels that are normally not perceptible to building occupants. For the purposes of this assessment, therefore, it is assumed that all route options will have a comparable low vibration impact during their operational phase. The ranking of route options during their operational phase is focused, therefore on the potential noise impact which will vary considerably between route options.

As part of the Stage 2 assessment, in order to assess and rank the six route options under consideration, each route option has been assessed to determine in greater detail, the number of properties likely to be exposed to noise levels at or above the operational design goal of 60dB L_{den}. The following methodology was adopted for this study:

- A 3D model of the scheme study area was developed using ground contour mapping and OS mapping;
- A 3D model of each route option was developed within the scheme study area using 3D alignment drawings provided by the Design Team;
- A noise contour grid was calculated for each route option taking account of the traffic volumes, speeds and other factors affecting the propagation of sound;
- The number of noise sensitive properties falling within the 60dB L_{den} noise contour line was determined; and
- The route options which were found to have the least overall noise impact to the surrounding environment were ranked in order of preference.

The approach used for this stage of the route selection study provides an accurate noise impact assessment of each route option as the effects of cuttings, embankments, at-grade sections and tunnels are all taken into account of for each route option. In addition, due to the detailed traffic modelling undertaken as part of the route selection stage, traffic volumes along key sections of each route option can be modelled, thus enabling a detailed noise model to be developed.

Route Model Development

A computer-based prediction model was prepared for each route option in order to quantify the traffic noise level associated with its operational phase. A proprietary noise calculation software Brüel & Kjær Type 7810 *Predictor* was used for calculating traffic noise levels in accordance with the CRTN and NRA guidance.

Input to the Noise Model

The noise model was prepared using the following data:

- Ordnance Survey mapping, 3D topographical data and 3D alignments of the proposed route options supplied by the design team; and
- Traffic flows and traffic speed along the various sections of each route option as supplied by the design team.

The calculations are based on Method A prescribed in the NRA guidelines using hourly traffic data, determined from the diurnal traffic profiles provided in Appendix 1 of the NRA guidelines. The results of the model converts hourly $L_{A10,1hr}$ values into L_{den} using the relevant TRL conversion methodology.

Output of the Noise Model

For each route option, an L_{den} noise contour grid was calculated out to approximately 400m either side of the road fenceline. A total of six route options (Red2, Orange2, Yellow2, Blue2, Pink2 and Green2) as described in **Section 7.1** have been assessed as part of the Stage 2 study.

Figures 7.6.10.1 to **7.6.10.6** present the calculated L_{den} noise contour grids for each of the route options.

Using the methodology described above, road traffic noise associated with each route option was calculated and the number of properties within the 60dB L_{den} noise contour line determined. This has enabled each route option to be assessed in detail.

It should be noted that whilst a similar route alignment is followed by some route options (e.g. Section 1 for the Orange2 and Red2 Route Options etc.) the expected traffic volumes along these same sections has the potential to be different. This is due the traffic flow patterns along the route in its entirety which has been calculated separately for individual sections of each route option. In this instance, for Section 1, a variation in traffic volumes between the Red2 and Orange2 Route Options would lead to a variation in the number of properties falling into the 60dB L_{den} noise contour line.

Within Section 2, the Yellow2, Red2 and Orange2 Route Options follow the same alignment from Terryland to the end of the scheme. Traffic volumes along the Orange2 and Red2 Route Options are nominally comparable along this section and hence have the same calculated noise impacts. For the Yellow2 Route Option, lower traffic volumes are calculated along this section and hence the calculated noise impacts are less for this route option. For further discussion on the traffic analysis for the individual route options, please refer to **Chapter 3** of this report.

During the construction phase for each route option, the potential noise and vibration impacts are discussed on a high level taking account of the likely construction options required for each.

7.6.10.3 Option Assessment

Section 1

Table 7.6.10.1 below summarises the number of properties counted within Section 1 of the scheme study area.

Table 7.6.10.1 Section 1 Noise Impact Assessment Summary

Route Option	No. of Properties Calculated to Exceed 60dB Lden			Order of Preference
	Bearna Relief Road	Section 1 Mainline	Total	
Red2	0	11	11	P
Orange2	0	10	10	P
Yellow2	0	16	16	I
Blue2	54	10	64	LP
Pink2	61	5	66	LP
Green2	0	72	72	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred

The property counts summarised in **Table 7.6.10.1** indicates that within Section 1 the greatest potential noise impact is predicted along the Green2 Route Option. This is due to the number of properties being exposed to noise levels in excess of 60dB L_{den} or greater. The distribution of noise sensitive properties in this area are dispersed typically in ribbon style development along the local roads across which this route option passes. Options for mitigation would likely require the use of a low noise surface (LNRS) and a significantly high number of acoustic barriers along the road boundary.

The Pink2 and Blue2 Route Options have the second and third highest potential noise impacts respectively both driven by the number of noise sensitive properties along the section of the existing Bearna Relief Road. Options for noise mitigation along this section would likely involve a LNRS which may be sufficient to reduce noise levels at the majority of properties to within the traffic design goal. For the mainline section of both these route options, a relatively low number of properties are likely to require noise mitigation which would likely involve the combined use of a LNRS and individual acoustic barriers.

The alignment followed by the Yellow2 Route Option within Section 1 has the third lowest calculated noise impact compared to the other route options. The actual number of properties along the mainline link road is however second highest (i.e. excluding specific noise impacts along the Bearna Relief Road). The requirements for noise mitigation along this route option would likely require the use of a LNRS and a high number of acoustic barriers along the road boundary.

The most preferred route option in Section 1 is followed by the Red2 and Orange2 Route Options. As noted above, a marginally higher noise impact is expected if this section connects to the full extent of the Red2 Route Option due to higher operational traffic volumes using this section of road. Overall, however this route option is preferred over the other five route options.

Section 2

Table 7.6.10.2 below summarises the number of properties counted within Section 2 of the scheme study area.

Table 7.6.10.2 Section 2 Noise Impact Assessment Summary

Route Option	No. of Properties Calculated to Exceed 60dB Lden			Order of Preference
	Section 2 Mainline	N59 Link Road	Total	
Red2	783	0	783	LP
Orange2	277	10	287	LP
Yellow2	346	12	358	LP
Blue2	93	22	115	I
Pink2	81	12	93	P
Green2	330	0	330	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred

The property counts summarised in **Table 7.6.10.2** indicates that within Section 2 the greatest potential noise impact is predicted along the Red2 Route Option. This route option has the highest number of noise sensitive properties falling within the calculated noise contour bands out to 60dB $L_{den.}$ Whilst a large number of these properties are already exposed to road traffic noise from the existing road corridor which the Red2 Route Option would follow, analysis of the traffic volumes for this route option indicates that noise levels are predicted to increase by the order of 1 to 5dB L_{den} between the Do-Nothing and Do-Something scenarios at properties adjacent to the route option. In line with the NRA Guidelines, where noise levels above 60dB L_{den} are increased in excess of 1dB due to the development of a new road, noise mitigation measures are recommended. In this instance, the extensive number of properties likely to experience increased traffic noise levels and hence require noise mitigation ranks this route option the least preferred compared to the other route options.

The Yellow2 Route Option is calculated to have the second highest potential noise impact, marginally above the Red2 Route Option. The number of noise sensitive properties impacted by this route option are predominately clusters of residential properties within residential estates and adjacent to village areas. The noise impact and extent of noise mitigation required to adequately reduce traffic noise to within acceptable levels is significant. This route option is ranked as least preferred.

The Green2 Route Option has a marginally lower calculated potential noise impact compared to the Yellow2 Route Option. Overall, the options for noise mitigation for this route option would be similar for the Yellow2 Route Option There are, however, a higher number of individual properties located along local roads which this route option crosses within the central part of the scheme which would likely result in a requirement for a greater number of individual acoustic barriers located along the length of the route. This route option is ranked as least preferred.

The Orange2 Route Option has the next highest calculated noise impact when compared to the other route options. The tunnel associated with this route option enables the route to pass through a high density residential area in close proximity to the city without generating any significant operational noise impacts. For the

majority of this route option, the impacted noise sensitive properties are located typically along the existing N6 following the Red2 Route Option and within clusters of residential estates which the route alignment passes in proximity. The options for noise mitigation would be more focused along this route option likely requiring the use of a LNRS and acoustic barriers/boundaries along estate boundaries or enhancing existing boundaries. This route option is ranked as least preferred.

The Blue2 Route Option is ranked marginally below the Pink2 Route Option due to the higher overall number of noise sensitive properties impacted by this route option both along the mainline and the N59 Link Road. Notwithstanding the higher number of properties impacted by this route option, the number of noise sensitive properties impacted by this route is significantly less compared to the other route options noted above. On review of the route alignment, mitigation measures in the form of a low noise road surface along the length of the route in addition to acoustic barriers at a number of specific areas in proximity to noise sensitive locations will be required. This route option is ranked as intermediate compared to the other route options.

The Pink2 Route Option has been determined to have the lowest potential noise impact within Section 2 compared to the other route options. The number of noise sensitive properties calculated to be exposed to road traffic noise above 60dB L_{den} is the lowest compared to the other route options leading to it being ranked the most preferable option. Noise mitigation measures along this route option would likely require a LNRS coupled with acoustic barriers along the road edge, the extent of mitigation would be significantly less than that required for the other routes discussed above. Similar considerations in terms of noise mitigation to the Blue Route Option would need to be considered for this route option.

Section 3

Section 3 of the assessment area relates to the tie in point to the existing N6 to the east of the scheme. The Red2, Orange2 and Yellow2 Route Options follow the same alignment at this location using a grade separated junction and N6 tie-in. The Blue2, Pink2 and Green2 Route Options each have separate tie-in points with the existing N6. All junction options are located to the east of the Ballybrit Crescent Road and the R339 Road depending on their alignment, hence the alignments east of this area were used as the breakline between Sections 2 and 3 on which impacted noise sensitive properties were counted.

Table 7.6.10.3 below summarises the number of properties counted within Section 3 of the scheme study area.

Table 7.6.10.3 Section 3 Noise Impact Assessment Summary

Route Option	No. of Properties Calculated to Exceed 60dB Lden	Order of Preference
Red2	6	I
Orange2	6	I
Yellow2	6	I
Blue2	8	I
Pink2	5	P
Green2	8	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

The number of noise sensitive properties affected in this section of the assessment is low compared to the other two sections. The difference between the number of properties counted for this section is marginal.

The Green2 and Blue2 Route Options have the highest number of properties potentially affected by its alignment which incorporates the section of these routes from Ballybrit Crescent to the end of the scheme. The higher number of properties in general relates to the longer section of route assessed for the Green2 Route Option and the marginally higher number of noise sensitive properties determined to be exposed to noise levels above 60dB $L_{den.}$ For the Blue2 Route Option the majority of properties exposed to traffic volumes above 60dB L_{den} are in the vicinity of the new N6 Junction.

The Orange2, Red2 and Yellow2 tie-in options with the existing N6 are the same in location. This junction option is mid ranking compared to the other junction options, however, given the small variation in property numbers affected between the other options it is deemed to be intermediate.

The Pink2 Route Option in this section of the scheme has the lowest property count. The majority of properties counted within this section for the Pink2 Route Option are along the R339 adjacent to the route crossing. The number of properties exposed to noise levels above 60dB L_{den} at the proposed N6 Junction is minor. The junction option for this route is therefore ranked as the most preferred.

Overall given the low number of properties affected in this section of the route options, all the proposed options are deemed to be acceptable with the Pink2 Route Option being the most preferred.

Construction Works

In terms of construction, the majority of the route options will involve standard road construction works which will involve excavation, cut and fill works, piling and structures and surfacing works. All of the above works have the potential to generate high level of noise in close proximity to the works. These activities are, however, standard construction methodologies and can be well mitigated through good site practices, site screening and control at source. There is minimal vibration impacts associated with these standard works beyond the work site boundary. These works are common to all route options under consideration.

Construction of the Red2 Route Option will involve a considerable level of intrusive works in close proximity to a high density of sensitive properties which are in close proximity to the works. The use of extensive surface works, cut and cover works, tunnel works and the construction of new structures would all take place within confined work areas with a high potential for construction works to occur during evenings, night-time and weekends. In this regard, achieving acceptable noise and vibration limits during the various construction phases of this route option would pose considerable challenges. The noise and vibration impacts during this phase are therefore considered to be significant and extensive and would rank this route option least preferred in terms of its construction phase. This coupled with the high potential impact during the operational phase ranks this route option overall as the least preferred.

Construction of the Orange2 Route Option will involve standard road construction works along a large portion of its route. In addition to standard construction works, the use of a Tunnel Boring Machine (TBM) is likely to be required to excavate the proposed tunnel section of this route option which will be constructed below a high density of residential properties. Depending on the tunnel depth, hours of work and methodologies employed, there is potential for ground borne noise and vibration impacts to sensitive properties above the tunnel during this phase. In addition to the below ground works, there is potential for high level of construction noise associated with the TMB launch sites depending on their proximity to noise sensitive areas.

At the tie-in point with the existing N6 Road, there will also be potentially high noise and vibration impacts to adjacent properties during road surface works, cut and cover works and the construction of new junctions. Taking all of the above into consideration, the noise and vibration impacts from the construction of the route option has the potential to be significant at specific points along the route, depending on the methodologies to be employed and the mitigation options available.

Construction of the Yellow2 Route Option will involve standard construction works along the majority of its route. This route option is common to the Red2 and Orange2 Route Options at the tie-in point to the existing N6 at Castlegar. In this regard, there is potential for high noise and vibration impacts to sensitive areas in close proximity to the cut and cover, surface works and structures proposed in this area of the alignment.

The remainder of the route option passes in close proximity to a high number of residential areas particularly to the east of the N59 link road. Whilst the construction methodologies employed along these sections of the route are likely to be standard construction works, depending on the proximity to sensitive properties, there is potential for high noise impacts and for vibration to a lower extent at these properties. With controlled methodologies and best practice noise and vibration mitigation, however, it is possible to design the construction phase to within acceptable noise and vibration limits along the majority of the route.

Construction of the Blue2 and Pink2 Route Options will involve standard road construction methodologies along the majority of their alignments. These route options follow a similar alignment to the Yellow2 Route Option to the west of the River Corrib crossing. In this regard, the same construction impacts in terms of excavations, cut and fill and construction of structures are all common to these route options. With controlled methodologies and best practice noise and vibration

mitigation, it is considered possible to design the construction phase to within acceptable noise and vibration limits along the majority of the routes.

Both the Blue2 and Pink2 Route Options will involve the construction of a tunnel through Lackagh Quarry. Sensitive properties are well set back from construction activity in this area and hence is not considered to pose significant noise and vibration impacts during its construction. Both route options include a cut and cover tunnel in the vicinity of Galway Racecourse. Noise sensitive properties are well separated from proposed works in this area. It should be noted, this assumes activities within the racecourse would not be operational during the construction works. Whilst the standard road construction would occur in close proximity to a number of noise sensitive properties, the nature of the works are likely to be mitigated to within the appropriate construction noise and vibration limits and the duration of the works in the vicinity of any one area would be relatively short-term.

The Green2 will involve standard road construction methods along the full extent of its route. Whilst the road construction would occur in close proximity to a high number of noise sensitive properties, the nature of the works are likely to be mitigated to within the appropriate construction noise and vibration limits and the duration of the works in the vicinity of any one area would be relatively short-term compared to other route construction options.

7.6.10.4 Summary

Table 7.6.10.4 below summarises the ranking preference for the three sections of the assessment. The preferred (P) option has been ranked 1 with the least preferred (LP) ranked number 6. Route options falling between 1 and 5 are ranked, intermediate (I).

Table 7.6.10.4 Summary of Noise and Vibration rankings of Route Options

Route Option	Section 1	Section 2	Section 3
Red2	P	LP	I
Orange2	P	LP	I
Yellow2	I	LP	I
Blue2	LP	I	I
Pink2	LP	P	P
Green2	LP	LP	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

Overall, in Section 1 the most preferred route option is that followed by the Red2 and Orange2 Route Options whilst the least preferred option is that followed by the Blue2, Pink2 and Green2 Route Option.

In Section 2 the most preferred route option is that followed by the Pink2 Route Option whilst the least preferred option is that followed by the Red2, Orange2, Yellow2 and Green2 Route Option.

The most preferred option for Section 3 is the Pink2 Route Option whilst all other options are considered to be intermediate.

7.6.10.5 References

Department of Transport (UK). (1988).*Calculation of Road Traffic Noise*.

County Galway Local Authorities City Council. *Noise Action Plan2013 to 2018*

Galway City Council. *Noise Action Plan 2013 to 2018*

National Road Authority. (March 2014) *Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes'*

National Road Authority. (October 2004) *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*

7.6.11 Human Beings

7.6.11.1 Introduction

This section details the Stage 2 assessment of the route options with respect to the socio-economic constraints associated with human beings as identified in **Section 4.17 Human Beings** of this report. The route options, as described in **Section 7.1,** with the constraints related to the socio-economic environment, are presented in **Figure 7.6.11.1** and **7.6.11.2**. The section can be read in conjunction with **Material Assets Non-Agriculture Section 7.5.8** which contains a Stage 1 assessment of the route options on residential properties and, by association, assessment in terms of individual dwellings. The **Air Quality and Climate Section 7.5.9** and **Noise and Vibration Section 7.5.10** also assess the route options in terms of human beings. **Landscape and Visual Section 7.5.5** also includes an assessment of the route options relative to amenities enjoyed by individuals. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options.

Section 7.6.11.2 outlines the methodology that was used to carry out the study and **Section 7.6.11.3** details the options assessment. A summary, along with summary tables, is presented in **Section 7.6.11.4** and references are listed in **Section 7.6.11.5**.

Information on the existing environment, including the location of community facilities and demographic data, can be found in **Section 4.3.9** of this report. The stage 2 assessment of the route options with respect material assets non-agriculture, (residential and commercial properties) is outline in **Section 7.6.8** of this report.

7.6.11.2 Methodology

The assessment identifies locations along the route options where impacts on local people and communities could potentially occur and has been prepared in accordance with the following guidelines:

- EPA Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (2003);
- EPA Guidelines on the Information to be contained in Environmental Impact Statements (2002); and
- NRA Environmental Impact Assessment of National Road Schemes – A Practical Guide (2006).

Impacts of human beings that are typically associated with road development fall into four principal categories, namely:

- Journey characteristics;
- Community severance;
- Amenity; and
- Economic.

7.6.11.3 Options Assessment

Since the Stage 1 assessment modifications have been made to each of the route options so as to reduce potential impacts durng the construction or operational phases. These changes are outlined in **Section 7.1.1.2**. From a human beings/socio-economic perspective, the changes are described as follows:

- Red2 Route Option: The addition of an extra lane between the N17 and N6 at Briarhill potentially introduces new construction impacts and adds to the existing high level of severance, although crossing of the road by pedestrians and cyclists will only be permitted at signalised crossings or junctions as is the case for the existing N6.
- Orange2 Route Option: Addition of an extra lane between the N17 and N6 above as for Red2 Route Option. New connection with the N59 minimises impact on residentially zoned lands and so avoids many of the construction impacts presented by other route options and operational impacts on residential amenity or community severance.
- Yellow2 Route Option: Addition of an extra lane between the N17 and N6 above as for Red2 and Orange2 Route Options. The modification of the route alignment in Section 1 reduces construction and operational impacts on residential properties in the vicinity of Bearna. The link road to the N59 takes account of residentially zoned lands and so minimises construction impacts on individual properties and operational impacts on residential amenity or community severance.
- Blue2 Route Option: In Section 2, the junction layout between the N84 and N17 has been revised to minimise impacts on residential properties in the vicinity of Castlegar, although there are residual residential and economic impactsPink2 Route Option. The layout of the section of the route option corresponding to the Bearna Inner Relief Road has been modified to minimise impacts on residential properties as above for the Blue2 Route Option. The route corridor in Section 1 north of Bearna has also been modified to minimise impacts on residential property. The link road to the N59 and the junction with the N59 have both been revised to minimise impacts on residential property. The junction layouts between the N84 and N17 and at Coolagh/Briarhill have been revised to minimise impacts on residential properties.
- The mainline alignment of this route option has been revised to minimise impacts on Bushypark National School and NUIG Recreational Facilites and avoid direct impact on Dangan Nuseries. These correspond to reduced impacts on residential and general amenity.
- Green2 Route Option: The route corridor and junction layout in the vicinity of Coolagh/Briarhill have been revised to minimise impacts on residential property.

Section 1

Red2 Route Option

Principal impacts:

- Continued community severance in Bearna
- More successful at collecting local Bearna traffic than other options (except Orange2 which has the same route); and
- Reduction in traffic on R336 and R337 into Galway City, east of Bearna.

Section 1 contains a considerable amount of individual private property and ribbon type residential development. During construction, the Red2 Route Option would impact on residential properties north of its connection to the R336 including several adjacent houses on the Barr Aille road.

On operation, the Red2 Route Option would attract traffic from the R336 to the east of Bearna at a point just after the Barr Aille road. As such, traffic accessing the route option from the west would need to continue along the main street and pass in front of the current location of Bearna Primary School producing a physical severance impact, at least until a proposed relief road is built or until the proposed move of the primary school occurs. The location of the option does mean that additional non-local traffic would be using the relief road adding to traffic volumes and social severance. However, the option would be relatively successful at collecting local traffic from Bearna. This assessment assumes that a separate relief road (unrelated to the current scheme) would be built in line with the Local Area Plan under both the Do-Minimum and Do-Something scenarios.

In common with other options, the Red2 Route Option would result in a reduction in traffic on the R336 and R337 into Galway Cityto the benefit of community facilities such as Bearna Church. On operation, there would be a slight negative impact in terms of local social severance in Ballard West. Taking both construction and operation phases into account, the Red2 Route Option is ranked as least preferred (LP) from a human beings perspective in Section 1.

Orange2 Route Option

The Orange2 Route Option follows the same path as the Red2 Route Option for Section 1 and hence the impacts are the same as that described above in the Red2 Route Option for Section 1.

Taking both construction and operation phases into account, the Orange2 Route Option is ranked as least preferred (LP) from a human beings perspective in Section 1.

Yellow2 Route Option

Principal impacts:

- Avoidance of significant house demolitions during construction;
- Avoidance of new community severance in Bearna and some relief from existing severance;
- Less successful at collecting local Bearna traffic than other options (except Green2); and

- Reduction in traffic on R337 into Galway City due to link with Cappagh Road.

During construction, the use of roundabout junctions with minor roads in Section 1 means that the Yellow2 Route Option would avoid impacting on an excessive number of properties in comparison with the Yellow1 Stage 1 option, for example at cul-de-sac to the west of na Foraí Maola Road in Na Foraí Maola Thiar.

On operation, the Yellow2 Route Option would collect R336 traffic to the west of Bearna and would avoid the impacts on community severance in the village that are associated with the other route options (aside from Green2 Route Option). Nevertheless, it could introduce a degree of social severance between the village and Bearna and its hinterland.

The option would be less likely to attract local city-bound traffic from Bearna by virtue of its location to the west. Instead, traffic would make use of another connection either at the Bearna to Moycullen Road or at the proposed connection with the Cappagh Road, with the result that the projected reduction in traffic on the R337 into Galway City is greater than for the Red2 and Orange2 Route Options thus providing greater relief from severance. Local traffic from Bearna would also be able to connect via the Bearna-Moycullen Road, although this is currently narrow and would need to be widened to permit such use. If so, the curtilage of up to 20 houses could be affected and the additional traffic would represent a significant increase on current volumes presenting an impact on local environmental amenity at a community level.

The Yellow2 Route Option would permit a considerable reduction in traffic volumes on the main street of Bearna. This reduction would likely exceed that which might be expected of the proposed relief road and would result in both reduced congestion and severance in the village centre, particularly at the crossroads with Pier Road. It would also reduce traffic and severance on the existing R336 in the vicinity of the current location of Bearna Primary School. This transference of traffic would allow the village to realise aspirations for an improved public realm and greater pedestrian and cyclist activity as set out in the Bearna Local Area Plan. The traffic model also projects that traffic east of Bearna would be reduced significantly. This would provide relief from severance to Bearna Church and reduced severance and improved environmental amenity on the R336 into Galway City, albeit with some impacts on passing trade for local businesses.

Taking both construction and operation phases into account, the Yellow2 Route Option is ranked as preferred (P) from a human beings perspective in Section 1.

<u>Blue2 Route Option</u>

Principal impacts:

- Option provides functional relief road for Bearna as set out in the LAP; New social severance in Bearna, but only slight-moderately greater than would apply once relief road is complete;
- Relief from physical severance in Bearna centre, but only a slight-moderate impact relative to the greater impact that would apply once a relief road is complete; and
- Relief from severance on the R336 into Galway City.

The Blue2 Route Option is the same as the Pink2 Route Option around Bearna village, it then progresses slightly to the south of the Pink2 Option (discussed

below) and involves a construction impact on one residential property (see **Section 7.6.8 Material Assets Non-Agriculture**). The route option cross two local roads in Ballard West where there would be a construction impact on at least one property.

On operation, the Blue2 Option would attract traffic from the R336 west of Bearna and provide for a relief road of the village while a T-junction with the existing R336 would allow access into the village itself. The Bearna Inner Relief Road was proposed to act as an additional village street and to serve as access to new community facilities, including a planned relocation of Bearna Primary School.

Although current traffic levels on this road are light, there is existing physical severance due to the presence of perimeter estate walls and the absence of any pedestrian connectivity in between the junctions at either end. Consequently, the Blue2 Option would not present significant new physical severance from structures. Traffic levels would be significantly higher than existing volumes and in this location traffic levels could increase during holiday periods. These levels would be similar to those that would apply if the Bearna Inner Relief Road were to be connected to serve as an alternative to the main street. However, the new use of this road would present new social severance between the core and inner village areas.

The Bearna Inner Relief Road element of the route option would permit a considerable reduction in traffic volumes on the main street of Bearna. This reduction would likely exceed that which might be expected of the proposed Inner Relief Road if it were to be installed in isolation and would result in both reduced congestion and severance in the village centre, particularly at the crossroads with Pier Road. It would also reduce traffic and severance on the existing R336 in the vicinity of the current location of Bearna Primary School. This transference of traffic would allow the village to realise aspirations for an improved public realm and greater pedestrian and cyclist activity as set out in the Bearna Local Area Plan. The traffic model also projects that traffic east of Bearna would be reduced. This would provide relief from severance to Bearna Church and reduced severance and improved environmental amenity on the R336 into Galway City.

Taking both construction and operation phases into account, the Blue2 Route Option is ranked as intermediate (I) from a human beings perspective in Section 1.

Pink2 Route Option

Principal impacts:

- Option provides functional relief road for Bearna as outlined in the LAP;
- New social severance in Bearna, but only slight-moderately greater than would apply once relief road is complete;
- Relief from physical severance in Bearna centre, but only slight to moderately greater than would apply if relief road is completed in isolation; and
- Relief from severance on the R336 into Galway City.

The Pink2 Route Option is similar to the Blue2 Route Option to the north of Bearna village but it avoids significant construction impacts on residential property (see **section 7.6.8 Material Assets Non-Agriculture**). This option would take a northerly direction almost midway between the Bearna-Moycullen Road and the Barr Aille Road and would cross two local roads in Ballard West where there would be a construction impact at several properties.

Operational impacts are as for the Blue2 Route Option highlighted above.

Taking both construction and operation phases into account, the Pink2 Route Option is ranked as intermediate (I) from a human beings perspective in Section 1.

Green2 Route Option

Principal impacts:

- Impacts on individual rural residential properties during construction;
- Avoidance of new community severance in Bearna and some relief from existing severance;
- Less successful at collecting local Bearna traffic than other options (except Green2); and
- Reduction in traffic on R337 into Galway City due to link with Cappagh Road.

The Green2 Route Option would commence on the R336 west of Bearna and from here head directly north across low intensity grazing land. The option does not include roundabout junctions with all minor roads unlike the Yellow2 Route Option, and this would lead to the loss of some residential properties on a cul-de-sac to the east of na Foraí Maola Road. This impact would be combined with an element of social severance for other properties at the end of this cul-de-sac representing a *slight* negative impact, but one that can potentially be reduced by a re-alignment of the entrance to the cul-de-sac. The removal of residential properties on a minor road characterised by ribbon development at Ballard West would potentially present a *slight* negative impact in terms of social severance from neighbouring properties and Bearna to the south.

On operation, the Green2 Option would require local traffic from Bearna village to make a journey of one kilometre or more westwards for journeys back east into Galway City. As such, it would reduce traffic in the centre of Bearna, but would be less convenient for local traffic than the other alternatives (aside from Yellow2 Route Option). Instead, traffic would make use of the proposed connection with the Bearna to Moycullen Road or connection to Cappagh Road with the result that the projected c on the R336 into Galway City would be reduced and so providing for greater relief from severance.

By capturing much of the traffic arriving on the R336 from the west, this route option would reduce the amount of non-local traffic using the main street in Bearna along with providing relief from community severance.

Taking both construction and operation phases into account, the Green2 Route Option is ranked as intermediate (I) from a human beings perspective in Section 1.

Section 2

Red2 Route Option

Principal impacts:

- Major-profound amenity impacts due to demolitions during construction of cut-and-cover tunnel at Gort na Bró, and Cruachan Park in Rahoon;
- Moderate-major physical and social severance along Seamus Quirke Road during construction of cut-and-cover;
- Major severance and disruption to local journey time at Browne Roundabout during construction;
- Major severance and disruption to local journey time between Browne Roundabout and Newcastle Road Junction during construction;
- Major amenity impact due to demolitions of residential, commercial and community facilities between Browne Roundabout and Newcastle Road;
- Major amenity impact due to demolition of Kingfisher Sports Club and difficulty of replacing facilities in the short-term;
- Significant construction impacts on journey amenity, green space and environmental amenity on elevated section between River Corrib and Kirwan Roundabout;
- New physical and social severance on the Western Distributor Road due to increased traffic in the operational phase;
- Potential for relief from physical and social severance and improved environmental amenity along Seamus Quirke Road complemented by good urban design and improved facilities for local journeys;
- Potential for relief from physical severance at Newcastle Road Junction;
- Improved access for emergency vehicles to Galway University Hospital;
- Much improved traffic flow and so journey time and amenity benefits at Bodkin Roundabout, Kirwan Roundabout and junction with N17; and
- Relief from severance on Tuam Road into Galway City centre.

West of River Corrib

In Section 2, the Red2 Route Option connects with the Western Distributor Road and so the construction phase would involve a slight degree of community severance due to works. At Gort na Bró the option enters a cut-and-cover tunnel section. Given the lengthy duration of cut-and-cover works, construction impacts for the Red2 Route Option become relatively significant compared with other route options. For the duration of the works, significant impacts would apply due to the need to demolish several properties on the Gort na Bró estate and to excavate across two pitches to the north off Miller's Lane which are used by various clubs. Additional *major-profound* negative construction impacts are presented by the need to demolish a large number of properties to the east off Cruachan Park and by impacts on access to many more properties during construction. Further impacts are presented by the temporary loss of use and disruption to an area of amenity green space and the historic Rahoon Graveyard. There is also the potential for noise related impacts to a nearby hotel on Bishop O'Donnell Road (see **Section 7.6.10 Noise and Vibration**).

The very significant construction works are required along Seamus Quirke Road for the Red2 Route Option. The extended duration of works present *major negative* impacts on journey amenity and severance along with knock-on implications for retail and community facilities such as - but not limited to - the Sacred Heart Church. There are relatively few residential properties along this section of road, mainly those at Currach Bui and Gleann Dara, but amenity and severance impacts would be of *major* significance. There would also be a direct demolition impact on at least one retail business (see **Section 7.6.8 Material Assets Non-Agriculture**).

Further construction impacts would apply to surface works at the location of the current Browne Roundabout and between here and the river. Existing severance at the roundabout and across both the N6 and Newcastle Road is very high, but construction works could add to this impact in the short-term. Once again, this would involve as yet unspecified impacts on traffic movement, but with inevitable impacts on journey amenity including at Newcastle Road. Physical severance and detours would be likely at times between departments of the university north and south of the works/N6.

East of Browne Roundabout, construction impacts on general environmental amenity would also apply to residential properties, most especially on Inchnagoill Road, Newcastle Road and Ardilaun Road where some demolitions would be necessary. There would be the prospect of a significant impact on the Ability West facility and on commercial businesses located off Snipe Avenue plus a service station on the N6. A very significant impact would be the demolition of the NUIG Kingfisher Sports Centre due to the need for new access to the Newcastle Road. The sports centre is a popular facility that is used by students and the wider community. A new facility would be needed, but with the certain loss of facilities in the short-term.

On operation, the Red2 Route Option would result in a projected increase in traffic on the Western Distributor Road. The road has been designed to accommodate a higher traffic volume than that prevailing at present, but the additional traffic would result in a *moderate* increase in severance along the western section of the road to a *major* increase in the east. This would be in the form of both social and physical severance between residential estates, but moderated by the relatively small number of community facilities.

The traffic model projects a significant increase in traffic by 2019. On the other hand, the use of cut-and-cover tunnel would result in relief from physical and social severance at the surface along the length of the existing Seamus Quirke Road. This positive impact could be reinforced through good urban design, landscaping and the addition of segregated foot and cycle paths between neighbourhoods and community facilities with additional benefits for social interaction and inclusion. Surface traffic would be limited to local access and pubic transport, albeit including access to busy shopping centres. There would also be the potential to provide improved access to Galway University Hospital.

However, to the east of Westside, as far as Newcastle Road, there is a risk of additional social severance once the option resurfaces above ground with a projected increase in traffic volumes.This impact could though be mitigated somewhat by the redesign of the junctions with Thomas Hynes Road and Newcastle Road. In principle, there is potential to reduce severance relative to the high severance experienced at present and to encourage a much higher level of cycle and

pedestrian journeys. Potentially, traffic movement could be improved at these two junctions with the potential to separate local and through traffic.

Of relevance to these sections of the Red2 Route Option, the Galway City Development Plan discusses the importance of increasing permeability and accessibility between residential areas. Therefore, the use of the cut-and-cover design could potentially lead to relief from severance on operation. The problem is that the construction phase could last for six years such that the very significant severance impacts during this period would be prolonged with, in some cases, permanent negative economic or social impacts. A more permanent impression of separation of the NUIG campus site would also be presented by the additional river crossing needed of the River Corrib. The Red2 Route Option would cross the river on the existing Quincentenary Bridge, but a new bridge would be needed for local traffic to the immediate south.

East of the River Corrib

Construction impacts on journey patterns and local environmental amenity (see **Section 7.6.5 Landscape & Visual** and **Section 7.6.10 Noise and Vibration**) can be expected along the proposed raised section of road above the Headford Road and the Terryland River. The construction would have a direct impact on part of the area occupied by one retail business.

From the Kirwan Roundabout, the route option follows the existing N6 without significant new socio-economic impacts until the Glenanail Estate where a general amenity impact is presented due to several private properties being directly impacted by the need to accommodate a junction with the N17. A direct impact would also apply to four businesses and to part of the premises of at least two other businesses adjacent to the N6 and N17 so as to allow space for a junction at this location (see **Section 7.5.8 Material Assets Non-Agriculture**).

Beyond the junction with the N17, construction works would be needed to add a new lane in each direction and this would add to existing significant community severance along this section of the road in Briarhill. Construction works would also affect traffic flow at the Briarhill Junction with the R339 and Monivea Road as well as impacting on private residences at this location. Along with environmental factors, any limitations on access during this phase could have an economic impact on a hotel and other nearby businesses. East of Monivea, the option passes relatively close to Coolagh and has a direct impact on at least one private residence.

On operation, the elevated section of the Red2 Option above the Headford Road would have east-west slip lanes to the Bodkin Roundabout. This would have the effect of transferring through traffic away from the roundabout and improving local access to retail and community facilities for pedestrians, cyclists and vehicles. The raised section would follow the Terryland River linear park and greenway, but the area to the west of the Bodkin Roundabout is well used by the local community and would incur a significant amenity impact due to this option and the proposed slip lanes. Further east, behind the retail area, the riverside path is rather underdeveloped. Some loss of green space would also occur between the existing N6 and Sandyvale Lawn. Although this green space is rather underdeveloped at present, there are proposals for a greenway linking the large Terryland Forest area to the north-east. The option would introduce noise and visual intrusion (see **Section 7.6.5 Landscape & Visual** and **section 7.6.10 Noise and Vibration**), but would not physically sever the greenway.

The junction proposed for the N17 would contribute to a decrease in traffic on the R366 Tuam Road with consequent improvements in journey time and amenity on what is currently a busy road into Galway City Centre. Although there are few residences and community facilities on this section of Tuam Road, these do include Colaiste na Coiribe School, a small shopping centre and a bar and restaurant.

To the east of the proposed N17 Junction, the Red2 Route Option follows the existing N6, with a third lane being added in either direction. Although these additional lanes would require widening of the road, the existing severance between the two sides of the road is already severe. Land use is largely commercial west of the Galway Racecourse, but there is a need for access to employment, most of which is inevitably car dependent at present despite the presence of cycle lanes on Ballybane Road.

Taking both construction and operation phases into account, the Red2 Route Option is ranked as least preferred (LP) from a human beings perspective in Section 2.

Orange2 Route Option

Principal impacts:

- Impacts from tunnel entrances during construction on private residences and local traffic;
- Impact on existing green space at eastern tunnel entrance both during construction and operation;
- Significant impacts on community facilities avoided along length of the tunnel;
- Good connectivity into the western city via connection with the Western Distributor Road;
- Good connectivity from the option to N59 through Ballagh avoiding residential areas;
- Opportunity for improved traffic flow with journey time benefits and journey amenity benefits on operation for pedestrians and cyclists at existing junctions between N6 and Thomas Hynes Road and Newcastle Road, Bodkin Roundabout and site of existing Kirwan Roundabout; and
- Reduction in community severance at above locations.

West of River Corrib

The Orange2 Route Option departs from the line of the Red2 Route Option at Barr Aille and follows that of the Blue2 Route Option to Circular Road where it enters a tunnel under the River Corrib and the suburbs of Newcastle and Terryland. The tunnel would be a major infrastructure undertaking and significant impacts can be expected during the construction phase especially at individual properties on its approach to the western tunnel portal entrance (see **Section 7.5.8 Material Assets Non-Agriculture** and **7.6.10 Noise and Vibration**). These impacts are likely to be accompanied by diversions and works on water utilities which could cause local traffic disruption and a negative impact on journey time. Similarly, at the eastern exit from the tunnel portal, direct impacts would occur to some properties on the Headford Road and in the Sandyvale Lawn Estate. Impacts on general amenity would also be experienced at a community level in the latter.

The Orange2 Route Option provides for good connectivity into Galway City from the west via a link to the Western Distributor Road. It also includes a link to the N59 that avoids construction impacts on the neighbourhoods of Ballagh and Bushypark by connecting to the road between Upper Dangan and Bushypark at a point where there is no roadside residential development. The link to the south to the Rahoon Road also avoids construction impacts that would be significant from a socio-economic perspective.

As the Orange2 Route Option is in a tunnel under much of the built-up area of Galway City, socio-economic impacts in the operational phase are avoided even though the tunnel runs below schools and community facilities between Thomas Hynes Road and Upper Newcastle Road and below the Corrib Village student accommodation The location of the proposed link with the N59 minimises potential impacts on community serverance and residential amentiy.

East of River Corrib

The route option continues in a tunnel below residential estates in Terryland emerging to the East of Kirwan Roundabout. An interchange is proposed here in an existing green space area between the N6, the Sandyvale Lawn estate and Cluain Fada. The location of the interchange would impose a significant negative impact on the use of the green space, beginning and continuing for the duration of the construction works. To the east, where the route follows that of Red2 Route Option, construction would have an impact on the community of Glenanáil Estate where several private properties would be directly affected. A direct economic impact also applies to four businesses and to part of the premises of at least two other businesses adjacent to the N6 and N17.

To the east of the N17 Junction, the option follows the existing N6, The construction of a third lane in either direction would add to the existing severance between the two sides of the road, but this is already severe as discussed above for the Red2 Route Option. Construction impacts would affect traffic flow at the Briarhill Junction with the R339 and Monivea Road as well as private residences at this location. Impacts on access could affect a hotel and other nearby businesses. The route option continues east to join the M6, but passes relatively close to Coolagh Village with a direct impact on at least one private residence (See **Section 7.5.8 Material Assets**)

In the operational phase, the interchange at Terryland Park would add to traffic levels on a section of the Headford Road, but community facilities in this location are set back from the road and have local access. Although the green space in which the interchange would be located is rather undeveloped, it does serve local estates as an amenity and provides residential estates with a barrier from the busy N6. Its loss would represent a negative impact. There would also be noise and visual impacts (see **Section 7.6.5 Landscape & Visual** and **Section 7.610 Noise and Vibration**).

The Orange2 Route Option connects with the alignment of the existing N6 east from the interchange in Terryland park and its impacts for the remainder of the route option to Coolagh are the same as those described for the Red2 Route Option assessment above. The junction with the N17 would contribute to a decrease in traffic on the R366 Tuam Road with consequent improvements in journey time and amenity as also discussed above for the Red2 Route Option.

Taking both construction and operation phases into account, the Orange2 Route Option is ranked as preferred (P) from a human beings perspective in Section 2.

Yellow2 Route Option

Principal impacts:

- Major negative amenity impact during both construction and operation on the playing fields of National University of Ireland Galway (NUIG);
- Very significant demolition impact on Sceilg Ard and Tornóg estates in Terryland with prospect of lasting impact on community amenity;
- Significant community amenity impact on green spaces in Terryland during both construction and operation; and
- Opportunity for improved traffic flow with journey time benefits and journey amenity benefits on operation for pedestrians and cyclists at existing junctions between N6 and Thomas Hynes Road and Newcastle Road, Bodkin Roundabout and site of existing Kirwan Roundabout.

West of River Corrib

In the construction phase, the Yellow2 Route Option alignment minimises demolition impacts on property in Aughnacurra Crescent east of the N59 in Dangan, but this is at the cost of a major negative construction and operational impact on the NUIG Recreational Facilities (see also Blue2 Route Option).

In the operational phase, the Yellow2 Route Option would provide for useful connectivity via links to the Cappagh Road and to the end of the Western Distributor Road. Further east, in the vicinity of Dangan, the Yellow2 Route Option passes close to the grounds of Bushypark National School, but without significant community impacts. As noted above this route option would have a major negative impact on the NUIG Recreational Facilities in that both a developed hockey pitch and running track are impacted along with a playing field beside the river. The route option also passes to the west and would present a potential impact on the long-established Dangan House Garden Centre which provides an element of community facility benefits. The route option then crosses above the existing riverside footpath on the west bank and above the line of a proposed greenway on the east bank. This would introduce an intrusion into an area that is currently peaceful, although the crossing is more distant from Menlo Castle than the Pink2 Route Option which is discussed below. (see also **Section 7.6.5 Landscape & Visual** and **7.6.10 Noise and Vibration**).

The link to the N59 would follow that of the Pink2 Route Option which is discussed below and avoid very significant socio-economic residential impacts in Ballagh. Traffic levels on the link to the existing N59 between the new junction and Newcastle are predicted to decrease. Traffic to the east of the Kirwan Roundabout is also predicted to be reduced. On the R338 Seamus Quirke Road, where more community facilities are located, traffic is projected to significantly reduce.

East of River Corrib

The Yellow2 Route Option passes close to private residences on a cul-de-sac off the Coolough Road, and has construction impacts on properties at the end of Carraig Bán estate. There are significant amenity impacts during construction on two green

spaces at the northern edge of the Crestwood Estate and on the Terryland Forest Park.

In between the two green spaces, the Yellow2 Route Option impacts on a large number of properties at the northern extent of Sceilig Árd and on much of the adjacent Tornóg Estate. The latter was developed shortly before the economic recession and contains a mix of occupied and empty apartments and a retail unit. The high number of demolitions here would impose a *major negative* impact on both estates and the established Sceilig Ard estate in particular.

After crossing the Terryland Forest Park, construction impacts for the Yellow2 Route Option correspond to those for the Red2 and Orange2 Route Options once the Yellow2 Route Option connects to the existing N6 as outlined in the sections above. Their impacts include significant negative community impacts on the Glenanail Estate and proximity to the village of Coolagh.

The Yellow2 Route Option involves a short realignment of the Coolough Road. This will not result in significant socio-economic impacts in the operation phase. The route option then takes a south-eastern alignment passing behind Coolough Road and across the entrance to Lackagh Quarry (currently inactive). As noted above, there is a significant community impact on the green space, at the northern edge of the Crestwood Estate including two pitches. There is also a very significant impact on the Terryland Forest area to the east of the Headford Road (see **Section 7.6.5 Landscape & Visual)**. Both green spaces are currently rather undeveloped, but each has considerable potential as future amenity areas for the local community and the city.

The demolition impact on the Sceilig Ard estate in particular could have a lasting impact on community amenity. There is existing social severance in that both the Tornog and Sceilig Ard estates are separated from one another by high walls with the latter also similarly separated from the neighbouring Ballinfoyle Park Estate.

Taking both construction and operation phases into account, the Yellow2 Route Option is ranked as least preferred (LP) from a human beings perspective in Section 2.

<u>Blue2 Route Option</u>

Principal impacts:

- Major negative amenity impact during both construction and operation on the playing fields of National University of Ireland Galway (NUIG);
- Direct construction impacts on some individual businesses at N84 and N17;
- Potential economic impact during and shortly after construction of cut-and-cover under Galway Racecourse;
- Positive impact on operation in terms of new access to Ballybrit Business Park and Galway technology Park from N17;
- Opportunity for improved traffic flow with journey time benefits and journey amenity benefits on operation for pedestrians and cyclists on existing R338 and for junctions at Browne Roundabout, Newcastle Road, Bodkin Roundabout, Kirwan Roundabout and N17 Junction;
- Significant projected increase in traffic on the N84 into Galway from the junction at Ballindooley with implications for journey time and amenity; and

- Significant projected reductions in traffic on the N6 east of Kirwan Roundabout with positive impacts for journey time, journey amenity and severance.

West of River Corrib

In the construction phase, the alignment of the Blue2 Route Option will minimise direct impacts on property in the Aughnacurra Crescent east of the N59, although this would be at the cost of a *major* negative impact on the NUIG Recreational Facilities in that both a developed hockey pitch and running track are impacted along with a playing field beside the river.

The route option includes a connecting link road south to the Bóthar Stiofán and north to the N59 at Gortacleva via Ballagh. The link to the N59 avoids significant residential impacts in the southern part of Ballagh, but does involve an impact on at least two properties to the north, see **Section 7.5.8 Material Assets Non-Agriculture**. The junction for these links from the Blue2 Route Option itself is located to the west of Dangan and presents no particular socio-economic impact.

In the operational phase, the Blue2 Route Option would take a slightly more southern route in the vicinity of Dangan than the Pink2 Route Option (described below). This brings the route option slightly closer to the grounds of St. James National School, Bushypark, but without significant community impacts. Between Dangan and the River Corrib there would be a *major* negative operational impact on the NUIG Recreational Facilities in that both the hockey pitch and running track and playing fields would need to be relocated elsewhere. Developed playing fields to the north of the route option would be separated from the main area to the south, but physical severance can be avoided by maintaining access below the route option and potentially elevating the road on a via duct.

The route option also passes just behind the long-established Dangan House Garden Centre similar to the Yellow2 Route Option outlined above.

While the link to the N59 avoids significant construction impacts in the southern part of Ballagh, it is likely to introduce a degree of social severance to the community on operation. Projected traffic volumes on the link to the N59 are slightly higher than for Yellow2 Route Option While, traffic on the N59 south of the link is predicted to be reduced.

East of River Corrib

In the construction phase, the Blue2 Route Option includes a junction to the east of the N84. This location and design aims to minimise impacts on residential properites and the community in the vicinity of Castlegar, but would present a direct impact on several houses located on the N84 and on part of the site occupied by a commercial property, representing an economic impact.

At the N17 Junction, the route option would impact directly on a large car sales business and the An Post distribution centre.

In addition an economic impact would likely arise from the construction of cut-and-cover tunnel under the racetrack at Galway Racecourse. The works could be accelerated and programmed to avoid interruption to the race calendar, but there could still be an impact on one or more racing events and on perceptions of the turf. These factors could in turn have knock-on economic impacts for the reputation of the Galway Racecourse and for the wider city.

A further construction and operation impact occurs to environmental amenity due to the proximity to Coolagh Village and the residential estate of An Sean Bhaile in Briarhill, but these impacts are more appropriately addressed by the sections on noise and visual impacts (see **Section 7.6.5.Landscape & Visual and 7.6.10 Noise and Vibration).**

The Blue2 Route Option cuts across the northern half of the Lackagh Quarry which is currently inactive. The significance of this route option for economic and employment impacts depends on how the possible future functioning of the quarry is affected and whether any permanent sterilisation of the excavation lands is introduced.

Continuing east in the operational phase, the option includes a junction with the N84 in Ballindooley. This junction would have the effect of significantly increasing projected traffic into Galway on this road with some consequent additions to severance in the urban section, but mostly for access out of adjoining residential estates and therefore journey time and amenity. This route option passes through the dispersed community of Castlegar including the end of an unsurfaced laneway which providesaccess between the two halves of the village community and the houses on School Road below Castlegar National School. A positive impact on the village would be the reduction in traffic levels experienced on School Road itself in the vicinity of the national school and the added community benefits associated with this. A major positive impact is presented on operation by the inclusion in the Blue2 Route Option of proposed access between the northbound N17 and the Ballybrit Business Park and Galway Technology Park.

Southbound traffic on the N17 travelling west continues south on the N17, before turning right onto the westbound slip road to the mainline of the Blue2 Route Option. Eastbound traffic continues south on the N17 and uses the existing infrastructure to travel east, joining the N6 at Coolagh if necessary. The junction provides good connectivity for westbound trips, but would be accompanied by a projected increase in traffic on the N17 to the south of the proposed junction. Although there are no community facilities between the proposed junction and the existing N17 Junction, the increased traffic would impact on journey amenity to businesses and on exits from the minor road to Castlegar Village. By comparison, traffic on the N6 between the N17 and Kirwan Roundabout is projected to be reduced significantly at this locationand beside the Ballybrit Business Park.

There are no particular socio-economic impacts for the proposed tie in junction with the existing N6.

Taking both construction and operation phases into account, the Blue2 Route Option is ranked as intermediate (I) from a human beings perspective in Section 2

Pink2 Route Option

Principal impacts:

- Moderate-major negative amenity impact during both construction and operation on the playing fields of National University of Ireland Galway (NUIG);
- Impact on riverside environmental amenity including in vicinity of Menlo Castle;
- Positive impact on operation in terms of new access to Ballybrit Business Park and Galway technology Park from N17;
- Opportunity for improved traffic flow with journey time benefits and journey amenity benefits on operation for pedestrians and cyclists on existing R338, at Browne Roundabout, Newcastle Road, Bodkin Roundabout, Kirwan Roundabout and N17 Junction;
- Significant projected increase in traffic levels on the N84 into Galway from the junction at Ballindooley with implications for journey time and amenity;
- Moderate economic impact on Galway Racecourse mainly during construction; and
- Significant projected reductions in traffic on the N6 east of Kirwan Roundabout with positive impacts for journey time, journey amenity and severance.

West of River Corrib

In the construction phase, the alignment of the Pink2 Route Option has a greater impact on individual properties in Aughnacurra Crescent east of the N59 than the Blue2 Route Option. The alignment consequently has a lesser negative impact on the NUIG Recreational Facilities. However, this impact would still be moderate to major in significance in that the developed hockey pitch would be impacted along with a playing field beside the river, although the direct impact on the running track would be less than for the Blue2 Route Option.

This route option includes a connecting link road south to the Bóthar Stiofán and north to the N59 at Gortnacleva via Bushypark. The location of the interchange for the N59 would be to the west of Dangan and presents no particular socio-economic impact. To the north of Ballagh, there are fewer impacts on private residences than for the Blue2 Route Option.

In the operational phase, the Pink2 Route Option takes a more northerly route in the vicinity of Dangan than the Blue2 which would distance this route option from the grounds of Bushypark National School relative to Blue2 Route Option, but only slightly. Between Dangan and the River Corrib there would be a moderate-major negative impact on the NUIG Recreational Facilities. The hockey pitch and playing field would need to be relocated while other playing fields to the north of this route option would be separated from the main area to the south. Severance can be avoided by maintaining access below the route option and potentially elevating the road on a viaduct.

An impact on the Dangan House Garden Centre is avoided by the more northerly alignment of the route relative to the Blue2 Route Option. The Pink2 Route Option crosses above the existing riverside footpath on the west bank and above the line of a proposed greenway on the east bank introducing additional noise and visual

intrusion, including to Menlo Castle to which it would be closer than Blue2 Route Option (see **Section 7.6.5.Landscape & Visual and 7.6.10 Noise and Vibration**).

In terms of links to the existing road infrastructure, the Pink2 Route Option involves a beneficialconnection to the end of the Western Distributor Road at Cappagh. The Pink2 Route Option includes a connection south to Bóthar Stiofáin and north to the N59 via Bushypark and Gortacleva. A degree of social severance would be introduced in Ballagh. Traffic on the existing N59 to the south of the N59 link connection is projected to be reduced by a low percentage. Traffic levels on the R338 at Seamus Quirke Road are predicted to be significantly reduced.

East of River Corrib

In the construction phase, the Pink2 Route Option cuts across the northern half of the Lackagh Quarry (currently inactive). As with the Blue2 Route Option outlined above, the significance of this impact depends on how the possible future functioning of the quarry is affected and whether any permanent sterilisation of the excavation lands is introduced. The Pink2 Route Option includes a junction with the N84. The location of this presents a direct impact on several houses located on the N84 and on part of the site occupied bya commercial property, representing an economic impact.

At the N17, the route option takes a more northerly alignment than Blue2 Route Option and therefore avoids a direct impact on a car dealershipand An Post distribution centre. A significant economic impact on Galway Racecourse is largely avoided by the use of a cut-and-cover tunnel to the north of the racetrack of the racecourse. There is some impact on the rear access to the racecourse during the construction phase and on the stables that would have to be addressed to ensure there is no indirect consequences for the racing as this could result in a possible economic impact. As the route option progresses south towards its connection to the existing N6, the Pink2 Route Option avoids impacts on Coolagh Village.

On operation, the proposed junction with the N84 in Ballindooley would have the effect of significantly increasing traffic between the proposed junction and southwards into Galway City with some consequent additions to severance in the urban section, but mostly for access out of adjoining residential estates and therefore journey time and amenity.

The Pink2 Route Option passes through the dispersed community of Castlegar including the end of an unsurfaced laneway which provides access between the two halves of the village community and the houses on School Road below Castlegar National School. A positive impact on the village would be the reduction in traffic levels experienced on School Road itself in the vicinity of the national school and the added community benefits associated with this. A major positive impact is presented on operation by the inclusion in the Pink2 Route Option of proposed access between the northbound N17 and the Ballybrit Business Park and Galway Technology Park.The Pink2 Route Option then enters the cut-and-cover tunnel section to the east of the Galway Racecourse.

Similar to the Blue2 Route, connectivity to the N17 is provided by the access for westbound traffic to the mainline, and for exits from the mainline for eastbound traffic. Similarly the N17 will also connect via a link road to the Ballybrit Business Park. Eastbound N17 traffic would continue to use the existing road infrastructure. The inclusion of proposed access to the Ballybrit Business Park and the Galway Technology Park, and the connection between these business parks and the

northbound N17 represents a major positive impact of the route option. An increase in traffic on the N17 south of the junction is projected to increase. Although there are no community facilities between the proposed junction and the existing N17 Junction, the increased traffic would impact on journey amenity to businesses and on exits from the minor road to Castlegar Village.

Similar to the Blue2 Route Option outlined above, traffic on the N6 between the N17 and Kirwan Roundabout is reduced.

Taking both construction and operation phases into account, the Pink2 Route Option is ranked as intermediate (I) from a human beings perspective in Section 2.

Green2 Route Option

Principal impacts:

- Construction impact and loss of existing equestrian facility at Tonabrocky;
- Impact on residential property in Ballagh and Bushypark followed by general amenity and social severance impact on operation;
- Good connectivity to Western Distributor Road and N59;
- Major to profound construction, amenity and social severance impact to the historic community of Menlough;
- Impacts to riverside amenity in the vicinity of Menlough Graveyard;
- Significant construction impacts due to proposed interchange at Ballindooley with implications for social severance, albeit with opportunities to provide relief from severance between the historic village of Ballindooley, the castle and lands to the east;
- Major economic impact on Roadstone Quarry;
- Good connectivity provided by interchange with N17, but with projections of increased traffic and some impacts on journey amenity to the south and into Galway City;
- Moderate economic impact on Galway Racecourse mainly during construction;
- Opportunity for improved traffic flow with journey time benefits and journey amenity benefits on operation for pedestrians and cyclists on existing R338 and for junctions at Browne Roundabout, Newcastle Road, Bodkin Roundabout, Kirwan Roundabout and N17 Junction; and
- Significant projected reductions in traffic on the N6 east of Kirwan Roundabout with positive impacts for journey time, journey amenity and severance.

West of River Corrib

The construction phase of the Green2 Route Option includes a direct significant amenity impact on a community facility, namely an equestrian centre off Tonabrocky Road close to the crossroads with the Gortnacleva Road. To the east, the route option cuts across the end of a residential cul-de-sac in Ballagh and impacts on a number of residential properties at Bushypark on the N59. The option passes through the middle of the community and directly impacts on a length of established houses on the N59. The proposed landtake needed to accommodate the junction on the N59 would involve a significant socio-economic impact by virtue

of the number of houses that would need to be demolished (see also **Section 7.6.5 Landscape & Visual and Section 7.5.8 Material Assets Non-Agricultural**).

In the operational phase, the Green2 Option passes beside a residential estate off Ballymoneen Road. Of all the route options, the Green2 Route Option passes closest to this estate, although impacts are more appropriately addressed in the assessments of noise and visual impacts. At Ballagh and Bushypark, the Green2 Route Option would present a significant impact on general amenity and social severance, although no community facilities are directly affected. There would also be an amenity impact to a corner of the Glenlo Abbey golf course. Traffic on the R338 at Seamus Quirke Road is projected to fall by over 36% to 7,409 AADT with the added benefits associated with relief from severance and higher amenity for pedestrians and cyclists.

The Green2 Route Option includes a useful connection to the Cappagh Road and therefore to the end of the Western Distributor Road to the benefit of connectivity and reducing journey time to and from the western side of the city. The option also includes a useful direct connection to the N59, although the projected change in traffic on the N59 south of the proposed junction is an increase of 7.4% compared with the reductions of similar scale that are projected for the Blue2 and Pink2 Route Options. This would introduce slight new severance to community facilities and built-up sections of the road to the south.

East of River Corrib

At Menlough, the Green2 Route Option involves a direct construction impact on the middle of the village with impacts on several residential properties. This impact is considered to be *major* negative. At Ballindooley, a significant landtake would be required for the interchange with the N84 in Ballindooley. Although located to the west of the heart of this dispersed community, the site nevertheless impacts on several private residences.

As with the Pink2 Route Option, the Green2 Route enters a cut-and-cover tunnel section along the eastern boundary of Galway Racecourse and commercial units of the Galway Technology Park. There are potential construction impacts on access and on the stables associated with the Galway Racecourse, one business and private properties at Ballybrit Crescent. The impacts on the stables could indirectly affect the racing season with a possible economic impact. There is also an impact on some properties near Breanloughaun Road before the crossing of the R339.

On operation, the Green2 Route Option passes behind the historic Menlo Graveyard beside the river, an overgrown site that is also used for casual walks. The crossing of the river here is also close to a jetty. Although slightly concealed from the public parking, noise impacts here are inevitable and the road itself would be visible from the western bank side of the river. The visual impact of the bridge itself is best addressed in **Section 7.6.5 Landscape and Visual impacts.** Refer also to **Section 7.6.10 Noise and Vibration.**

This route option then continues through the middle of the village of Menlough. The alignment, while avoiding potentially more impacts on residences and community facilities to the north or south, presents significant social severance for a historic community whose heritage contribution is acknowledged in the Galway City Development Plan. This impact is considered to be *major-profound* negative. The route option then progresses eastwards to the rear of private residences on Monument Road where it presents visual intrusion between these residents and the

road, and the view of Lough Corrib. The location is listed as a Protected View in the Development Plan. The impact is of relevance to journey amenity and potentially to tourism, but is addressed specifically in the section on visual impacts (see **Section 7.6.5 Landscape & Visual**).

The Green2 Route Option continues south to Ballindooley. This community is dispersed along minor roads parallel to the Headford Road with a slightly greater concentration of houses to the north. Although the link road is located to the west of the heart of this dispersed community of Ballindooley, the location for the realignment of the N84 and the junction would contribute further to the social severance of the two parts of the community. The junction would, however, contribute to a transfer of much traffic from the existing N84 and this would reduce severance between Ballindooley, Ballindooley Castle, the lough and the landscape east towards Castlegar (see also **Section 7.6.5, Landscape & Visual**). The net impact would likely tend to the negative, but could be mitigated.

To the east of the N84, a direct *major* economic impact would occur on the Roadstone Quarry at Twomileditch, including to current buildings, yards and access as well as sterilisation of known aggregate deposits. The quarry is a major working facility and, being close to a major city, presents less transport-related impacts than more distant sources of stone. The economic and employment impact is assessed as significant.

A full junction is provided with the N17 providing for east and west connectivity. However, the traffic projections for the N17 south of the junction show a big increase. Community facilities on the road are mostly represented by retail and employment to which access is typically by motor vehicle. The increase could require mitigation to allow exits onto the N17 from the enterprises and from the minor Castlegar Road. At present, these manoeuvres are rather hazardous and represent an adverse impact on journey amenity.

The Green2 Route Option is the only route option which avoids Coolagh, Briarhill. It passes to the north, avoiding impacts on a historic community whose heritage, like that of Menlough, is acknowledged in the City Development Plan.

Traffic on the existing N6 is projected to reduce in the vicinity of the Ballybrit Business Park and between the N17 and Kirwan Roundabout. These reductions are similar to those predicted for the Blue2 and Pink2 Route Options and would have similar positive impacts in terms of journey time, journey amenity and relief from severance. The residual traffic levels would be of a similar, but slightly higher than Blue2 and Pink2 Route Options due to the more distant location of the route option from the city.

Taking both construction and operation phases into account, the Green2 Route Option is ranked as least preferred (LP) from a human beings perspective in Section 2.

Section 3

Section 3 assesses the proposed junction with the existing N6 for each of the route options. For the Red2, Orange2, Yellow2, Blue2 and Pink2 Route Option, the junction proposed for Briarhill are all the same and would permit access to the existing N6 (Bóthar na dTreabh) and to the R339 for local access including to retail,

hotel and other commercial facilities. There are no particular socio-economic impacts for the proposed tie in junction with the existing N6 for these route options.

Similary, there are no particular socio-economic impacts for the proposed tie in junction with the existing N6 for the Green2 Route Option, although this is located close to the edge of the historic community of Coolagh. Taking both construction and operation phases into account, the all of the route options are ranked as intermediate from a human beings perspective in Section 3.

7.6.11.4 Summary

The route options in Section 1 avoid residential properties to a varying degree in a location which has experienced much ribbon type residential development. However, their respective functionality is dependent on the delivery of a Bearna relief road outside of the scheme and the level of traffic that is judged to be acceptable for it to carry through a short, length of built-up area.

The Yellow2 Route Option in Section 1 is the preferred route option, and the Green2 Route Option in second place and ranked as intermediate. The Blue2 and Pink2 Route Options are also ranked as intermediate. The Red2 and Orange2 Route Option is the least preferred in terms of socio-economic and human impacts.

In Section 2, there are some key impacts of high significance to an assessment of the welfare of human beings. For the Green2 Route Option, there are three significant severance and amenity impacts applying to the communities of Ballagh, Ballindooley and, especially, Menlough. The location of numerous sites of natural heritage value and locations of historic or cultural value make it difficult to identify a route option in this area that avoids these impacts in their entirety.

For the Blue2 Route Option, there are significant severance impacts in Upper Dangan, at the crossing of the NUIG Recreational Facilities and at the Galway Racecourse. By comparison, the alignment of the Pink2 Route Option has a lesser impact on the playing fields, but a greater relative impact on residential properties in Dangan while avoiding a direct impact on the racetrack of Galway Racecourse. In connecting to the N59, the Blue2 and Pink2 Route Options both impact on the community of Ballagh, although the respective alignments offer some opportunities to minimise impacts on residential property. The link to the N59 offered by the Orange2 Route Option has the least impact of the N59 Link options. The Yellow2 Route Option brings the scheme closer tothe city, but at the expense of significant impacts on residential estates and amenity green space causing this route option to become an inferior option relative to the Blue2 and Pink2 Route Options.

The Red2 Route Option takes the scheme through the city. Potentially, there are benefits to improved traffic flow and relief from severance at locations that already present significant adverse impacts to the local community posed by the existing road. However, any gains would be achieved at the expense of considerable number of demolitions and impacts on the local community. There will also be a long construction period during which there will be very significant severance and amenity impacts.

In addition to the local community impacts, each of the route options must demonstrate an ability to address the city's traffic problems in a context where only a percentage of N6 traffic finds its way into west County Galway. The location,

number and functionality of junctions on each route option is an added consideration in this respect.

The ranking below (which combines the construction and operational phases) is based on the summary impacts which are described in **Table 7.6.11.1** below. These list the principle impacts under the headings of construction, journey characteristics, journey amenity, general amenity, severance and economic impacts. Impacts vary in their significance and magnitude, the latter a reflection of the number or receptors (people or businesses) affected. The levels of significance and magnitude can be scored. If construction impacts are weighted at two-thirds of operational impacts, the totals in Section 1 favour the Yellow2 Route Option, but without a distinct margin. In Section 2, the order is Orange2, Pink2, Blue2, Yellow2, , Green2 and Red2 Route Options. Sections of these route options with the lowest impacts can be combined to provide a preferred route option. For Section 3 there are no particular socio-economic impacts for the proposed tie in junction with the existing N6 for any of the route options and, as such, they are all ranked as intermediate from a human beings perspective.

Table 7.6.11.1 Summary of Human Being ranking of Route Options

Route Option	Section 1	Section 2	Section 3
Red2	LP	LP	I
Orange2	LP	P	I
Yellow2	P	LP	I
Blue2	I	I	I
Pink2	I	I	I
Green2	I	LP	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

Table 7.6.11.2 Summary of Construction Impacts

Route Option	Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
RED2	Amenity	Gort na Bro	Residential estate	Demolition of properties at end of crescent due to cut-&cover	Major negative	Low
	Amenity	Gort na Bro/ Miller's Lane	Two pitches	Loss of amenity during construction	Moderate negative	Medium
	Amenity & severance	Rahoon	Residential estates	Community level impacts due to demolition of high number of properties on Gort Crein, Cruchan Park & Bun Caise.	Major-profound negative	High
	Amenity	Rahoon	Historic graveyard and green space	Temporary loss of use	Moderate negative	Medium
	Economic	Hanley Oaks Hotel, Rahoon	Hotel beside busy road	Noise and visual intrusion due to works	Slight negative	Low
	Journey time and journey amenity	Seamus Quirke Road	Busy road subject to congestion	Detours and prospect of delay	Major negative	Very High
	Amenity and severance	Seamus Quirke Road	Residential areas & community facilities	Noise and visual intrusion plus severance	Moderate-major negative	High
	Economic	Seamus Quirke Road	Retail facilities	Severance, direct impact on two businesses and indirect impact from journey amenity	Moderate negative	High
	Journey time and severance	Browne Roundabout	Busy traffic junction	Impacts on journey time and severance	Major negative	Very high
	Journey time	N6/Newcastle Road	High traffic volumes and busy junction	Disruption. Need to provide alternative routes.	Major negative	Very high

Route Option	Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
	Amenity	Inchnagoill Road, Newcastle Road and Ardilaun Road	Residential estates and properties. Hugh traffic envir	Some demolitions. Proximity to major road works	Major negative	Medium
	Community facility Amenity	Ability West, Snipe Avenue	Community facility	Loss of facility.	Major negative	Medium
	Economic	University College Hospital Galway	Busy public hospital	Noise and visual intrusion due to works	Moderate negative	
	Severance	NUIG and Newcastle Road	High severance at Newcastle Road. N6 elevated at NUIG	Diversions for pedestrians and vehicles likely	Major negative	Very high
	Economic	Snipe Avenue	Single businesses	Loss of building	Major negative	Low
	Economic	N6	Service station	Loss of premises	Major negative	Low
	Economic	Newcastle Road (south)	Guest house	Loss of premises	Major negative	Low
	Amenity	Kingfisher Sports Centre	Busy sports facility	Loss of premises. Although loss of facilities may be temporary	Major negative	Very high
	Amenity	Green space along Terryland River	Highly trafficked environment	Construction works	Major negative	Medium
	Journey time and journey amenity	Eastbound approach to Bodkin Roundabout	High traffic volumes	Likelihood of disruption and diversions	Major negative	Very high
	Economic	Bodlkin Roundabout	Dunnes Stores	Temporary and possibly permanent loss of part of store	Moderate negative	Medium

Route Option	Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
	Economic	N6/N17 Junction	At least two businesses	Loss of four and part of at least two other business premises	Major negative	Low
	Journey amenity	Briarhill Junction	High traffic volumes	Likely disruption	Negative (unspecified)	Very high
	Economic	Clayton Hotel at Briarhill Junction	High traffic volumes	Possible access and noise impacts	Slight negative	Low
ORANGE2	Journey amenity	Circular Road	Moderate traffic volumes at peak times	Likely diversions and tunnel works at Circular Road	Negative (unspecified)	Medium
	Amenity	Bushypark	Bushypark Church	Noise and visual intrusion due to works	Slight negative	
	Journey amenity	Headford Road & Kirwan Roundabout	High traffic volumes at peak times	Likely disruption due to tunnel works	Negative (unspecified)	Very high
	General amenity	Sandyford Lawn	Residential estate	Environmental impacts	Negative (See Noise)	Medium
YELLOW2	Amenity	Terryland	Residential estates	Community level impacts due to demolition of high number of properties on Sceilig Ard, Tornog and Carraig Bán Estates.	Major negative	High
YELLOW2 &PINK2	Amenity	NUIG Recreational Facilities	Sports grounds	Visual, severance and construction traffic impacts	Moderate Negative	High
	Traffic	Clybaun Junction	Busy junction	Likely disruption	Moderate to Major negative	Very high
YELLOW2 & BLUE2	Community Facility	St James National School, Bushypark	Local national school	Noise and visual intrusion due to works	Slight negative	

Route Option	Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
	Amenity					
BLUE2	Economic	Galway Racecourse	n/a	Potential impact of cut-&-cover on race meets and business	Major negative	Medium
	Traffic	Clybaun Junction	Busy junction	Likely disruption	Moderate to Major negative	Very high
	Amenity	NUIG Recreational Facilities	Sports grounds	Visual, severance and construction traffic impacts	Major Negative	High
PINK2	Economic	Galway Racecourse	n/a	Impact of route option on racecourse buildings & disruptions during construction	Major negative	Medium
GREEN2	Severance & general amenity	Ballagh / Bushypark	n/a	Severance and amenity impacts	Major negative	Medium
	Severance & general amenity	Menlough	n/a	Severance and amenity impacts	Major negative	Medium
	Severance & general amenity	Ballindooley	n/a	Severance and amenity impacts	Major negative	Medium
	Economic	Galway Racecourse	n/a	Impact of route option on racecourse buildings & disruptions during construction	Major negative	Medium

Table 7.6.11.3 Summary of Operational Characteristics

Route Option	Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
Section 1 ALL	Severance and amenity	Bearna	Moderate traffic volumes. Higher in holiday period.	Reduced severance along with improved residential amenity and parking opportunity	Moderate positive	High
Section 1 RED2	Connectivity	Bearna	Congestion at peak times	Option effective at collecting local Bearna traffic	Moderate positive	Medium
Section 1 ORANGE2	Connectivity	Bearna	Congestion at peak times	Option collects local Bearna traffic but requirement for 1km+ diversion west or use of minor Bearna-Moycullen road.	Slight positive	Medium
Section 1 YELLOW2	Journey time, convenience and connectivity	Bearna	Congestion at peak times	Option collects local Bearna traffic but requirement for 1km+ diversion west or use of minor Bearna-Moycullen road.	Slight positive	Medium
Section 1 BLUE2	Connectivity (as PINK2)	Bearna	Congestion at peak times	Option effective at collecting local Bearna traffic	Moderate positive	Medium
Section 1 PINK2	Connectivity (as BLUE2)	Bearna	Congestion at peak times	Option effective at collecting local Bearna traffic	Moderate positive	Medium
Section 1 GREEN2	Connectivity	Bearna	Congestion at peak times	Option collects local Bearna traffic but requirement for 1km+ diversion west or use of minor Bearna-Moycullen road.	Slight positive	Medium
Section 2 ALL OPTIONS	Improved journey amenity	N6, Seamus Quirke Road and Bishop O'Donnell Road	Congestion and high traffic volumes	A proportion of traffic transferred to proposed scheme	Major positive	Very high
	Reduced delay and hazard	Bodkin Roundabout	Delay and congestion for pedestrians and	Separation of local and through traffic	Major positive	Very high

Route Option	Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
			vehicles. No cycle facilities			
	Reduced delay and hazard	Kirwan Roundabout	Delay and congestion for pedestrians and vehicles. No cycle facilities	Separation of local and through traffic	Major positive	Very high
Section 2 RED2	Connectivity	Western Distributor Road	n/a	Useful connection into western city suburbs onto suitable road	Moderate positive	Medium
	Connectivity	Rahoon Road and N59	n/a	Useful connection with local road and with primary road	Major positive	High
	Reduced delay and hazard	Thomas Hynes Road and Newcastle Road	Awkward and hazardous connection with roundabout	Separation of local and through traffic likely with new junction design	Major positive	Very high
	Linear green space	Terryland River east of Bodkin	Green space	Flyover overhead, but potential to improve green space	Neutral / Slight negative	Low
	Connectivity	Galway Racecourse	Temporary access to Galway Racecourse from N6 during race meetings	No access will be available to the racecourse from the Red2 route option.	Moderate negative	
	Environmental	Coolagh	Historic community	Environmental impact on heritage value	Moderate negative	Medium
	Area of green space	Between N6 and Sandyvale Lawn	Green space	Loss of part of green space to Red2 Option	Slight negative	Low
Section 2 ORANGE2	Connectivity	N59	n/a	No direct connectivity to N59, an important route for tourism and regional development	Major negative (unspecified)	Very high

Route Option	Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
	Area of green space	Between N6, Sandyvale Lawn and Cluain Fada	Green space	Loss of much of green space	Moderate negative	Low
	Environmental	Coolagh	Historic community	Environmental impact on heritage value	Moderate negative	Medium
Section 2 YELLOW2	Green space	Crestwood	Green space and pitches	Area of significant future potential amenity value	Moderate negative	Medium
	Green space	Terryland Forest	Natural green space	Area of significant future potential amenity value	Major negative	High
Section 2 RED2, ORANGE2 YELLOW2	Connectivity	N17/ Tuam Road (Bothar Thuaa)	Congestion at peak times	Reduced traffic on the Tuam Road into Galway City Centre	Moderate positive	Very high
	General amenity	Coolagh	Dispersed, but historic community	Option passes close to Coolagh with noise and visual impacts	Negative (see Section 7.6.5and 7.6.10	Medium
Section 2 BLUE2	Severance of playing fields. Direct impact on pitch and running track	NUIG Recreational Facilities	n/a	Severance of fields impacts on the collection of facilities at a single site. There is capacity to reconfigure fields, but a direct impact on the hockey pitch and running track	Major negative	High
	Crossing of footpath and proposed greenway	River Corrib	n/a. Greenway proposed only	Impact on amenity due to noise and visual intrusion (including to Menlo Castle)	See Visual and Noise chapters	Medium
Section 2 PINK2	Severance of playing fields	NUIG Recreational Facilities	n/a	Severance of fields impacts on the collection of facilities at a single site, but there is capacity to reconfigure fields.	Moderate-Major negative	High

Route Option	Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
	Crossing of footpath and proposed greenway	River Corrib	n/a. Greenway proposed only	Impact on amenity due to noise and visual intrusion (including to Menlo Castle)	See Visual and Noise chapters	Medium
	Connectivity	Western Distributor Road	n/a	Useful connection into western city suburbs onto suitable road	Moderate positive	Medium
	Connectivity	Rahoon Road and N59	n/a	Useful connection with local road and with primary road	Major positive	High
	Economic	Galway Racecourse	n/a	Impact of route option on racecourse buildings	Major negative	Medium
Section 2 GREEN2	Equestrian centre	Tonabrocky	Private business community facility	Loss of facility	Slight negative	Low
	Connectivity	N59	n/a	Useful connection with local road and with primary road	Major positive	High
	Journey amenity and tourism	Monument Road, Menlough	Ribbon development, but with views of Lough Corrib	Visual intrusion of route option	Negative (see Visual)	Medium
	Improved safety	Ballindooley	Hazardous connections to local road	Transfer of much traffic to link road	Moderate positive	Medium
	Golf course	Glenlo Park	n/a	Impact on one hole at south-western corner of course	Slight negative	Low
	Environmental	Menlough	Historic graveyard and riverside amenity	No direct impact, but close proximity	Moderate negative	Medium

Route Option	Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
	Environmental	Menlough	Historic community	Environmental impact on heritage and tourism value	Major to profound negative	High
	Economic	Galway Racecourse	n/a	Impact of route option on racecourse buildings	Major negative	Medium
Section 2 GREEN2, BLUE2, PINK2	Journey time, journey amenity and severance	N6 between Kirwan Roundabout and Coolagh	Heavy traffic	Transfer of traffic to route options with reductions in journey time, improvements in journey amenity and relief form severance	Major positive	Very high

Table 7.6.11.4 Summary of Severance

Route Option	Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
ALL OPTIONS (except RED2)	Relief from severance	Bearna centre	Congestion especially at peak times and holiday periods	Though traffic and much local traffic transferred to options	Moderate positive	High
ALL	Relief from severance	R336 and R337 into Galway City	High traffic volumes	Transfer of proportion of traffic	Moderate positive	High
RED2 & (OTHER OPTIONS	Relief form severance	Seamus Quirke Road	Busy road providing access to local facilities and to west	Non-local traffic taken below ground with surface traffic limited to access to residential estates, retail and community facilities.	Major positive	Very high
RED2, ORANGE2	New severance (physical)	Tuam Road (Bothar Thuama)	High severance	Reduced traffic contributing to relief from severance for	Slight positive	Medium

Route Option	Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
				community facilities such as Colaiste Na Coiribe		
RED2	New severance (physical and social severance)	Bearna Inner (relief) road (if built)	Slight-Moderate physical severance	Additional traffic making for moderate severance and new social severance.	Moderate negative	Medium
	Relief from severance	Thomas Hynes Road/ N6	High physical level of severance	Reduced severance likely due to new junction design	Major positive	Very high
	Relief form severance	Newcastle Road/ N6	High physical and social severance	Potential to reduce severance if not traffic volumes	Positive	Very high
	New severance (social)	Ballard West	Ribbon development	New severance (social)	Slight negative	Low
	New severance (social and physical)	Western Distributor Road	Moderate traffic volumes	Increase in traffic volumes particularly east of Clybaun Road	Moderate or Major Severance -	High
YELLOW2	New severance (social)	Between Bearna and its hinterland	Rural area but with ribbon development	Prospect of social severance between Bearna and its rural hinterland	Slight negative	Low
BLUE2	New severance (physical and social severance)	Bearna Inner (relief) Road	Slight-Moderate physical severance	Additional traffic making for moderate severance and new social severance.	Moderate negative	Medium
	New severance (social)	Ballard West	Ribbon development	New severance (social)	Imperceptible to Slight negative	Low

Route Option	Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
	New severance (social)	Ballagh	Dispersed community	Severance (social)	Slight negative	Low
	New severance (social)	NUIG	Separation of site due to bridge and busy N6	Additional bridge, but potential to reduce severance at Newcastle Road	Moderate negative	High
	New severance (social)	Castlegar	Dispersed community	Options cuts across Castlegar minor road below school and across end of a minor road between two halves of Castlegar	Slight negative	Medium
PINK2	New severance (physical and social severance)	Bearna Inner (relief) Road	Slight-Moderate physical severance	Additional traffic making for moderate severance and new social severance.	Moderate negative	Medium
	New severance (social)	Ballagh	Dispersed community	Severance (social)	Slight negative	Low
	New severance (social)	Upper Dangan	Severance north-south due to busy N59	Additional social severance brought about by crossing the community east-west.	Moderate negative	Low
	New severance (social)	Castlegar	Dispersed community	Options cuts across Castlegar minor road below school and across end of a minor road between two halves of Castlegar	Slight negative	Medium
GREEN2	New severance (social)	Cul-de-sac north of Bearna	Recent ribbon development along cul-de-sac	Social severance of end of cul-de-sac and loss of several houses	Slight negative	Low
	New severance (social)	Ballard West	Ribbon development	New severance (social)	Slight negative	Low

Route Option	Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
	New severance (social)	Bushy Park	Established linear development	New severance combined with loss of several established properties (social)	Moderate negative	Medium
	New severance (physical)	N59 / Newcastle Road	Existing severance	Increase in traffic volumes	Slight negative	
	Views to east and castle (private residence)	Ballindooley	Social/psychological severance due to busy N84	Link with community improved by transference of some traffic	Moderate positive	Medium
	New severance (social, phys poss)	Ballindooley	Dispersed established community	Social severance introduced by proposed route and link roads to N84.	Major negative	Medium
	New severance (social)	Menlough	Historic community	Social severance due to road passing through middle of village	Major negative	Medium

Table 7.6.11.5 Summary of Economic Impacts

Route Option	Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
BLUE2	Business (and some community)	Dangan House Garden Centre	Established business in old house	Close proximity, potential noise and visual intrusion	See Noise	Medium
	Business	N84 Headford Road	Single business	Impact on edge of site	Slight negative	Low
	Lackagh Quarry	Menlough	Currently not working	Possible sterilisation of lands	Slight negative	High
	Impact on Kenny Car Sales	Kenny Motors N17	Single business	Direct impact	Major negative	Low
	Galway Racecourse	Galway Racecourse	Business, amenity and tourism	Possible impacts on events. Direct or perceived impact on running of the business.	Major negative	High
	Improved access	Ballybrit and Galway Technology Parks	No current direct access to N17	Direct connection to N17	Major positive (potential to provide link without scheme)	High
PINK2	Business	N84 Headford Road	Single business	Impact on edge of site	Slight negative	Low
	Quarry	Lackagh	Currently not in use	Possible sterilisation of lands	Slight negative	High
	Improved access	Ballybrit and Galway Technology Parks	No current direct access to N17	Direct connection to N17	Major positive (potential to provide link without scheme)	High
	Impact on car park	Briarhill Business Park	Car park	Loss of car park. Alternative location required.	Slight negative	Low

Route Option	Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude
	Economic	Galway Racecourse	Business, amenity and tourism	Impact of route option on racecourse buildings	Major negative	Medium
GREEN2	Equestrian centre	Tonabrocky	Single business	Loss of facility	Major negative	Low
	Impact on quarry	Roadstone	Working quarry	Impacts on operation and possible sterilisation of lands	Major negative	High
	Single business	Galway Technology Park	Builders suppliers	Loss of yard area and most likely of premises	Major negative	Low
	Economic	Galway Racecourse	Business, amenity and tourism	Impact of route option on racecourse buildings	Major negative	Medium

7.6.11.5 References

Environmental Protection Agencey. (2003) *Advice Notes on Current Practice in the Preparation of Environmental Impact Statements*

Environmental Protection Agency. (2002) *Guidelines on the Information to be contained in Environmental Impact Statements;* and

National Roads Authority. (2006) *Environmental Impact Assessment of National Road Schemes – A Practical Guide*

Galway County Development Plan 2015-2021

Galway City Development Plan 2011-2017

7.6.12 Planning

7.6.12.1 Introduction

This section details the Stage 2 assessment of the route options described in **Section 7.1** with respect to the planning policies and constraints identified in **Section 4.9** (**Land Use and Planning)** of this report. The planning constraints along with the land use zoning are presented in **Figures 7.6.12.1** to **7.6.12.2 10**. These six route options are referenced as Red2 Route Option, Orange2 Route Option etc. to differentiate that these are Stage 2 route options.

Section 7.6.12.2 outlines the methodology that was used to carry out the study and **Section 7.6.12.3** details the assessments. A summary is presented in **Section 7.6.12.4** and references are listed in **Section 7.6.12.5**.

7.6.12.2 Methodology

The planning policy assessment focuses on the city and county planning policy and how it interacts with the route options outlined in **Section 7.1**. The assessment identifies where the route options fulfil policy objectives, and where conflicts may arise.

For the purposes of this assessment, the City and County Development Plans (including draft provisions) were reviewed and assessed, in addition to any subsidiary plans, for example, Local Area Plans (LAPs).

For the following assessments, the route options are divided into three sections. **Section 1** extends from the R336 to the Galway City boundary and Section 2 extends from the Galway City boundary to the existing N6 in the east of the city. The final section, **Section 3** has been incorporated in order to compare the junction layouts at the N6 tie-in at Coolagh, Briarhill for the Stage 2 Assessment.

Policies and objectives in both the City and County Development Plans, seek to enhance the natural and built environment, continue to improve economic competitiveness, and deliver an integrated land use and sustainable transport system.

The proposed N6 Galway City Transport Project seeks to respond to the broad policy objectives of the County and City Plans, and the six route options proposed, seek to balance the wider county and city objectives with local objectives. All of the route options provide the potential to improve public transport infrastructure through the removal of through traffic from the city street network, allowing public transport and public realm improvements to take place, facilitating the modal shift to public transport and other non-private vehicles modes such as walking and cycling, as per Government and local policy.

In addition, each of the route options will facilitate the delivery of the planned new town at Ardaun (east Galway) as per the City and County Development Plan objectives. Regeneration of key land banks in the city centre, including at Ceannt Station and the port, will also be facilitated through the easing of congestion on the city street network, making their regeneration more attractive in city-building

terms, thus achieving the city's objective of city consolidation and a strong land use mix in the city core.

7.6.12.3 Options Assessment

Red2 Route Option

The Red2 Route Option closely follows the line of the existing Seamus Quirke Road through the existing established city suburbs and city core. This route option seeks to reuse existing infrastructure where possible, through the existing urban environment, and its delivery would therefore have minimum impact on the wider Galway Metropolitan Area, the sensitive ecological environment around Galway City, and its natural landscape and setting. By seeking to separate through traffic from local traffic, it releases road space on the city's streets and roads for public transport and public realm improvements. However, it would equally introduce significant interventions to the existing road infrastructure and corresponding urban environment, which would have dramatic consequences for the nature of the urban environment of Galway City.

The principal issues arising in planning policy terms from this route option are considered within:

1. The context of the 2011-2017 City Development Plan's strategic goals (Section 1.3) which focus on the economic role of Galway City in the region, a high quality urban environment, and social inclusion, and a number of broad objectives and policies which would be compromised by its delivery;
2. The context of the County Development Plan (2015-2021) including Strategic Aims (Section 1.7), section 2.5 Core Strategy Objectives, section 2.6 Settlement Strategy, and Chapter 9;and
3. Bearna Local Area Plan (2007-2017) including Strategic Vision section 2.1.2, Land Use Strategy section 2.3.2, Village Design Strategy section 2.4.2, and Section 3.

Specifically, it is considered that while policies in the City Development Plan do not specifically preclude the delivery of the Red2 Route Option, there are a number of broad objectives and policies which would be significantly compromised by its delivery. The planning policy framework for Galway City broadly seeks a more connected city structure, a less car dominated environment, and a more consolidated city fabric in land use terms. It is considered that this route option further severs the city and will work against the broad policy objectives.

These policies focus on the following:

- Improvement in the city's urban environment is sought through measures such as enhancement of the built and natural environment to foster sustainable development, and developing plans for parks (including Terryland Park) in conjunction with local residents (Policy 1.7 Environmental Strategy; Chapter 4, Policies 4.6, 4.8, 4.10 Specific Objectives 4.10, Section 7.1, 7.4);
- Integration of land use and sustainable transport systems (as prescribed for LAPs to be delivered in Chapter 2 page 17, Policy 3.2), which addresses quality of life, quality of the environment, and economic competitiveness (as per 3.1

Strategy Integrated Sustainable Transportation, Policy 3.5, 9.2.4 Headford Road LAP);

- Social Inclusion and ease of access to the city is sought in the objective to *Promote Galway as a Child Friendly City, Healthy City and an Age Friendly City* (Chapter 4 page 38, and Policy 6.2); and
- Emphasis on linkages to the city centre and throughout the City including green networks (Chapter 9, Policies 4.2, 4.3).

In addition, policies in the County Development Plan and Bearna Local Area Plan which are impacted by this route option, are noted, as follows:

County Development Plan

- The aim to promote and facilitate sustainable communities (Section 10.2), inclusive communities and integrated development (Strategic Aims 5&6);
- Focal Point and Views Objective, and Landscape Conservation and Management Policies (Policy LCM 1, Objective FPV 1); and
- Development of an integrated sustainable transport system which promotes closer coordination between land use and sustainable transport (Policy TI2, TI4, TI5, TI11).

Bearna Local Area Plan

- To promote consolidation of the Village, protect and enhance the existing landscape setting, character and unique identity of the village (particularly LU1, LU2, LU3, LU4, LU5, Policy 2.4.2A, 2.4.2B, 2.6.3I); and
- Transport policy which promotes the integrity of the Village (Policy 2.7.2A).

Key areas of concern arising in planning policy terms from the Red2 Route Option largely impact Section 2 of the route option, with associated impacts on Section 1:

<u>Section 1</u>

- Provision of major road infrastructure through established residential communities;
- Impacts on consolidation of Bearna Village;
- Demolition of existing residential properties in Knockaunnacarragh (Bearna) and Ballard West
- Direct landtake/removal of existing (retained) residential amenities, including footpaths, gardens, roads, and associated open space at Bearna, Ballard West (north of Bearna);
- Direct land take/removal of existing open space, amenity, parkland, plantings along the road corridor north of Bearna;
- Impact on Protected View No 72 north of Bearna Village; and
- The direct and indirect effect of the loss of existing residences from with the communities at Ballard West.

Section 2

- The construction of significant over ground structures – including an elevated viaduct – through the existing urban area. This will radically alter the character of the city, further divide the NUIG campus, and act as a barrier to consolidated development of the city centre area;
- Impact on protected views on existing Seamus Quirke Bridge over the River Corrib, as well as along R338 east to Headford Road Roundabout and north south along the east bank of the River Corrib;
- The provision of a second bridge over the River Corrib in close proximity to the existing bridge – which includes protected views - and through existing developed areas of NUI Galway;
- The provision – at various levels – of a wide (25 – 75m) corridor of multi-lane road development through an existing sensitive community of mixed residential, community, social, hospital and amenity land uses in the vicinity of Browne Roundabout;
- Demolition of significant numbers of existing residential property – particularly in the vicinity of Browne Roundabout and through Rahoon;
- Direct land take/removal of existing (retained) residential amenities, including footpaths, gardens, roads, and associated open space – most especially from the River Corrib west along Seamus Quirke Road through Rahoon to the Western Distributor Road;
- Direct take/removal of existing open space, amenity, parkland, along the road corridor – particularly through Terryland Forest/River Park to River Corrib;
- The direct and indirect effect of the loss of a significant number of existing residences from within the communities at Rahoon; and
- Impact on existing residential communities and businesses during construction stage.

Section 3

- Demolition of existing residential properties and associated amenities at Coolagh-Briarhill;
- The direct and indirect effect of the loss of existing residences from with communities at Coolagh-Briarhill;
- Provision of major road infrastructure through established residential communities.

Overall route:

While positive impacts from the Red2 Route Option arise in relation to the separation of major through-traffic from locally-based traffic and transport movements, and it works towards the enhancement of the Galway Metropolitan Area, it is considered that the negative impacts outlined, particularly in terms of the city centre, outweigh potential positive impacts that would emerge.

Orange2 Route Option

The Orange2 Route Option runs north from east of Bearna past Ballyburke to a proposed tunnel that extends from Letteragh northwest of the city, underneath Newcastle, the River Corrib at Jordan's Island, and Terryland to emerge at Glenanail on the northeast side of the city. From Glenanail the Orange2 Route Option follows the existing N6 past Ballybrit to the east of the city.

The principal issues arising in planning policy terms from this route option are considered within:

1. The context of the 2011-2017 City Development Plan's strategic goals (Section 1.3) and a number of broad objectives and policies which would be compromised by its delivery;
2. The context of the County Development Plan (2015-2021) including Strategic Aims (Section 1.7), section 2.5 Core Strategy Objectives, 2.6 Settlement Strategy, and Chapter 9; and
3. Bearna Local Area Plan (2007-2017) including Strategic Vision section 2.1.2, Land Use Strategy section 2.3.2, Village Design Strategy section 2.4.2, and Section 3.

These specific policies focus on the following:

City Development Plan

- Improvement in the city's urban environment is sought through measures such as enhancement of the built and natural environment to foster sustainable development, and retaining and enhancing the city's special character, and developing plans for parks (including Terryland Park) in conjunction with local residents (Policy 1.7 Environmental Strategy; Chapter 4, Policies 4.6, 4.8, 4.10, Specific Objectives 4.10, Section 7.1, 7.4);
- Views of Special Amenity Value and Interest (Policy 4.8); and
- Integrated sustainable transport strategy (Section 3.1) which focuses on the delivery of a high quality integrated sustainable transportation system to foster social inclusion, economic competitiveness, and quality of life improvements.

County Development Plan

- The aim to promote and facilitate sustainable communities (Section 10.2), inclusive communities and integrated development (Strategic Aims 5&6);
- Focal Point and Views Objective, and Landscape Conservation and Management Policies (Policy LCM 1, Objective FPV 1); and
- Development of an integrated sustainable transport system which promotes closer coordination between land use and sustainable transport (Policy TI2, TI4, TI5, TI11).

Bearna Local Area Plan

- To promote consolidation of the village, protect and enhance the existing landscape setting, character and unique identity of the village (particularly LU1, LU2, LU3, LU4, LU5, Policy 2.4.2A, 2.4.2B, 2.6.3I); and
- Transport policy which promotes the integrity of the village (Policy 2.7.2A).

The Orange2 Route Option offers the positive effect that major traffic infrastructure will be tunnelled under the city, the NUIG campus, and the River Corrib, thereby reducing its impact on the city's character and structure. This will effectively separate through traffic from local city-based traffic, and alleviate congestion at the River Corrib's existing bridge infrastructure, with minimum impact on the city core, Terryland amenity area, and the University area, all of which sit favourably with planning policy and strategic plans. By seeking to separate through traffic from local traffic, it releases road space on the city's streets and roads for public transport and public realm improvements.

In addition, it seeks to support the enhancement of the Galway Metropolitan Area, and promote regional development.

The following are the principal aspects of the Orange2 Route Option that raise concern in the context of planning policy:

Section 1

- Demolition of existing residential properties in Knockaunnacarragh (Bearna) and Ballard West;
- Direct landtake/removal of existing (retained) residential amenities, including footpaths, gardens, roads, and associated open space at Bearna, Ballard West (north of Bearna);
- Direct landtake/removal of existing open space, amenity, parkland, plantings along the road corridor north of Bearna;
- Impact on Protected View No 72 north of Bearna Village;
- The direct and indirect effect of the loss of existing residences from with the communities at Ballard West; and
- Provision of major road infrastructure through established residential communities.

Section 2

- Demolition of existing residential properties – particularly in Letteragh, and Glenanail;
- Direct landtake/removal of existing (retained) residential amenities, including footpaths, gardens, roads, and associated open space at Ballyburke-Keeraun, at Mincloon, at Letteragh, at Terryland and at Bushypark (realigned N59);
- Direct landtake/removal of existing open space, amenity, parkland, plantings along the road corridor at Terryland Forest Park;
- The direct and indirect effect of the loss of existing residences from with the communities at Terryland/Glenanail and elsewhere along the route option;
- Provision of major road infrastructure through established residential communities;
- Impact of major road infrastructure on existing established amenity at Terryland Forest Park; and
- The provision of two tunnel portal sites within existing established residential areas.

Section 3

- Demolition of existing residential properties and associated amenities at Coolagh-Briarhill;
- The direct and indirect effect of the loss of existing residences from with communities at Coolagh-Briarhill; and
- Provision of major road infrastructure through established residential communities.

Yellow2 Route Option

The Yellow2 Route Option passes outside of, and in parts through, the outer central suburbs to the north of the city. The Yellow2 Route Option is in-part similar to the Blue2 and Pink2 Route Options - but in contrast, has a more westerly tie-in to the R336 west of Bearna and utilises a greater length of the existing N6 at Ballybrit to the east of the city.

The principal issues arising in planning policy terms from this route option are considered within:

1. The context of the 2011-2017 City Development Plan's strategic goals (Section 1.3) and a number of broad objectives and policies which would be compromised by its delivery;
2. The context of the County Development Plan (2015-2021) Strategic Aims (Section 1.7) and section 2.6 Settlement Strategy; and
3. Bearna Local Area Plan (2007-2017) including Strategic Vision section 2.1.2, Land Use Strategy section 2.3.2, Village Design Strategy section 2.4.2, and Section 3.

These specific policies focus on the following:

City Development Plan

- The integrity of village settlements within the city boundary (Policy 9.4). Named villages are Menlough, Castlegar, Coolagh-Briarhill and Coolagh-Menlough. Specific Objective 9.7 seeks to prepare a plan for the Menlough area which will explore the amenity potential of the area to the benefit of the wider city, and seek to protect and enhance the character and amenity of Menlough (Policy 9.4, Specific Objective 4.10);
- Integrated green network policy approach (Policy 4.2 Parks and Green Network) seeks to link key amenity areas and natural routeways including high amenity lands such as at Menlough, with riverside walks along the River Corrib, and recreational and amenity zoned lands (Table 4.1, Specific Objectives 4.10);
- Views of Special Amenity Value and Interest (Policy 4.8);
- Networks of Local Biodiversity Areas (Table 4.5) which includes Menlough to Coolagh Hill as an area of high value habitats, and Ballindooley – Castlegar, centred on Ballindooley Lough and Castlegar area; and
- Support for the continued expansion and development of educational institutions in the City (Section 5.2.1).

County Development Plan

- The aim to promote and facilitate sustainable communities (Section 10.2), inclusive communities and integrated development (Strategic Aims 5&6);
- Focal Point and Views Objective, and Landscape Conservation and Management Policies (Policy LCM 1, Objective FPV 1); and
- Development of an integrated sustainable transport system which promotes closer coordination between land use and sustainable transport (Policy TI2, TI4, TI5, TI11).

Bearna Local Area Plan

- To promote consolidation of the village, protect and enhance the existing landscape setting, character and unique identity of the village (particularly LU1, LU2, LU3, LU4, LU5, Policy 2.4.2A, 2.4.2B, 2.6.3I); andTransport policy which promotes the integrity of the village (Policy 2.7.2A).

The Yellow2 Route Option provides the benefit of linking more westerly to the R336, west of Bearna and therefore largely respecting the integrity of the village, and its connection to Galway City. Equally, its fuller utilisation of the existing N6 lessens its negative impacts on areas through which this passes. In addition, it largely protects the integrity of the city proper, running just beyond the city's main built up area, providing the infrastructure to create a more compact city structure.

The following are the principal aspects of the Yellow2 Route Option that raise concern in the context of planning policy:

Section 1

- Demolition of existing residential properties – particularly at local roads at Na Foraí Maola Thiar (Bearna), and at Ballard West;
- The direct and indirect effect of the loss of a significant number of existing residences from within the communities at Na Foraí Maola Thiar (Bearna), Ballard West, Upper Dangan, Carraig Bán/Sceilg Ard,/Ballinfoyle - and elsewhere along the route option;
- Direct landtake/removal/impact on existing/proposed open space, natural amenity, landscape character in running along stream/proposed greenway north of Bearna;
- Potential impact on Greenway proposals, along stream north of Bearna; and
- Impact on Protected View No's 72 & 74 north of Bearna Village.

Section 2

- Demolition of existing residential properties – between The Heath and Aughnacurra to either side of the N59 at Upper Dangan, at Carraig Bán, at Sceilg Ard (near the crossing of the N84 at Ballinfoyle), at Glenburren Park/Glenanail, and at Bushypark (along realigned N59);
- The direct and indirect effect of the loss of existing residences from within the communities at Upper Dangan, Carraig Bán/Sceilg Ard,/Ballinfoyle - and elsewhere along the route option;
- Direct landtake/removal of existing (retained) residential amenities, including property boundaries, portions of gardens, etc. – most particularly to either side

of the N59 at Upper Dangan; as well as at dispersed locations along the length of the scheme, including at Coolagh to Ballinfoyle;

- Impact on the existing amenity, sports and recreational facilities of NUI Galway at Dangan Upper, and at St James's National School, Bushypark where major road infrastructure passes in close proximity to the school grounds, and Terryland Forest Park;
- Significant new bridging of the River Corrib at naturally attractive setting in foreground of view/setting of Menlo Castle;
- Direct landtake/removal/impact on existing/proposed open space, natural amenity, landscape character – particularly in crossing the natural setting of the River Corrib and in passing Coolagh, in crossing open space/stream west of Ballyburke and at Terryland Forest Park;
- Provision of major road infrastructure through established residential communities at Upper Dangan, Coolagh-Menlough, Carraig Bán, Sceilg Ard, Ballinfoyle; and
- Potential impact on Greenway proposals, along River Corrib and at Terryland Forest Park.

Section 3

- Demolition of existing residential properties at Coolagh-Briarhill;
- The direct and indirect effect of the loss of existing residences from with communicates at Coolagh-Briarhill; and
- Provision of major road infrastructure through established residential communities at Coolagh-Briarhill.

Blue2 Route Option

The Blue2 Route Option passes outside of, and in parts through, the outer suburbs of the city. The Blue2 Route Option is broadly similar to the Pink2 Route Option - but in contrast, passes through the racetrack at Galway Racecourse.

The principal issues arising in planning policy terms from this route option are considered within:

1. The context of the 2011-2017 City Development Plan's strategic goals (Section 1.3) and a number of broad objectives and policies which would be compromised by its delivery;
2. The context of the County Development Plan (2015-2021) including Strategic Aims (Section 1.7), section 2.5 Core Strategy Objective, section 2.6 Settlement Strategy and Chapter 9; and
3. Bearna Local Area Plan (2007-2017) including Strategic Vision Section 2.1.2, Land Use Strategy section 2.3.2, Village Design Strategy section 2.4.2 and Section 3.

These specific policies focus on the following:

City Development Plan

- The integrity of village settlements within the city boundary (Policy 9.4). Named villages are Menlough, Castlegar, Coolagh-Briarhill and Coolagh-Menlough. Specific Objective 9.7 seeks to prepare a plan for the Menlough area which will explore the amenity potential of the area to the benefit of the wider city, and seek to protect and enhance the character and amenity of Menlough (Policy 9.4, Specific Objective 4.10). Policy 9.4 also specifically references Castlegar and the potential to reinforce its identity through the protection and enhancement of existing amenities, through the development of a Plan in consultation with local residents (Specific Objective 9.7);
- Integrated green network policy approach (Policy 4.2 Parks and Green Network) seeks to link key amenity areas and natural routeways including high amenity lands such as at Menlough, with riverside walks along the River Corrib, and recreational and amenity zoned lands including at Galway Racecourse (Table 4.1, Specific Objectives 4.10);
- Views of Special Amenity Value and Interest (Policy 4.8);
- Networks of Local Biodiversity Areas (Table 4.5) which includes Menlough to Coolagh Hill as an area of high value habitats, Galway Racecourse, and Ballindooley – Castlegar, centred on Ballindooley Lough and Castlegar area; and
- Support for the continued expansion and development of educational institutions in the City (Section 5.2.1).

County Development Plan

- The aim to promote and facilitate sustainable communities (Section 10.2), inclusive communities and integrated development (Strategic Aims 5&6);
- Focal Point and Views Objective, and Landscape Conservation and Management Policies (Policy LCM 1, Objective FPV 1); and
- Development of an integrated sustainable transport system which promotes closer coordination between land use and sustainable transport (Policy TI2, TI4, TI5, TI11).

Bearna Local Area Plan

- To promote consolidation of the Village, protect and enhance the existing landscape setting, character and unique identity of the village (particularly LU1, LU2, LU3, LU4, LU5, Policy 2.4.2A, 2.4.2B, 2.6.3I); and
- Transport policy which promotes the integrity of the Village (Policy 2.7.2A including Objective RT4 relating to the New Village Street).

The Blue2 Route Option has the benefit of running just beyond the city's main built up area, largely protecting the integrity of the city proper, and providing the infrastructure to create a more compact city structure, while seeking to deliver on the objectives of the Galway Metropolitan Area.

The following are the principal aspects of the Blue2 Route Option that raise concern in the context of planning policy:

Section 1

- Direct landtake/removal of existing (retained) residential amenities, including property boundaries, portions of gardens, etc. at Bearna;
- Provision of major road infrastructure at Bearna;
- Direct take/removal/impact on existing/proposed open space, natural amenity, landscape character, plantings in running along stream/proposed greenway north of Bearna;
- Impact on Protected View No 72 north of Bearna Village; and
- Potential impact on Greenway proposals along stream north of Bearna.

Section 2

- Demolition of existing residential properties – particularly in crossing the N59 (from The Heath through Aughnacurra) at Dangan, in crossing the N84 and in passing through Castlegar, but also at dispersed locations along the length of this route option;
- Corresponding impacts of the removal of residential properties/businesses, including impact on the integrity of the community, impact on the urban fabric, and on the vitality of local community infrastructure;
- Direct landtake/removal of existing (retained) residential amenities, including property boundaries, portions of gardens, etc. – most particularly to either side of the N59 at Dangan; as well as at dispersed locations along the length of this route option, Ballyburke, Letteragh, Coolagh-Menlough and in crossing R339 at Ballybrit;
- N59 link has a significant impact on established residential areas at Ballagh/Bushypark;
- Provision of major road infrastructure through established residential communities at Upper Dangan, Ballindooley, Castlegar and Coolagh;
- Significant new bridging of the River Corrib at naturally attractive setting in foreground of view/setting of Menlo Castle;
- Impact on the existing amenity, sports and recreational facilities of NUI Galway at Dangan Upper, and St. James's National School, Bushypark, where major road infrastructure passes in close proximity to the school grounds;
- Very significant impact on Galway Racecourse operations, during construction phase
- Direct take/removal/impact on existing/proposed open space, natural amenity, landscape character, plantings – particularly in crossing the natural setting of the River Corrib and in passing Castlegar, but also in running along stream/proposed greenway north of Bearna, in crossing open space/stream west of Ballyburke, in crossing Ballybrit;
- Impact on Scenic View at N84 – Ballinfoyle; and
- Potential impact on Greenway proposals along River Corrib.

Section 3

- Direct take/removal/impact on existing/proposed open space, natural amenity, landscape character, plantings in crossing Coolagh.
- Demolition of existing residential properties and associated amenities at Coolagh-Briarhill;
- The direct and indirect effect of the loss of existing residences from with communities at Coolagh-Briarhill; andProvision of major road infrastructure through established residential communities.

Pink2 Route Option

The Pink2 Route Option passes outside of, and in parts through, the outer suburbs of the city. The Pink2 Route Option is broadly similar to the Blue2 Route Option - but in contrast, passes to the north of the racetrack of Galway Racecourse.

The principal issues arising in planning policy terms from this route option are considered within:

1. The context of the 2011-2017 City Development Plan's strategic goals (Section 1.3) and a number of broad objectives and policies which would be compromised by its delivery;
2. The context of the County Development Plan (2015-2021) including Strategic Aims (Section 1.7) section 2.5 Core Strategy Objectives, section 2.6 Settlement Strategy and Chapter 9; and
3. Bearna Local Area Plan (2007-2017) including Strategic Vision section 2.1.2, Land Use Strategy section 2.3.2, Village Design Strategy section 2.4.2 and Section 3.

These specific policies focus on the following:

City Development Plan

- The integrity of village settlements within the city boundary (Policy 9.4). Named villages are Menlough, Castlegar, Coolagh-Briarhill and Coolagh-Menlough. Specific Objective 9.7 seeks to prepare a plan for the Menlough area which will explore the amenity potential of the area to the benefit of the wider city, and seek to protect and enhance the character and amenity of Menlough (Policy 9.4, Specific Objective 4.10). Policy 9.4 also specifically references Castlegar and the potential to reinforce its identity through the protection and enhancement of existing amenities, through the development of a Plan in consultation with local residents (Specific Objective 9.7);
- Integrated green network policy approach (Policy 4.2 Parks and Green Network) seeks to link key amenity areas and natural routeways including high amenity lands such as at Menlough, with riverside walks along the River Corrib, and recreational and amenity zoned lands including at Galway Racecourse (Table 4.1, Specific Objectives 4.10);
- Views of Special Amenity Value and Interest (Policy 4.8);

- Networks of Local Biodiversity Areas (Table 4.5) which includes Menlough to Coolagh Hill as an area of high value habitats, and Ballindooley – Castlegar, centred on Ballindooley Lough and Castlegar area; and

Support for the continued expansion and development of educational institutions in the City (Section 5.2.1).

County Development Plan

- The aim to promote and facilitate sustainable communities (Section 10.2), inclusive communities and integrated development (Strategic Aims 5&6);
- Focal Point and Views Objective, and Landscape Conservation and Management Policies (Policy LCM 1, Objective FPV 1); and
- Development of an integrated sustainable transport system which promotes closer coordination between land use and sustainable transport (Policy TI2, TI4, TI5, TI11).

Bearna Local Area Plan

- To promote consolidation of the village, protect and enhance the existing landscape setting, character and unique identity of the village (particularly LU1, LU2, LU3, LU4, LU5, Policy 2.4.2A, 2.4.2B, 2.6.3I); and
- Transport policy which promotes the integrity of the Village (Policy 2.7.2A including Objective RT4 relating to the New Village Street).

The Pink2 Route Option has the benefit of running just beyond the city's main built up area, largely protecting the integrity of the city proper, and providing the infrastructure to create a more compact city structure, while seeking to deliver on the objectives of the Galway Metropolitan Area. It passes to the north of the racetrack at Galway Racecourse, minimising disruption to its racetrack itself, and further north of the NUIG Recreational Facilities, than the Blue2 Route Option, again seeking to minimise adverse impacts on the university's infrastructure

The following are the principal aspects of the Pink2 Route Option that raise concern in the context of planning policy:

<u>Section 1</u>

- Demolition of existing residential properties at Ballard West;
- Direct landtake/removal of existing (retained) residential amenities, including property boundaries, portions of gardens, etc. at Bearna
- Provision of major road infrastructure at Bearna, and Ballard West;
- Direct take/removal/impact on existing/proposed open space, natural amenity, landscape character, plantings in running along stream/proposed greenway north of Bearna;
- Impact on Protected View No 72 north of Bearna Village; and
- Potential impact on Greenway proposals along stream north of Bearna.

<u>Section 2</u>

- Demolition of significant numbers of existing residential properties from The Heath to Aughnacurra (in crossing the N59 at Dangan and west thereof) and also at dispersed locations along the length of this route option;

- The direct and indirect effect of the loss of a significant number of existing residences from the communities at Upper Dangan - and elsewhere along this route option, including at Menlough, Ballindooley and Castlegar;
- Corresponding impacts of the removal of residential properties/businesses, including impact on the integrity of the community, impact on the urban fabric, and on the vitality of local community infrastructure;
- Direct landtake/removal of existing (retained) residential amenities, including property boundaries, portions of gardens, etc. – most particularly to either side of the N59 at Dangan; as well as at dispersed locations along the length of this route option, including Castlegar;
- Provision of major road infrastructure through established residential communities at The Heath, Upper Dangan, Menlough, Ballinfoyle Castlegar;
- Impact on the proposed future expansion of, sports and recreational facilities of NUI Galway at Dangan Upper, and St. James's National School, Bushypark, where major road infrastructure passes in close proximity to both the university and to the school grounds;
- Significant new bridging of the River Corrib at naturally attractive setting in foreground of view/setting of Menlo Castle;
- Impact on Galway Racecourse operations, during operation phase due to impact on the stables;
- Direct landtake/removal/impact on existing/proposed open space, natural amenity, landscape character, plantings – particularly in crossing the natural setting of the River Corrib and in passing Castlegar, in crossing open space/stream west of Ballyburke and Coolagh; and
- Potential impact on Greenway proposals along River Corrib.

<u>Section 3</u>

- Direct landtake/removal of existing (retained) residential amenities, including property boundaries, portions of gardens, etc. at Coolagh-Briarhill; and
- Provision of major road infrastructure close to established residential communities at Coolagh-Briarhill.

Green2 Route Option

The Green2 Route Option runs through the more rural or edge of city landscape north of Galway City. This route option interacts with significant areas of established development – primarily residential and amenity/recreation related.

The principal issues arising in planning policy terms from this route option are considered within:

1. The context of the 2011-2017 City Development Plan's strategic goals (Section 1.3) and a number of broad objectives and policies which would be compromised by its delivery;

2. The context of the County Development Plan (2015-2021) including Strategic Aims (Section 1.7), section 2.5 Core Strategy Objectives, section 2.6 Settlement Strategy and Chapter 9; and
3. Bearna Local Area Plan (2007-2017) including Strategic Vision section 2.1.2, Land Use Strategy section 2.3.2, Village Design Strategy section 2.4.2 and Section 3.

These specific policies focus on the following:

City Development Plan

- The integrity of village settlements within the city boundary (Policy 9.4). Named villages are Menlough, Castlegar, Coolagh-Briarhill and Coolagh-Menlough. Specific Objectives 9.7 seek to prepare a plan for the Menlough area which will explore the amenity potential of the area to the benefit of the wider city, and seek to protect and enhance the character and amenity of Menlough (Policy 9.4, Specific Objective 4.10);
- Integrated green network policy approach (Policy 4.2 Parks and Green Network) seeks to link key amenity areas and natural routeways including high amenity lands such as at Menlough, with riverside walks along the River Corrib (Table 4.1, Specific Objectives 4.10);
- Views of Special Amenity Value and Interest (Policy 4.8); and
- Networks of Local Biodiversity Areas (Table 4.5) which includes Menlough to Coolagh Hill as an area of high value habitats, and Ballindooley Lough.

County Development Plan

- The aim to promote and facilitate sustainable communities (Section 10.2), inclusive communities and integrated development (Strategic Aims 5&6);
- Focal Point and Views Objective, and Landscape Conservation and Management Policies (Policy LCM 1, Objective FPV 1); and
- Development of an integrated sustainable transport system which promotes closer coordination between land use and sustainable transport (Policy TI2, TI4, TI5, TI11).

Bearna Local Area Plan

- To promote consolidation of the Village, protect and enhance the existing landscape setting, character and unique identity of the village (particularly LU1, LU2, LU3, LU4, LU5, Policy 2.4.2A, 2.4.2B, 2.6.3I); and
- Transport policy which promotes the integrity of the Village (Policy 2.7.2A).

This Green2 Route Option largely avoids the city proper, passing north of NUIG lands, and north of the racetrack at Galway Racecourse, minimising impact on the City. The Green2 Route Option provides the benefit of linking more westerly to the R336, west of Bearna and therefore largely respecting the integrity of the village, and its connection to Galway City, while seeking to deliver on the objectives of the Galway Metropolitan Area.

The following are the principal aspects of the Green2 Route Option that raise concern in the context of planning policy:

Section 1

- Demolition of existing residential properties at An Foraí Maola Thiar (Bearna);
- Corresponding impacts of the removal of residential properties/businesses, including impact on the integrity of the community, impact on the urban fabric, and on the vitality of local community infrastructure;
- Direct landtake/removal of existing (retained) residential amenities, including property boundaries, portions of gardens, etc. at An Foraí Maola (Bearna);
- Provision of major road infrastructure through established residential communities; and
- Impact on Protected Views No's 72 & 74 north of Bearna Village.

Section 2

- Demolition of existing residential properties in crossing the N59 at Ballagh/Bushypark/Dangan Lower, in passing through the village settlement of Menlough, in passing through Ballindooley and in crossing Ballybrit Crescent and the R339 at Coolagh-Briarhill;
- Corresponding impacts of the removal of residential properties/businesses, including impact on the integrity of the community, impact on the urban fabric, and on the vitality of local community infrastructure;
- Direct landtake/removal of existing (retained) residential amenities, including property boundaries, portions of gardens, etc. to either side of the N59 at Gortacleva; in passing through the village settlement of Menlough and east thereof, as well as at dispersed locations along the length of this route option;
- Division between the settlements of Menlough and Menlo Castle;
- Resulting separation of Menlo Castle and its curtilage/demesne (recorded monument and protected structure) from its natural hinterland of Menlough Village;
- Provision of major road infrastructure through established residential communities;
- Significant new bridging of the River Corrib at remote, naturally attractive setting close to link mouth from Lough Corrib;
- The provision of a bridge over the River Corrib in an existing high quality natural landscape setting close to riverside setting of Menlo Castle;
- Impact on existing amenity/recreation facilities (e.g. Equestrian facility at Tonabrocky, Glenlo Abbey Golf Course, and general amenity along the River Corrib);
- Impact on Galway Racecourse operations, during operation phase due to impact on the stables;
- Impact on Scenic Views at N59, at Monument Road (Menlough-Killoughter) and to a lesser extent at N84 - Ballinfoyle; and
- Potential impact on Greenway proposals - most especially along River Corrib towards Lough Corrib.

Section 3

- Demolition of existing residential properties in crossing the R339 at Coolagh-Briarhill;
- Corresponding impacts of the removal of residential properties/businesses, including impact on the integrity of the community, impact on the urban fabric, and on the vitality of local community infrastructure;
- Direct landtake/removal of existing (retained) residential amenities, including property boundaries, portions of gardens, etc. at Coolagh-Briarhill; and
- Provision of major road infrastructure through established residential communities.

7.6.12.4 Summary

The proposed route options seek to deliver on broad planning policy objectives and to work with national, regional, county, city and local objectives, minimising impacts where possible, in order to achieve an overall transport solution for the Galway Metropolitan Area.

Section 1

The Yellow2 and Green 2 Route Options are preferred in Section 1, due to the benefit of linking more westerly to the R336, west of Bearna and therefore largely respecting the integrity of the village, and its connection to Galway City.

Section 2

The Pink2 Route Option is preferred in Section 2. The Pink2 Route Option has the benefit of running just beyond the city's main built up area, largely protecting the integrity of the city proper, and providing the infrastructure to create a more compact city structure.

It has a route which runs north of the racetrack at Galway Racecourse, more northerly of NUIG than the Yellow2 and Blue2 Route Options, and south of Menlough/Menlo Castle & Demesne.

Section 3

The Pink2 Route Option is preferred in Section 3, due to its early tie-in with existing road infrastructure to the east at the N6, and minimised impact on the integrity of Coolagh-Briarhill and its ability to serve the future planned town at Ardaun.

Table 7.6.12.1 below summaries the order of ranking for the route options for each of the three sections.

Table 7.6.12.1 Summary of Planning ranking of Route Options

Route Option	Section 1	Section 2	Section 3
Red2	LP	LP	LP
Orange2	LP	LP	LP
Yellow2	P	LP	LP
Blue2	LP	LP	LP
Pink2	LP	P	P
Green2	I	I	LP

Note: P = Preferred, I = Intermediate, LP = Least Preferred

7.6.12.5 References

Galway City Council. (2011) *Galway County Development Plan 2011-2017;*

Galway County Council. (2007) *Bearna Local Area Plan 2007-2017;*

Galway County Council. (2015) *Galway County Development Plan 2015-2021*;

National University of Ireland. *Galway Strategic Plan* (2015 - 2020)

Ardaun LAP Stage 1. (2014) *Pre-Draft Public Consultation Issues Paper*.

7.6.13 Environmental Summary Matrix

An overall summary of the rankings for each of the environmental appraisals for each of the three sections is included in **Tables 7.6.13.1** to **7.6.13.3** below. Each of the route options were ranked with respect to their impacts for each environmental discipline as follows: Preferred (P), Intermediate (I), and Least Preferred (LP). These terms are used to comparatively assess route options in either Section 1, Section 2 or Section 3 and should not be interpreted to compare the significance of impacts between these sections. For example by virtue of the fact that route options in Section 2 cross a European site whereas in Section 1 they do not, the route option(s) assigned a ranking of LP in Section 2 for ecology are likely to have a much greater impact on the ecological environment than the route option(s) assigned a ranking of LP in Section 1.

The overall ranking for each route option in terms of the environment took into consideration the overall number of preferred, intermediate and least preferred rankings. During the course of the assessment process *Human Beings, Ecology*, *Landscape and Visual, and Material Assets – Non Agricultural* were identified as disciplines which had key significant constraints. For example, impacts on human beings such as communities and residential property acquisitions and impacts on ecology such as on European designated sites were all key significant constraints which required further consideration during the decision making process. Therefore, these disciplines are shown in italics in the summary tables and are referred to as "key environmental disciplines" below.

Section 1

The Yellow2 Route Option is the preferred route option overall for Section 1. It has five preferred, five intermediate and two least preferred rankings. Of the five preferred rankings, three are for key environmental disciplines. Of the two least preferred rankings, one of these was for a key environmental discipline (ecology), however as noted above, route options in Section 2 cross a European site whereas in Section 1 they do not, therefore ecological constraints in Section 1 are not as significant as those in Section 2. The Yellow2 Route Option has the lowest number of least preferred rankings overall.

The Pink2 Route Option has been assigned an Intermediate ranking overall for Section 1. The Pink2 Route Option has one preferred, seven intermediate and four least preferred rankings. The Pink2 Route Option has no key environmental discipline which has a preferred or least preferred ranking,

The Blue2 Route Option has also been assigned an Intermediate ranking overall for Section 1. The Blue2 Route Option has one preferred, six intermediate and five least preferred rankings. Of the five least preferred rankings, one of these was for a key environmental discipline (landscape and visual). This route option has no preferred rankings for a key environmental discipline.

The Red2, Orange2 and Green2 Route Options have all been assigned a Least Preferred ranking overall for Section 1.

The Red2 Route Option has six preferred, two intermediate and four least preferred rankings. Of the four least preferred rankings, three are for key environmental disciplines. The Orange2 Route Option has seven preferred, one intermediate and four least preferred rankings. Of the four least preferred rankings, three are for key

environmental disciplines. The Green2 Route Option has one preferred, five intermediate and six least preferred. Of the six least preferred, three are for key environmental disciplines.

In conclusion, the Yellow2 Route Option is the preferred route option for Section 1.

Section 2

The Orange2 and Pink2 Route Options are both the preferred route options overall for Section 2. The Blue2 Route Option has been assigned an Intermediate ranking overall for Section 2. The Red2, Yellow2 and Green2 Route Options have all been assigned a Least Preferred ranking overall for Section 2. The overall rankings are discussed further below. In addition, given that the Lough Corrib cSAC is one of the more significant constraints in Section 2, ecology ranking is also discussed in more detail below.

Orange2 Route Option

The Orange2 Route Option has been assigned a preferred ranking for Section 2. The Orange2 Route Option has the greatest number of preferred rankings (six), two intermediate and four least preferred. Of the four least preferred rankings, none are for a key environmental discipline. The Orange2 Route Option includes a 3.5km tunnel and therefore many of the environmental constraints are not directly impacted, therefore it has been assigned a preferred ranking overall.

As detailed in Section **7.6.1 Ecology**, the Orange2 Route Option is the preferred route option from an ecological perspective as it avoids direct impacts on the Lough Corrib cSAC and as a significant length of this route option is either predominantly online or underground, its impact is reduced on many of the other ecological receptors identified within the scheme study area.

Pink2 Route Option

The Pink2 Route Option has also been assigned a preferred ranking for Section 2. The Pink2 Route Option has the second highest number of preferred rankings (four), six intermediate rankings and two least preferred. Of the two least preferred rankings, none are for a key environmental discipline. Of the preferred rankings, one is for a key environmental discipline (Material Assets Non-Agriculture). The Pink2 Route Option has the lowest number of least preferred rankings taking all environmental disciplines into consideration.

As detailed in Section **7.6.1 Ecology**, the Pink2 Route Option is ranked as Intermediate from an ecological perspective in Section 2.

Both the Pink2 and Blue2 Route Options are similar from an ecological perspective as although they avoid any direct impacts to Annex I habitats within the boundary of the Lough Corrib cSAC, they will result in some degree of habitat loss within the designated site. Pink2 Route Option has a larger footprint than the Blue2 Route Option within the Lough Corrib cSAC and a greater impact than the Blue2 Route Option on Annex I habitat overall in this section.

Blue2 Route Option

The Blue2 Route Option has been assigned an Intermediate ranking overall for Section 2. It has one preferred ranking, seven intermediate, and four least preferred. Of the four least preferred rankings, one is for a key environmental discipline (landscape and visual). This route option has no preferred rankings for a key discipline.

As detailed in Section **7.6.1 Ecology**, the Blue2 Route Option is ranked as Intermediate from an ecological perspective in Section 2. Blue2 is slightly more preferred than the Pink2 Route Option from an ecological perspective due to its smaller footprint within the Lough Corrib cSAC and lesser impact than the Pink2 Route Opiotn on Annex I habitat overall in this section.

However, other negative impacts were experienced by other environmental disciplines for the Blue2 Route Option, for example the Material Assets Non-Agricultural impacts on NUIG Recreational Facilities and other commercial properties in the vicinity and Landscape and Visual impacts.

Red2 Route Option

The Red2 Route Option has been assigned a Least Preferred ranking overall for Section 2. The Red2 Route Option has three preferred rankings, one intermediate and eight least preferred. Of the eight least preferred, three are key environmental disciplines. This route option has one preferred ranking for a key discipline (Ecology).

As detailed in Section **7.6.1 Ecology**, the Red2 Route Option is ranked as preferred from an ecological perspective in Section 2 (refer to Section **7.6.1 Ecology**). The Red2 Route Option is one of the route options with the lowest overall impact on the Lough Corrib cSAC, the lowest impact on Annex I habitats of all the route options and, by virtue of being predominantly on-line, is likely to have the least impact on most other ecological receptors.

Although the Red2 Route Option is preferred for ecology, it has been assigned a Least Preferred ranking overall because, potential significant/profound impacts have been identified on the Red2Route Option for landscape and visual, archaeology and heritage, material assets non-agriculture and human beings. Other negative impacts are also experienced for other environmental disciplines such as soils and geology, air and climate, planning and noise and vibration. The cumulative impact of all of the other significant/profound negative impacts experienced by the other environmental disciplines means that this route option has been assigned a ranking as Least Preferred overall.

Yellow2 Route Option

The Yellow2 Route Option has been assigned a Least Preferred ranking overall for Section 2. The Yellow2 Route Option has one preferred, four intermediate, one intermediate/least preferred and six least preferred. Of the six least preferred rankings, four are for key environmental disciplines.

As detailed in Section **7.6.1 Ecology**, the Yellow2 Route Option is ranked as least preferred from an ecological perspective in Section 2 because it is the route option with the greatest potential for impacts to QI Annex I habitat within the Lough Corrib cSAC. The Yellow2 Route Option was found to likely result in adverse effects on the integrity of Lough Corrib cSAC (Refer to **Appendix A.7.4**).

Green2 Route Option

The Green2 Route Option has been assigned a Least Preferred ranking overall for Section 2. The Green2 Route Option has one preferred, four intermediate and seven least preferred. Of the seven least preferred rankings, three are key environmental disciplines.

As detailed in Section **7.6.1 Ecology**, the Green2 Route Option is ranked as least preferred from an ecological perspective in Section 2 as it is likely to result in indirect impacts to QI Annex I habitat within the Lough Corrib cSAC but less than that associated with the Yellow2 Route Option. Green2 Route Option was found to likely result in adverse effects on the integrity of Lough Corrib cSAC (Refer to **Appendix A.7.4**).

In conclusion, the Orange2 and Pink2 Route Options are both Preferred for the Environmental Appraisal for Section 2. The Blue2 Route Option is ranked as Intermediate whilst Red2, Yellow2 and Green2 Route Options are ranked as Least Preferred for Section 2.

Section 3

All route options have a similar number of preferred, intermediate and least preferred rankings however the Pink2 Route Option is the preferred for Section 3. It has five preferred, two intermediate and five least preferred rankings. Of the five preferred rankings, two are for key environmental disciplines (landscape and visual and material assets non-agriculture). Of the five least preferred rankings, one is for a key environmental discipline (ecology), however ecological impacts in Section 3 are not on a European site. All other route options are ranked Intermediate as they are all similar in the number of preferred, intermediate and least preferred rankings.

In conclusion, the Pink1 Route Option is the preferred option for Section 3.

Table 7.6.13.1 Environmental Summary Matrix – Section 1

Route Option	***Ecology** *	**Soils & Geology**	**Hydrogeology**	**Hydrology**	***Landscape & Visual**	**Archaeology & Heritage**	**Material Assets - Agri**	***Material Assets - Non Agri**	**Air & Climate**	**Noise & Vibration**	***Human Beings**	**Planning**	**Overall Ranking**
Red2 Option	**P**	I	I	**P**	LP	**P**	**P**	LP	**P**	**P**	LP	LP	LP
Orange2 Option	**P**	**P**	I	**P**	LP	**P**	**P**	LP	**P**	**P**	LP	LP	LP
Yellow2 Option	LP	I	LP	I	**P**	I	I	**P**	**P**	I	**P**	**P**	**P**
Blue2 Option	I	**P**	LP	I	LP	I	I	I	LP	LP	I	LP	I
Pink2 Option	I	I	**P**	LP	I	I	I	I	LP	LP	I	LP	I
Green2 Route	LP	LP	I	I	LP	I	LP	LP	I	LP	I	**P**	LP

*Note: **P (bold & underlined)** = Preferred, I = Intermediate, LP = Least Preferred*

Table 7.6.13.2 Environmental Summary Matrix – Section 2

Route Option	***Ecology** *	**Soils & Geology**	**Hydrogeology**	**Hydrology**	***Landscape & Visual**	**Archaeology & Heritage**	**Material Assets - Agri**	***Material Assets - Non Agri**	**Air & Climate**	**Noise & Vibration**	***Human Beings**	**Planning**	**Overall Ranking**
Red2 Option	**P**	LP	**P**	I	LP	LP	**P**	LP	LP	LP	**LP**	**LP**	LP
Orange2 Option	**P**	LP	I	**P**	**P**	**P**	I	**P**	LP	LP	**P**	LP	**P**
Yellow2 Option	LP	I	I	I/LP	LP	I	I	LP	**P**	LP	LP	LP	LP
Blue2 Option	I	I	LP	I	LP	I	LP	I	**P**	I	I	LP	I
Pink2 Option	I	I	LP	I	I	I	LP	**P**	**P**	**P**	I	**P**	**P**
Green2 Route	LP	**P**	I	I	LP	LP	LP	I	I	LP	LP	LP	LP

*Note: **P (bold & underlined)** = Preferred, I = Intermediate, LP = Least Preferred*

Table 7.6.13.3 Environmental Summary Matrix – Section 3

Route Option	***Ecology****	**Soils & Geology**	**Hydrogeology**	**Hydrology**	***Landscape & Visual****	**Archaeology & Heritage**	**Material Assets - Agri**	***Material Assets - Non Agri****	**Air & Climate**	**Noise & Vibration**	***Human Beings****	**Planning**	**Overall Ranking**
Red2 Option	**P**	I	I	I	LP	**P**	**P**	LP	LP	I	I	LP	I
Orange2 Option	**P**	I	I	I	LP	**P**	**P**	LP	LP	I	I	LP	I
Yellow2 Option	**P**	I	I	I	LP	**P**	**P**	LP	LP	I	I	LP	I
Blue2 Option	**P**	I	I	I	LP	**P**	LP	I	LP	I	I	LP	I
Pink2 Option	LP	**P**	LP	LP	**P**	LP	LP	**P**	I	**P**	I	**P**	**P**
Green2 Route	LP	**P**	I	**P**	I	LP	LP	I	**P**	I	I	LP	I

*Note: **P (bold & underlined)** = Preferred, I = Intermediate, LP = Least Preferred*

7.7 Project Appraisal

7.7.1 Introduction

A project appraisal of Stage 2 Route Options was carried out using the project appraisal matrix (comprising the 5 Common Appraisal Criteria[25] of Economy, Safety, Environment, Accessibility and Social Inclusion and Integration). (Note each of the five appraisal criteria were initially appraised separately in **Sections 7.2-7.6** above). A matrix of this project appraisal for each of the three sections is included in **Section 7.7.2** below. The Galway City boundary line represents the assessment breakline between Section 1 and 2 as this is the point at which route options merge and it becomes possible to switch between route options. The Bearna section, i.e. R336 to the Galway City boundary (Section 1) is assessed independently to ensure that the optimum solution for Bearna is obtained. An additional break down at the N6 tie-in at Briarhill, Coolagh has been incorporated in order to compare the junction layouts at the N6 tie-in for the Stage 2 assessment. This section is referred to as Section 3.

Given the key constraints for Section 2 of the route options, a pair-wise comparison for this section was also carried out and this is outlined in **Section 7.7.3** below.

7.7.2 Project Appraisal Matrix

Table 7.7.1 below presents the project appraisal for the route options in Section 1.

Table 7.7.1 Project Appraisal – Section 1

Route Option	Economy[26]	Safety	Environment	Accessibility	Integration	Overall
Red2	-	Similar	LP	Similar	Similar	LP
Orange2	-	Similar	LP	Similar	Similar	LP
Yellow2	-	Similar	P	Similar	Similar	P
Blue2	-	Similar	I	Similar	Similar	I
Pink2	-	Similar	I	Similar	Similar	I
Green2	-	Similar	LP	Similar	Similar	LP

[25] Dept. of Transport Guidelines on a Common Appraisal Framework for Transport Projects & Programmes.
[26] As outlined in Section 7.2.4 a cost benefit analysis (COBA) was undertaken for each route option in its entirety and informed the overall rankings under the heading of Economy. As the economy criterion did not influence the route selection for Sections 1 and 3 it is included in Section 2 only and omitted from Sections 1 and 3.

Table 7.7.2 below presents the project appraisal for the route options in Section 2.

Table 7.7.2 Project Appraisal – Section 2

Route Option	Economy	Safety	Environment	Accessibility	Integration	Overall
Red2	I	Similar	LP	Similar	Similar	LP
Orange2	LP	Similar	P	Similar	Similar	LP
Yellow2	P	Similar	LP	Similar	Similar	LP
Blue2	P	Similar	I	Similar	Similar	I
Pink2	P	Similar	P	Similar	Similar	P
Green2	P	Similar	LP	Similar	Similar	LP

Table 7.7.3 below presents the project appraisal for the route options in Section 3.

Table 7.7.3 Project Appraisal – Section 3

Route Option	Economy[27]	Safety	Environment	Accessibility	Integration	Overall
Red2	-	Similar	I	Similar	Similar	I
Orange2	-	Similar	I	Similar	Similar	I
Yellow2	-	Similar	I	Similar	Similar	I
Blue2	-	Similar	I	Similar	Similar	I
Pink2	-	Similar	P	Similar	Similar	P
Green	-	Similar	I	Similar	Similar	I

As can be seen from the above tables, the Yellow2 Route Option is Preferred for Section 1, the Blue2 and Pink2 Route Options are Intermediate and the Red2, Orange2 and Green2 Route Options are Least Preferred.

In Section 2 the Pink2 Route Option is Preferred, with the Blue2 Route Option ranked as Intermediate and Red2, Orange2, Yellow2 and Green2 Route Options being Least Preferred. It is noted that the Orange2 Route Option was assigned an environmental Preferred ranking for Section 2. However, as detailed in **Section 7.2.4**, the overall cost of Orange2 Route Option is extreme and the risk of increased cost is probable, plus there will be high on-going operating costs for the tunnel which is likely to make this route option unrealisable. Therefore the Least Preferred ranking for economy outweighs the Preferred ranking for environmental for the Orange2 Route Option. Therefore it has been assigned an overall rating of Least Preferred. Whilst the Green2 and Yellow2 Route Options have a ranking of Preferred under the heading of economy, they have an overall ranking of Least Preferred as they are likely to result in adverse effects on the integrity of Lough Corrib cSAC.

The Preferred route option in Section 3 is the Pink2 Route Option. The Red2, Orange2, Yellow2, Blue2 and Green2 Route Options are all Intermediate.

[27] As outlined in Section 7.2.4 a cost benefit analysis (COBA) was undertaken for each route option in its entirety and informed the overall rankings under the heading of Economy. As the economy criterion did not influence the route selection for Sections 1 and 3 it is included in Section 2 only and omitted from Sections 1 and 3.

7.7.3 Pair-wise comparison – Section 2

7.7.3.1 Introduction

As discussed in **Section 7.1**, Environmental Workshop No. 4 took place on 19 March 2015. During this workshop a switch from the Green2 Route Option to the Blue2 Route Option immediately east of the River Corrib crossing was evaluated to address the queries raised at the public consultation. This 'Green2 - Blue2 Switch Route Option' shown on **Figure 7.1.3**, provided an alternative route option which included the Green2 Route Option from the R336 to and including, the River Corrib crossing point. It then connects with the Blue2 Route Option before entering into Lackagh Quarry and followed the path of the Blue2 Route Option to the existing N6. This is referred to as the 'Green2 – Blue2 Switch Route Option'. Further to this workshop an assessment of this route option, 'Green2 – Blue2 Switch Route Option' was carried out and is provided in **Appendix A.7.1**.

7.7.3.2 'Flaw Analysis'

During Environmental Workshop No. 4, a 'Flaw Analysis' was carried out on each route option in Section 2 as one mechanism to qualitatively assess the Stage 2 Route Options which in turn could be used to test the assessment ranking of each route option and the selection process. Each route option through Section 2 was reviewed in turn and each discipline identified their most critical flaws, the result of which is listed as follows:

Red2 Route Option

- Material Assets Non-Agriculture - Property Acquistion (73 residential and 19 commercial);
- Noise and Vibration / Air and Climate – Constructability;
- Human Beings – Communtiy Impacts and Constructability;
- Landscape & Visual – Constructability;
- Archaeology, Architecture and Cultural Heritage – Rahoon archaeological site;
- Planning – Conflict with vision for the city development and does not allow the city to implement other objectives;
- Engineering – Constructability;
- Ecology – Unlikely to have adverse effects on the integrity of the cSAC; and
- Economic – Overall cost is extreme.

Orange2 Route Option

- Material Assets Non-Agriculture - Property Acquistion (32 residential and 9 commercial);
- Ecology – Unlikely to have adverse effects on the integrity of the cSAC;
- Engineering and soils and geology – Constructability through limestone and granite; and
- Economic – Overall cost is extreme and risk of increased cost is probable, plus high operating costs for the tunnel.

Yellow2 Route Option

- Material Assets Non- Agriculture - Property Acquistion (97 residential and 11 commercial);
- Human Beings – Community Impacts; and
- Ecology – Likely to have adverse effects on the integrity of the cSAC.

Blue2 Route Option

- Material Assets Non-Agriculture– Property Acquistion (42 residential & 6 commercial), NUIG Recreational Facilities, Galway Racecourse and Dangan Nurseries; and
- Ecology – Unlikely to have adverse effects on the integrity of the cSAC.

Pink2 Route Option

- Material Assets Non-Agriculture – Property Acquistion (42 residential and 6 commercial, NUIG Recreational Facilities and Galway Racecourse; and
- Ecology – Unlikely to have adverse effects on the integrity of the cSAC..

Green2 Route Option (including Green2 - Blue2 Switch Route Option)

- Material Assets Non-Agriculture - Property Acquistion (54 residential and 10 commercial);
- Human Beings– Menlough, Killoughter Ballindooley and Bushypark communities;
- Landscape and Visual – Menlo Castle, Menlough, Killoughter and Ballindooley communities; and
- Archaeology, Architecture and Cultural Heritage – Menlo Castle and Menlough Village;
- Ecology – Likely to have adverse effects on the integrity of the cSAC.

The scale and nature of the infrastructure required for the on-line portion of Red2 and Orange2 Route Options is of significant magnitude; this is because the route option would be retrofitted into a sensitive urban environment demanding a more complicated solution than that of a lesser developed area within the city (reference **Appendix A.5.3** for full assessment detail of the on-line option).

The design legacy of such significant heavy engineering solutions associated with both the Red2 and Orange2 Route Options is likely to radically permanently impact on the experience and image of the city. Galway City is relatively small in scale, of a low height profile and of a linear pattern. Notwithstanding the efforts in design to partially submerge and tunnel the route option and elevate it where it traverses through parklands, the associated infrastructure would likely contribute to a permanent cumulative negative impact on the existing urban landscape of the city.

Even with such a heavily engineered solution including tunnels and viaducts, the Red2 Route Option requires acquisition of 73 residential properties and 19 commercial properties within Section 2, with additional impacts resulting from partial landtake from a further 23 properties. In addition, the residential impacts are very concentrated and have very significant impacts on particular areas of Rahoon and Newcastle with 26 of the residential properties from within housing estates in the Rahoon area potentially being acquired. Whilst the Orange2 Route Option requires the acquisition of less residential properties, it requires the acquisition of 9 commercial properties in Section 2 alone. The vision in the City Development Plan for neighbourhoods including those affected by the on-line route options, is to endeavour through future re-developments, design guidance and local authority investment to re-balance the existing car dominated environments, increase permeability and linkage, provide for more sustainable modes of transport paralleled by improvement to the adjacent public realms. The scale of impact of this barrier effect would be a retrograde step for the urban landscape of the city.

Both Red2 and Orange2 Route Options provide for the through traffic and the urban traffic in so far as capacity requirements and in terms of relieving congestion. However, both route options accommodate the through traffic and the urban traffic on parallel networks over the on-line sections, which has the effect of creating a wide physical barrier dominated by traffic in an urban environment which is in conflict with the safety objectives. This also renders the implementation of sustainable transport policies for shorter commutes more difficult to deliver as there is minimal road space to reallocate for such provision and requires significant provision of additional segregated linkages for vulnerable road users in order to cross the infrastructure on existing desire lines.

The timescale for the construction of the Red2 Route Option is of the order of six years, and again the enormity of this construction and the scale of impact could be detrimental to the economy of Galway City, the improvement of which is set as a scheme objective, as well as having a significant impact on the daily lives of all those impacted by it.

The cost of the construction of the Orange2 Route Option is of such an order as to be the least cost effective alternative, whilst noting that delivery of a cost effective solution is a project objective.

Therefore, Red2 Route Option and Orange2 Route Option were not advanced as the scale of impact of these route options on human beings and the city of Galway is not proportionate to the over-riding need for the scheme.

The Yellow2 Route Option has similar issues on the on-line section as the Orange2 and Red2 Route Options on the eastern side of the city. It has a very significant impact on human beings in the Ballinfoyle area off the Headford Road, with the acquisition of 24 residential properties and an apartment block (37 residential units).

The consensus from this comparative assessment was that the Red2, Yellow2 and Orange2 Route Options through Section 2 are not feasible in so far as they are not deliverable or realisable as they create disproportionate impacts on the sensitive urban environment of Galway City and on its inhabitants, communities and neighbourhoods. The scale of this impact is so significant as to deem them to be at significant variance with some of the project objectives outlined in **Chapter 1**.

This variance is considered to be on such a large scale as to be disproportionate to the over-riding need for the proposed scheme. Equally as further mitigation by avoidance is unlikely to improve these route options, these route options are not included in the pair wise comparison.

In addition, the Yellow2 Route Option is likely to have adverse effects on the integrity of Lough Corrib cSAC; and of the route options available, would affect the Qualifying Interests (QI) habitats to the greatest degree. Therefore, the Yellow2 Route Option was not advanced as there are less damaging alternatives available for crossing the cSAC.

It is acknowleged that the Green2 Route Option is likely to result in adverse effects on the integrity of Lough Corrib cSAC however it was brought forward for further analysis because it offers an alternative route option which avoids direct impacts on NUIG Recreational Facilities and Galway Racecourse.

7.7.3.3 Pair wise comparison

A pair wise comparison analysis was carried out on the remaining route options through Section 2 namely the Blue2 Route Option, the Pink2 Route Option, the Green2 Route Option and the Green2 - Blue2 Switch Route Option. The following is the outcome of this pair-wise comparison:

1. **Blue2 Route Option versus Green2 Route Option**:

   Blue2 Route Option carried forward for the following reasons:

   - The Blue2 Route Option has lesser impacts on communities and residential properties in Menlough, Killoughter and Ballindooley communities;
   - The degree of impacts on communities and residential properties in Menlough, Kiloughter and Ballindooley communities of the Green2 Route Option contravenes the objective to preserve existing well established communities on a significant scale;
   - The impact on Menlough Village of the Green2 Route Option contravenes the scheme objective of not being unduly detrimental to the architectural, cultural or linguistic heritage of the area;
   - The Blue2 Route Option also has a lesser impact on the demesne of Menlo Castle;
   - The Green2 Route Option would result in the highest amount of direct impacts on both the recorded and previously unrecorded archaeological, architectural and cultural heritage resource and is least preferred from this perspective;
   - The Green2 Route Option would also have a significant direct impact on a large number of sites. These include the village of Menlough (AH

117) and three demesne landscapes. These are associated with Bushypark House (DL 6), Menlo Castle (DL 10) and Glenlo Abbey (DL 5). It should be noted that both Menlo Castle and Bushypark House are protected structures; and

- In addition the River Corrib Bridge crossing for the Blue2 Route Option is preferable than the Green2 Route Option from an ecological perspective as Green2 Route Option is likely to have adverse effects on the integrity of the Lough Corrib cSAC at the River Corrib Bridge crossing.

Blue2 Route Option carried forward.

2. **Pink2 Route Option versus Green2 Route Option**:

Pink2 Route Option carried forward for the following reaons:

- Pink2 Route Option has lesser impacts on communities and residential properties in Menlough, Killoughter and Ballindooley communities;
- The degree of impacts on communities and residential properties in Menlough, Kiloughter and Ballindooley communities of the Green2 Route Option contravenes the objective to preserve existing well established communities on a significant scale;
- The impact on Menlough Village of the Green2 Route Option contravenes the scheme objective of not being unduly detrimental to the architectural, cultural or linguistic heritage of the area;
- The Pink2 Route Option also has a lesser impact on the demesne of Menlo Castle;
- The Green2 Route Option would result in the highest amount of direct impacts on both the recorded and previously unrecorded archaeological, architectural and cultural heritage resource and is least preferred from this perspective;
- The Green2 Route Option would also have a significant direct impact on a large number of sites. These include the village of Menlough (AH 117) and three demesne landscapes. These are associated with Bushypark House (DL 6), Menlo Castle (DL 10) and Glenlo Abbey (DL 5). It should be noted that both Menlo Castle and Bushypark House are protected structures; and
- In addition the River Corrib bridge crossing for the Pink2 Route Option is preferable than the Green2 Route Option from an ecological perspective as Green2 Route Option is likely to have an adverse effect on the integrity of the Lough Corrib cSAC at the River Corrib Bridge crossing.

Pink2 Route Option carried forward.

3. **Green2 Route Option versus Green2 - Blue2 Switch Route Option**:

Green2 – Blue2 Switch Route Option is carried forward for the following reasons:

- Although the Green2 - Blue2 Switch Route Option has a greater impact from an ecological perspective than the Green2 Route Option due to the potential impacts on the Lesser horsehoe bats at Menlo Castle, the Green2 - Blue2 Switch Route Option is carried forward due to lesser impacts on communities and residential properties at Menlough Village and lesser impacts on NUIG Recreational Facilities.
- It should be noted that both route options are equal in terms of their impact on the integrity of Lough Corrib cSAC in so far as both route options are likely to have adverse effects on the integrity of Lough Corrib cSAC.

Green2-Blue2 Switch Route Option carried forward.

4. **Blue2 Route Option versus Pink2 Route Option**:

The alignment of the Blue2 and Pink2 Route Options, through the Lough Corrib cSAC, is very similar with the key difference being that the Blue2 Route Option has a perpendicular river crossing whereas the Pink2 Route Option is a skewed river crossing.

Pink2 Route Option is carried forward for the following reasons:

- Both the Blue2 and Pink2 Route Options are unlikely to have adverse effects on the integrity of the European sites. When other disciplines including Human Beings, Landscape and Visual, Material Assets Non-Agriculture are taken into consideration and balancing the impacts across all key constraints the Pink2 Route Option was deemed to be the preferred route option due to the lesser impacts on adjacent commercial premises, educational premises and sporting facilities as this is an impact on the wider community and region as a whole; and
- The Pink2 Route Option is also more preferred in the area of Briarhill, Coolagh.

Pink2 Route Option is carried forward.

5. **Green2 Route Option versus Green2 - Pink2 Switch Route Option**:

Pink2 Route Option is carried forward for the following reasons:

- The Pink2 Route Option is preferred due to lesser impacts on residential properties and Menlo Castle;
- The River Corrib crossing for the Pink2 Route Option is also preferred from an ecological perspective; and
- The Green2-Blue2 Switch Route Option is likely to have an adverse effect on the integrity of the Lough Corrib cSAC.

Pink2 Route Option is the preferred route option.

This flaw analysis followed by pair wise comparison is a further check on the project appraisal.

7.7.4 N59 Link

During Environmental Workshop No. 4, a review of the constraints and the potential impacts of the N59 Link options was completed in order to select the optimum link connection.

There are three options to connect the N59 to the mainline when the mainline is offset from the N59:

- Orange2 N59 Link;
- Yellow2 N59 Link/Pink2 N59 Link; and
- Blue2 N59 Link.

It should be noted that each of the N59 Link Options could be connected with the mainline of the route options, e.g. Orange, Yellow, Blue and Pink. The principal differences between the link options are as follows:

1. The Yellow2 N59 Link, Pink2 N59 Link and Blue2 N59 Link connect to the N59 in the vicinity of Gleno Abbey whereas the Orange2 N59 Link connects approximately 1km further south, closer to the city, adjacent to Bushypark Church;
2. The Yellow2 N59 Link, Pink2 N59 Link and Blue2 N59 Link cross at least two local roads whereas the Orange2 N59 Link does not interact with any local road;
3. The junction form at Gleno Abbey for the Blue2 N59 Link will be a priority junction with the N59 realigned along the proposed link and the old N59 tying into it;
4. The junction form at Bushypark Church for the Orange2 N59 Link will be a signalised junction; and
5. The junction form at Gleno Abbey for the Yellow2 N59 Link and Pink2 N59 Link will be a signalised junction.

An engineering appraisal of the N59 link road options above under the relevant headings of geometry, length, junction strategy, constructability and traffic was completed.

Table 7.7.4 Engineering Assessment – N59 Link

N59 Link Option	Geometry	Length	Junction Strategy	Constructability	Traffic
Orange2	Similar	P	P	P	LP*
Yellow2	Similar	I	I	I	P
Blue2	Similar	I	I	I	P
Pink2	Similar	I	I	I	P

Note: P = Preferred, I = Intermediate, LP = Least Preferred

*When the Orange2 N59 Link was modelled with Blue/Pink/Yellow mainline it attracted more traffic and is equal in order of preference to the other options.

This assessment showed that the Orange2 N59 Link is the shortest link with minimal interaction with the surrounding local road network, but the traffic figures on this link are much lower than on the link options to the north namely the Yellow2 N59 Link, Pink2 N59 Link and Blue2 N59 Link. This was attributed to the fact that

the mainline of the Orange2 Route Option did not offer equivalent connection opportunities on the east side of the city as the Yellow2, Pink2 and Blue2 Route Options. Therefore, the Orange2 N59 Link was subsequently tested in the traffic model with the emerging preferred route corridor. This showed that the traffic volumes on this link were greater than any of the other link options under consideration. Therefore, from an engineering perspective the preferred N59 Link is the Orange2 N59 Link.

An environmental appraisal was also carried out on the N59 Link with the key differences being the consideration of human beings and non-agricultural material assets. As noted in **Section 7.6.13**, *Human Beings, Ecology*, *Landscape and Visual, and Material Assets – Non Agricultural* were identified as disciplines which had key significant constraints. For example, impacts on human beings such as communities and residential property acquisitions and impacts on ecology such as on European designated sites etc were all key significant constraints which required further consideration during the decision making process. Therefore, these disciplines are shown in italics in the summary tables and are referred to as "key environmental disciplines" below. A summary table of the environmental appraisal of the N59 Link is included below:

Table 7.7.5 Environmental Assessment – N59 Link

N59 Link Option	*Ecology**	Soils & Geology	Hydrogeoogy	Hydrology	*Landscape & Visual**	Archaeology, Architectural & Cultural Heritage	Material Assets – Agriculture	*Material Assets – Non Agriculutre**	Air & Climate	Noise & Vibration	*Human Beings**	Planning	Overall Ranking
Orange 2	LP	P	LP	I	P	I	P	P	P	P	P	LP	P
Yellow 2	P	I	P	I	I	P	P	I	I	I	I	P	I
Blue2	P	I	P	I	LP	LP	LP	LP	LP	LP	LP	I	LP
Pink2	P	I	P	I	I	P	P	I	I	I	I	P	I

Note: P = Preferred, I = Intermediate, LP = Least Preferred

The Orange2 N59 Link is the preferred route option from an environmental perspective. It has seven preferred, two intermediate and three least preferred rankings. Three of the seven preferred rankings were for a key environmental discipline, landscape and visual, material assets non-agriculture and human beings. Of the three least preferred rankings, one of these was for a key environmental discipline (ecology). However ecological impacts due to the Orange N59 Link are not on a European site.

The Yellow2 and Pink2 N59 Links have been assigned an Intermediate ranking. They have five preferred, seven intermediate and no least preferred rankings. Of the preferred rankings, one of these was for a key environmental discipline (ecology).

The Blue2 Route Option is least preferred from an environmental perspective. The Blue2 Route Option has two preferred, three intermediate and seven least preferred rankings. Of the five least preferred rankings, three of these were for a key environmental discipline (landscape and visual, material assets non-agriculture and human beings).

On review of the engineering and the environmental assessments of the N59 Link, the overall preference is the Orange2 N59 Link.

7.8 Recommendation

Upon completion of the project appraisal outlined above, the Emerging Preferred Route Corridor was developed as an amalgamation of different route options over two sections, namely R336 to the Galway City boundary and the Galway City boundary to the existing N6 and the N6 junction for Section 3.

The preferred route option for Section 1 is the Yellow2/Green2/Pink2 Route Option and for Section 2 is the Pink2 Route Option. The N59 Link associated with the Orange2 Route Option is preferred to that of the Pink2 Route Option as it has a lesser impact on residential properties and it is also preferable in terms of traffic when tested with the Emerging Preferred Route Corridor. This Emerging Preferred Route Corridor is referred to as the Maroon Route Option.

Therefore, the Maroon Route Option as shown in **Figure 7.8.2** is the Yellow2/Green2 Route Option over the initial part of Section 1, connecting the Pink2 Route Option at Barr hAille and follows to the path of the Pink2 Route Option to its termination at the N6 in Briarhill, Coolagh, with the exception of the N59 Link with a slight modification to tie to the Pink2 Route Option. The N59 Link will comprise the link as presented in the Orange2 Route Option. The Emerging Preferred Route Corridor is presented on **Figure 7.8.1**.

8 Stage 3 Preferred Route Corridor PABS

8.1 Public Display of Emerging Preferred Route Corridor

Public consultation sessions were held on 25 and 26 May 2015 on the Emerging Preferred Route Corridor (EPRC) at two locations in Galway, one west of the River Corrib and one east of the River Corrib. Details of the EPRC and the route selection process were on display over the two day period and are available at the project office until the end of August 2015.

Galway City Council in conjunction with the National Transport Authority (NTA) also consulted with the public over this two day period on the details of the Integrated Transport Management Programme (ITMP). The display boards for the ITMP were moved to City Hall for unattended viewing following the public display sessions.

The joint presentation and consultation on the overall solution was very worthwhile as it afforded the public an opportunity to see how the component parts of the solution fit together to deliver an overall transport solution.

The general feedback on the road component of the solution included commentary on the following issues:

1. Implementation of improved public transport and smarter mobility should be prioritised over a road scheme;
2. Greater importance give to the protection of environmental habitats over humans;
3. Viability of going back to the N6 Galway City Outer Bypass (2006) route in the Bearna area;
4. Impacts of demolition to homes and businesses; and
5. Impact to communities and cultural heritage of many townlands e.g. Castlegar, Coolagh, Dangan/Bushypark and Bearna.

Further design iterations are necessary to minimise and reduce the extent of the impacts on the residential communities; this process will form part of the *Phase 3 Design* work.

Full details of this consultation and submissions received from the public are included in **Appendix A.8.1**.

8.3 Option Cost Estimate Preferred Route Corridor

Section 6.6 of this report outlines the methodology used to calculate the Option Cost Estimates for each route option in Stage 1. The same methodology was used to calculate the Option Cost Estimates for each route option in Stage 2 and for the preferred route corridor (PRC) Option Cost Estimate. The PRC Cost Estimate was agreed with the NRA Cost Estimation Unit. The final PRC Cost Estimate is shown below.

Table 8.2.1 Preferred Route Corridor Option Comparison Estimate

Route Option	Total (millions) Incl. VAT
PRC	€519

Further cost benefit analysis work was carried out using the PRC Cost Estimate; the output from this cost benefit work is utilised in various sections of the PABS spreadsheet.

8.4 Project Appraisal Balance Sheet of the Preferred Route Corridor

The Project Appraisal Balance Sheet (PABS) is a summary appraisal of project impacts based on the outputs of various forms of assessment carried out during the planning and design stages of project development. The PABS acts as a tool in summarising the expected impacts of proposed investment. The PABS is completed at Route Selection stage on the preferred route corridor and is subsequently updated throughout the later stages of the project.

The PABS is based on a qualitative and quantitative evaluation of a range of criteria and elements as outlined in the Department of Transport Common Appraisal Framework namely, Environment, Safety, Economy, Accessibility & Social Inclusion and Integration. A detailed multi-criteria assessment under each of these criteria was carried out on the various route options under consideration in **Chapter 7**. This summary assessment is now completed using the PABS template on the emerging preferred route corridor.

The PABS is made up of four sections as follows:

1. Part A: This contains general information on the project;
2. Part B: This section deals only with the environmental appraisal of the project. A summary rating of the scale of impact on each of the environment elements is proposed. At the end of the spreadsheet, a summary ranking for the Environment section is automatically generated based on the individual scales presented for each element;
3. Part C: This section includes an assessment of each of the remaining four appraisal criteria namely Safety, Economy, Accessibility & Social Inclusion and Integration; and
4. Part D: This is the PABS Summary Sheet which is automatically populated based on Part A, B and C inputs.

The completed PABS for Phase 2 Route Selection using the medium growth scenario is presented in the following sections.

8.4.1 PABS Part A

Part A of the PABS contains general project information namely the project title, project reference number, project contact details and a brief description of the project.

8.4.2 PABS Part B

Part B of the PABS deals with the Environmental appraisal of the project. The environmental assessments provided in Chapter 7 are used in the compilation of Part B. The overall scaling statement when all environmental disciplines are considered is Moderately Negative.

8.4.3 PABS Part C

Part C of the PABS deals with the remaining four criteria for assessment namely Safety, Economy, Accessibility & Social Inclusion and Integration.

8.4.3.1 Safety

Safety considers two principal road safety impacts, accident reduction and security of road users. There is a high level of traffic transferred on to a newer safer road with associated communication systems and information technology to raise security of travellers. Equally, there is an opportunity to reallocate road space for vulnerable road users on the existing urban network. The overall scaling statement in terms of Safety is Moderately Positive.

8.4.3.2 Economy

The key measure of economic efficiency is the Benefit to Cost Ratio, which shows how projects could increase overall welfare after allowing for the cost of implementation of the project. However, the BCR does not capture all of the potential economic benefits of a project. This project in particular has set out among its project objectives at the outset to achieve economic benefits for Galway City and environs through improved accessibility to internal markets and the wider national markets. Equally, linking markets and employment opportunities on either side of the River Corrib is a key project objective. Therefore, as this project presents these opportunities, it is ranked more positively than a rural scheme without any potential to improve accessibility to markets.

In terms of inward investment, this project scores positively as it has the potential to attract further investment, most markedly in the area of the high technology employment centres at Ballybrit and Parkmore, by virtue of the provision of access to these areas, the release of congestion on the existing network and resultant reduction of delay incurred by employees accessing there areas.

Provision of the proposed scheme will improve access to international markets, improve access to existing employment areas, facilitate reallocation of road space to better serve existing city markets, facilitate regeneration of city zones, and is vital for the retention of Galway as a key economic hub of the western region.

The scheme is forecast to save over €1 billion in delay costs (in 2009 prices) in the Galway area over 30 years, when compared with a scenario where no scheme is

provided. This project represents value for money as it has the potential to generate significant return on investment of public funds. The overall scaling statement in terms of Economy is Moderately Positive.

8.4.3.3 Accessibility and Social Inclusion

The scheme provides improved access to the western region as a whole, and particularly improved access to the Gaeltacht areas. The associated reallocation of freed road space has the potential for significant improved public transport facilities thus facilitating movement and access for all sectors of society. The overall scaling statement in terms of Accessibility & Social Inclusion is Moderately Positive.

8.4.3.4 Integration

This project is part of an overall transport strategy for Galway which will identify a series of supporting infrastructure, operational and policy measures to help optimise travel by sustainable modes in order to meet both the current and future travel needs of Galway. In terms of wider integration, the N6 around Galway forms part of the TEN-T comprehensive network in Ireland; it suffers from congestion problems and capacity constraints. This project provides a new link for the TEN-T network from the M6 to the R336 to the west of Galway. The overall scaling statement in terms of Integration is Moderately Positive.

8.4.4 PRC PABS Part D

Part D of the PABS is a summary statement of the assessment which is compiled on the basis of the input to Parts A, B and C. Appraisal is carried out under five criteria. A Moderately Positive scaling statement is achieved on four of the five criteria namely Safety, Economy, Accessibility & Social Inclusion and Integration. A Moderately Negative scaling statement is attributed to the Environment criterion.

8.5 Summary of Road Safety Audit Stage F (Part 2)

An independent road safety audit was undertaken for Emerging Preferred Route Corridor in accordance with NRA *HD 19 (Road Safety Audit)*. The Stage F Road Safety Audit is appended to this report in **Appendix A.8.2 Road Safety Audit Stage F Report (Part 2)**. The audit raised issues such as treatment of local access roads, private residential entrances, junction design and consistency. It is possible to resolve all items raised in this Road Safety Audit (Part 2) during Phase 3 *Design.* There are no non-conformance issues remaining in this audit.

In terms of safety benefits, the PRC is forecast to deliver significant safety benefits to the network as a result of transferring high levels of traffic on to newer, safer roads.

8.6 Recommendation

Project appraisal of the road component of the N6 Galway City Transport Project has demonstrated that this is a project with a Moderately Positive scaling statement on four of the five assessment criteria. The economic assessment has demonstrated that, based on the scheme costs developed to date and the associated forecast performance of the transport network, the proposed option represents value for

money. The environmental assessment has shown a Moderately Negative scaling statement; during *Phase 3 Design* significant design work and mitigation design will be undertaken to minimise impacts on sensitive receptors within the receiving environment.

The recommendations of this Route Selection Report are:

1. As a road component is needed, adopt the preferred route corridor of the N6 Galway City Transport Project as the optimum corridor for additional road infrastructure which meets the project objectives outlined in **Chapter 1** of this report; and
2. Review the extent of provision of road infrastructure necessary within this preferred route corridor in conjunction with the wider integrated management transport programme for Galway which will identify the level of service requirements for each mode of transport; including walking, cycling, public transport and private vehicle.

The parallel processes of identification of a preferred route corridor for the road component and the identification of the maximum service provision by other transport modes, will ensure delivery of an overall sustainable transport solution in order to meet both the current and future travel needs of Galway.