Appendix A.4.1

N6 Galway City Outer Bypass, (2006)
Route Option Report

A.4.1 N6 Galway City Outer Bypass, (2006) Route Option Report

Galway County Council

N6 Galway City Transport Project

N6 Galway City Outer Bypass, (2006) Route Option Report

GCOB-4.04.REP006

Issue 1 | 28 August 2015

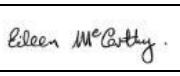
Job number 223985-00

Arup
Corporate House
City East Business Park
Ballybrit
Galway
Ireland

ARUP

Document Verification

ARUP

Job title		N6 Galway City Transport Project		**Job number** 223985-00	
Document title		N6 Galway City Outer Bypass, (2006) Route Option Report		**File reference** 4-04-03	
Document ref		GCOB-4.04.REP006			
Revision	**Date**	**Filename**	GCOB-4.04-REP006 (2006 GCOB).docx		
Issue 1	28 August 2015	**Description**	Issue 1		
			Prepared by	Checked by	Approved by
		Name	Niamh O'Regan	Mary Hurley	Eileen McCarthy
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
			Issue Document Verification with Document		✓

Contents

1 Introduction

1.1 Overview

Arup was appointed to provide multi-disciplinary engineering consultancy services for delivery of Phases 1, 2, 3 and 4 of the NRA Project Management Guidelines (NRA PMG) for the N6 Galway City Transport Project. This appointment includes the examination of studies, documents and court rulings relating to the earlier unsuccessful scheme, followed by feasibility studies, route selection, design and planning for a revised scheme.

The commission commenced at *Phase 1: Scheme Concept & Feasibility Studies*. As public funding will be required for any future potential scheme, a Preliminary Appraisal was undertaken during Phase 1. The purpose of this appraisal was to ensure that public funds are allocated in an efficient manner by establishing the merits of a proposal using a consistent and comprehensive framework. Phase 1 has now been completed and *Phase 2: Route Selection* is on-going.

1.2 Scheme Background

Consultants were appointed in 1999 to undertake feasibility studies, route selection, design and planning for a Galway City Outer Bypass (GCOB) Scheme. The resultant scheme including the Compulsory Purchase Order (CPO) and Environmental Impact Statement (EIS) was submitted to An Bord Pleanála (ABP) in December 2006. This scheme consisted of 21.4km of mainline, 9km of link roads, associated intersections and a major bridge crossing of the River Corrib.

ABP granted approval for only part of the scheme, the section from the N59 east to the existing N6 and refused permission for the section of the scheme from the R336, west of Bearna to the N59. The ABP decision granting approval of this eastern section was appealed to the High Court. The High Court undertook a judicial review of the ABP decision. The High Court confirmed ABP approval but allowed an appeal to the Supreme Court. The Supreme Court sought the opinion of the Court of Justice of the European Union (CJEU) on an interpretation of the Habitats Directive. Following receipt of the CJEU opinion, the Supreme Court quashed the earlier ABP decision.

1.3 Purpose of this Report

The scheme is currently at Phase 2 - Route Selection stage. The objective of this phase is to identify a suitable study area for the examination of alternative routes and transportation solutions, to identify key constraints within this study area, to develop feasible route options and transportation solutions and to carry out a systematic assessment of these options leading to the selection of a preferred route corridor or transportation solution which will form the basis for the detailed design to follow.

As part of this process the feasibility and applicability of a number of options and alternatives need to be considered for inclusion or otherwise in the route selection process.

This report details the Stage 1 assessment of the N6 Galway City Outer Bypass 2006 (2006 GCOB) scheme, without alteration, which was submitted for planning permission and refused as outlined above. This option is known as the 2006 GCOB Route Option and is shown on **Figure 1.1**.

1.4 Route Option Description

The 2006 GCOB commences at the R336, with an at-grade roundabout junction approximately 2km to the west of Bearna and travels north, passing around Na Foraí Maola and to the south of Lough Inch, with an at-grade roundabout junction on the Bearna to Moycullen Road. It then travels east as far as Cappagh, with a link road connecting the 2006 GCOB to the existing roundabout at the junction of the Cappagh Road and the Western Distributor Road. The mainline continues north-east from here, travelling through Tonabrocky, Gortacleva and Killeen, where there is a grade separated junction with the N59. It travels around the northern side of Glenlo Abbey, turning south-east, and crosses the River Corrib on a bridge structure between Menlough Village and Menlo Castle. The 2006 GCOB crosses over the Menlough Road and travels north towards Ballindooley. There is a grade separated junction located to the west of Ballindooley, and the N84 is realigned to connect to the 2006 GCOB here. The 2006 GCOB continues east, curving north around Pollkeen and Twomileditch, and crossing under the N17 without a connection. It then travels south-east, crosses under the R339 in Ballintemple, and connects to the existing N6 to the east of Coolagh.

2 Engineering Assessment

2.1 Introduction

This section details the Stage 1 engineering assessment of the 2006 GCOB Route Option with respect to the engineering constraints identified in **Chapter 4 of the Route Selection Report. Section 2.2** outlines the methodology that was used to carry out the assessment and **Section 2.3** details the engineering assessment. A summary is presented in **Section 2.4**.

2.2 Methodology

The engineering assessment of the 2006 GCOB Route Option has been carried out in a similar manner to the engineering assessment of the six route options considered at Route Selection Stage 1, using the same criteria. These criteria are geometry, cross-section, length, junction strategy, structures, topography and earthworks, constructability, and traffic.

A full design was previously carried out for the 2006 GCOB Route Option, including geometry, drainage, and accommodation works. This was not the case for the six route options assessed at Route Selection Stage 1 of the N6 GCTP, so a direct comparison of the engineering characteristics across all options is not possible. The 2006 GCOB Route Option is assessed as a standalone option, based on how the design of the previous scheme meets the project brief for the N6 GCTP.

2.3 Assessment

2.3.1 Geometry

The mainline alignment for the 2006 GCOB Route Option was assessed for compliance with the NRA DMRB. It should be noted that the 2006 GCOB Route Option was designed as a Type 1 dual carriageway, unlike the other route options considered for the N6 GCTP, which were designed according to the requirements for a Type 2 dual carriageway.

The horizontal component of the geometric assessment comprises the calculation of the percentage of the alignment that achieves at least the desirable minimum curvature.

The vertical geometric component has been assessed based on the extent that the alignment achieves at least the desirable minimum vertical curvature and does not exceed the maximum or minimum permitted gradients.

The 2006 GCOB Route Option complies fully with the NRA standards for horizontal alignment along its full length. The vertical gradient is less than 0.5% for 1906m, which represents 8.9% of the total length. However, as a full design was carried out, it is assumed in this assessment that adequate drainage was provided, and checks for ponding were carried out against this. A detailed assessment of the 2006 GCOB Route Option geometry and a list of approved departures from standards may be found in the Preliminary Design Report of the 2006 GCOB Scheme.

2.3.2 Cross-Section

The 2006 GCOB Route Option is designed with sections of 2+1, 1+1 and Type 1 dual carriageway, with revisions agreed with the NRA to ensure adequate forward visibility. As these were stated in the Preliminary Design Report for the 2006 GCOB scheme to have been agreed with the NRA at the time, they are also deemed acceptable in this assessment.

2.3.3 Length

The length parameter is a measure of the 2006 GCOB Route Option's length from its westernmost extent, where it connects to the R336 in the vicinity of Bearna, to the tie-in with the existing N6 Galway to Dublin Road. This is the distance which a vehicle would have to travel on the mainline to go from the westernmost extent to the existing N6.

The overall length of the 2006 GCOB Route Option is 21.39 km.

2.3.4 Junction Strategy

This assessment considers the number of junctions along the 2006 GCOB Route Option. At-grade junctions could cause delays on the mainline, with the delay increasing as the number of at-grade junctions increases. At-grade junctions also have the potential to increase traffic volumes and delay on the adjoining local road networks. However, it is vital to provide sufficient connectivity via junctions to cater for traffic from the local networks.

Conversely, a higher number of grade separated junctions provides greater connectivity to the mainline with potentially no significant delay experienced by the mainline traffic.

The number of at-grade signalised, roundabout and priority junctions, as well as the number of grade separated junctions, was counted. The totals can be seen in **Table 2.1** below.

The project objectives include a requirement to enhance transportation connectivity. A check was carried out on the 2006 GCOB Route Option as to whether there is a direct connection between this route option and the existing national routes with a simple yes or no. In terms of junction configuration the 2006 GCOB Route Option performs well as all of the junctions are standard (e.g. dumb-bell) and perform well from a driver comfort and safety perspective.

Table 2.1 Junction Assessment

Route Option	Number of At-Grade Signalised Junctions or Roundabouts	Number of At-Grade Priority/Left In Left Out Direct Access Junctions	Number of Fully Grade Separated Junctions	Direct Connectivity to National Routes
2006 GCOB	3	0	3	N

2.3.5 Structures

The River Corrib and associated Lough Corrib candidate Special Area of Conservation (cSAC) lie within the centre of the scheme study area. The 2006 GCOB Route Option crosses over the river with the mainline on a new bridge structure.

The total number of bridge structures along the mainline has been quantified. This includes the number of river and stream bridge crossings and the mainline crossing existing roads, either on an overbridge or in an underpass. Fewer bridge crossings, in general, leads to lower construction costs and ongoing structural maintenance costs. The number of structures on the 2006 GCOB Route Option was quantified as shown in **Table 2.2** below.

Table 2.2 Structures Assessment

Route Option	River/Stream Bridge	Mainline on Overbridge	Mainline in Underpass	Total Number of Bridges
2006 GCOB	8	7	5	20

An assessment of the extents of significant structures was also included. This takes account of the fact that the 2006 GCOB Route Option includes a long bridge crossing on the River Corrib, but this was not judged to be a major issue from a structures perspective, given that there are no tunnel or viaduct sections, and is therefore not included in **Table 2.5** above.

2.3.6 Topography and Earthworks

A preliminary assessment of the earthworks quantities was not carried out on each of the route options considered as part of Route Selection Stage 1 and was therefore not considered for the 2006 GCOB Route Option assessment.

2.3.7 Constructability

Due to the extent of existing residential housing, commercial businesses, farms, local roads and accesses throughout the scheme study area, a route option with the greatest length of on-line construction would be the most difficult to construct. As the 2006 GCOB Route Option is entirely off-line, it is envisaged that construction would be relatively straightforward.

2.4 Summary

From an engineering perspective, the 2006 GCOB Route Option is a feasible route option.

3 Environmental Assessment

3.1 Introduction

This section details the Stage 1 environmental assessment of the 2006 GCOB Route Option with respect to the constraints identified **Chapter 4 of the Route Selection Report Section 3.2** outlines the ecological assessment, **Section 3.3** the Soils and Geology assessment, **Section 3.4** the Hydrogeology assessment, **Section 3.5** Hydrology assessment, **Section 3.6** the Landscape and Visual assessment, **Section 3.7** the Archaeological, Architectural and Cultural Heritage assessment, **Section 3.8** Material Assets – Agriculture, **Section 3.9** Material Assets – Non Agriculture, **Section 3.10** Air Quality, **Section 3.11** Noise and Vibration and **Section 3.12** outlines the Human Beings assessment.

3.2 Ecology

3.2.1 Introduction

The ecological assessment of the of the 2006 GCOB Route Option has been carried out with respect the ecological constraints identified in **Section 4.3 of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.1 of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.3.1** to **4.3.23 of the Route Selection Report** and **Figures 3.2.1** to **3.2.7** of this Report.

3.2.2 Assessment

The 2006 GCOB Route Option impacts directly on Lough Corrib cSAC at numerous locations between the River Corrib and Ballindooley: the crossing point of the River Corrib, to the south west of Menlough Village; in the vicinity of the Coolagh Lakes and the Menlough Road[1]; and, as it crosses the hill between Menlough Village and Ballindooley Lough. Across these areas this route option would result in the loss of priority, and non-priority, Qualifying Interest (QI) Annex I habitat types for which Lough Corrib cSAC has been designated.

Within the boundary of Lough Corrib cSAC at the proposed River Corrib crossing, there are six Annex I habitat types[2] that are either directly impacted by, or are in close proximity to, the alignment of the 2006 GCOB Route Option and would likely

[1] 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. Therefore, references to direct impacts within designated, and any habitat areas calculated therein, 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.

[2] The nomenclature used 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). The use of an asterisk (*) symbol preceding the four digit habitat code denotes that that habitat type is a *priority* habitat type.

be either directly or indirectly affected by construction works: Alkaline fen [7230], Transition mire [7140], *Molinia* meadows [6410], Wet heath [4010], Residual alluvial forests [*91E0] and, Blanket bog (active) [*7130]. Alkaline fen and Molinia meadows are QI habitats of Lough Corrib cSAC. The total footprint of the road alignment through this part of the Lough Corrib cSAC, including both Annex I and non-Annex habitats, is approximately 4.3ha. Studies to date indicate that it is possible to design and construct a bridge structure which would not result in any direct impacts to these habitat types. Nevertheless, during operation, the presence of a bridge would likely impact on the habitats underneath due to the effects that shading from the bridge deck and the associated reduction in direct precipitation.

Within the boundary of the Lough Corrib cSAC in the vicinity of the Coolagh Lakes the scheme impacts on an area of *c.*0.85ha of Limestone pavement [*8240], *c.*546m^2 of Residual alluvial forests, and *c.*170m^2 of Hydrophilous tall herb fringe [6430]. Limestone pavement is a QI habitat of Lough Corrib cSAC. The total footprint of the road alignment through this part of the Lough Corrib cSAC, including both Annex I and non-Annex habitats, is approximately 1.8ha.

Within the boundary of the Lough Corrib cSAC as the 2006 GCOB Route Option crosses the hillside between Menlough and Ballindooley, there are relatively large areas of Annex I habitat affected within the fenceline: *c.*5.85ha of a mosaic of Limestone pavement and Calcareous grassland [*6210/6210], of which *c.*5.43ha is Limestone pavement. Both of these habitat types are QIs of Lough Corrib cSAC. The total footprint of the road alignment through this part of the Lough Corrib cSAC, including both Annex I and non-Annex habitats, wold be approximately 3.8ha.

The 2006 GCOB Route Option would also impact directly on approximately *c.*4.0 ha of Annex I habitat in Moycullen Bogs NHA at Tonabrocky; comprising areas of Blanket bog (active) [*7130], Dry heath [4030], Wet heath and Transition mire [7140]. It would also impact on peatland habitats within the NHA here which support the legally protected plant species Slender cotton-grass *Eriophorum gracile*. This route option also impacts on a substantial area of Annex I habitat within Moycullen Bogs NHA at a second location, Na Foraí Maola, to the south-west of Lough Inch. Here, approximately 8.7ha of Blanket bog, Dry heath, Wet heath and *Rhyncosporion* depressions [7150] would be directly impacted. At both locations, there is also the potential for wider indirect hydrological impacts to affect adjoining areas of peatland habitats.

Outside of designated areas for nature conservation, the 2006 GCOB Route Option would impact on many areas of Annex I habitats across the scheme study area, totalling approximately 31.5ha. In the western part of the scheme study area (west of the River Corrib), areas totalling approximately 17ha of mainly Blanket bog (active), Dry heath, and Wet heath, but also including a few scattered small patches of Transition mire, *Rhyncosporion* depressions, and Residual alluvial forests, would be affected. The majority of the impacts to bog and heath habitats occur in the zone between Tonabrocky and the coast road near Bearna (R336). Around the margins of Lough Corrib cSAC at Menlough/Ballindooley, there are areas of Limestone pavement, Calcareous grassland, a Turlough [*3180], Lowland hay meadow [6150] and a small patch of Blanket bog totalling approximately 2.9ha. From Ballindooley to the proposed N6 Junction, approximately a further 11.6ha are within the fenceline of the 2006 GCOB Route Option, comprised mainly of Limestone pavement but also Calcareous grassland, Lowland hay meadow, and a small patch of *Molinia* meadows.

The 2006 GCOB Route Option would likely have a significant impact on the Menlough Lesser horseshoe bat population[3] given its close proximity to the maternity roost site, that it would remove a known roosting site (night roost) near Ballindooley Lough, and would result in large scale habitat loss, severance and displacement impacts within their foraging area. It would also result in the loss of a Daubenton's bat roost and two Brown long-eared bat roosts. The 2006 GCOB Route Option is also within 500m of a Barn owl nest site and significant impacts to the local population are likely as a result. It would also result in the loss of several areas of confirmed breeding habitat of the Annex II Marsh fritillary butterfly[4] at Cappagh, Lough Inch and Kentfield.

The watercourse crossings associated with the 2006 GCOB Route Option have the potential to impact on aquatic species[5] such as Atlantic salmon, lamprey species and Otter, particularly where realignments of river/stream channels are required. Construction works within the Lough Inch River catchment have the potential to impact on a known Freshwater pearl mussel population.

3.2.3 Summary

Overall, the 2006 GCOB Route Option has the potential to result in significant negative impacts to Lough Corrib cSAC and Moycullen Bogs NHA.

The loss of QI habitats in Lough Corrib cSAC associated with this route option would constitute an adverse effect on the integrity of this European site based on the previous EU judgment as the alignment through here is as per the 2006 GCOB. Therefore, for the 2006 GCOB Route Option to be advanced through the planning process in accordance with the requirements of Article 6(4) of the EU Habitats Directive, there must be no feasible alternative solutions and, despite the predicted impact, there must also be imperative reasons of overriding public interest for progressing the option. Aside from the impacts to designated sites, the 2006 GCOB Route Option would also likely result in significant impacts to areas of Annex I habitat, the legally protected plant species Slender cotton-grass, the Marsh fritillary butterfly, Barn owl and a range of other sensitive ecological receptors, many of which are listed on Annex II and/or Annex IV of the EU Habitats Directive.

3.3 Soils and Geology

3.3.1 Introduction

This section details the Stage 1 soils and geology assessment of the 2006 GCOB Route Option with respect to the soils and geology constraints identified in **Section 4.4 Soils and Geology of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.2 Soils and Geology of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.4.1** to **4.4.11 of the Route Selection Report** and **Figure 3.3.1** to **3.3.12** of this Report.

[3] All bat species in Ireland are protected under Annex IV of the EU Habitats Directive; the Lesser horseshoe bat is also listed on Annex II
[4] The Marsh fritillary butterfly is listed on Annex II of the EU habitats Directive 92/43/EEC
[5] Otter, Atlantic salmon, lamprey species and the Freshwater pearl mussel are all listed on Annex II of the EU habitats Directive 92/43/EEC; Otter is also listed on Annex IV

3.3.2 Assessment

3.3.2.1 Overview of Solid Geology, Subsoils and Soils

Bedrock geology

The bedrock geology underlying this route option is shown on **Figures 3.3.3** and **3.3.4**. There are two principle forms of bedrock underlying this route option. To the west of the N59, where the 2006 GCOB Route Option would cross at Kentfield, the bedrock consists of undifferentiated granite and associated rock. East of the N59 at Kentfield, the bedrock consists of Lower Carboniferous (Visean) Age Burren Limestone.

Subsoils

The initial section of the 2006 GCOB Route Option, up to the N59 at Kentfield, consists of either glacial till or sandy gravely clay. This is further complicated by the presence of a thin layer of peaty soil in areas such as Tonabrocky, Aille and Na Foraí Maola. The glacial till predominates in the first few kilometres of the 2006 GCOB Route Option, with frequent local exposures of outcropping rock being common in this section. There are many large granite boulders present within the brown stony till, which is generally of 1.0 – 1.5m depth. In the area of the route option that would pass relatively close to Lough Inch, between Na Foraí Maola and Aille, the land is underlain by a layer of peat with a depth of <3.0m.

As this route option continues through the townlands of Cappagh and Keeraun the bedrock is overlain by a thin layer of shallow till with local areas of peat and with occasional intrusions of the granite bedrock.

In Tonabrocky, there is also an extensive area of blanket peat with a depth of <3.0m. In Gortacleva, the glacial till is mainly sandy gravely clay with a depth of approximately 3m containing many granitic cobbles and boulders. Some of the soils in this area are locally peaty.

Along the western banks of the River Corrib, the 2006 GCOB Route Option is underlain by soft calcareous or organic clay and peat over limestone bedrock. Upon crossing the River Corrib, the 2006 GCOB Route Option encounters an area of rock outcrop on the eastern side of the bank. Extensive outcropping of limestone rock extends approximately 3.1km from the east bank of the River Corrib and is present until beyond the townland of Menlough. At Ballindooley, this route option crosses a small area of basin peat. In between the outcropping and the basin peat, shallow glacial till over limestone bedrock would be encountered. Several other limestone outcrops are passed from Brockagh to where this route option ties in with the existing N6.

Soils

On the western side of the River Corrib where outcrops are not present, the soils are of a peaty nature and are of very poor quality from an agricultural perspective. Much of these soils lie fallow. Between the N59 and the River Corrib, there is a small quantity of medium quality soils (approx. 25%), 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, but this is so shallow in most areas that there is very little tillable land.

Made Ground is typically limited to modifying ground at the River Corrib (e.g. Glenlo Abbey Golf Course), road works and stockpiles from quarry operations.

3.3.2.2 Cuttings and embankments

Areas with a max cutting or embankment depth less than 5m and an overall impact of **Low** have been excluded from the principle cutting and embankment tables in **Tables 3.3.1 and 3.3.2** and are shown on **Figures 3.3.11** and **3.3.12**.

Table 3.3.1 Principal cuttings along the 2006 GCOB Route Option

Name	Location	Length	Max cutting depth	Level of impact
C3	Aille	940m	10 - 15	Medium
C4	Cappagh	1110m	10 - 15	High[1]
C5	Keeraun	570m	0 - 5	High[2]
C6	Tonabrocky	190m	5 - 10	High[2]
C7	Tonabrocky	290m	5 - 10	Low
C8	Gortacleva	830m	10 - 15	Medium
C10	Menlough	170m	5 - 10	Medium[3]
C11	Menlough	430m	5 - 10	Medium[3]
C12	Ballindooley	880m	10 - 15	High[3]
C13	Ballindooley	600m	10 - 15	High[3]
C14	N84 Realignment	740m	5 - 10	Low
C15	Ballygarraun	900m	5 - 10	Medium[3]
C18	N17 to M6	2720m	> 15	High[3]

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

1. Length of cutting and the presence of soft ground;
2. Presence of soft ground; and
3. Presence of a number of Karst Features.

Table 3.3.2 Principal embankments along the 2006 GCOB Route Option

Name	Location	Length	Max embankment height (m)	Level of impact
E1	Na Foraí Maola Thiar	2120m	5 - 10	High[1]
E2	Cappagh	290m	5 - 10	Medium[2]
E3	Tonabrocky	490m	5 - 10	Low
E4	Gortacleva	360m	5 - 10	Low
E5	Kentfield	1750m	5 - 10	High[3]
E6	Menlough 1	210m	5 - 10	Low
E7	Menlough 2	210m	5 - 10	High[4]
E8	Menlough 3	100m	5 - 10	Medium[5]

Name	Location	Length	Max embankment height (m)	Level of impact
E9	Menlough 4	920m	5 - 10	Low
E10	Ballindooley West	250m	5 - 10	Low
E11	Ballindooley East	320m	5 - 10	High[4]
E12	Pollkeen	780m	5 - 10	Low
E14	Boleybeg Road Junction	520m	10 - 15	High[2]
E15	Menlough Underpass	110m	10 - 15	High[5]

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

1. Length of embankment and the presence of soft ground;
2. Presence of soft ground;
3. Length of embankment, presence of soft ground and of a number of Karst Features;
4. Presence of soft ground and a number of Karst Features; and
5. Presence of a number of Karst Features.

3.3.2.3 Overview of Ground Conditions and Features in Karst Limestone Areas

The 2006 GCOB Route Option is underlain by limestone from Kentfield at the N59 to the eastern end. The limestone is highly prone to karstification.

A range of solution features were found within the scheme study area which are presented and ranked in **Section 4.4** of the Route Selection Report. Desk and field surveys were undertaken in order to identify and classify the karstic features. The report for these surveys is appended to the Route Selection Report (**Appendix A.4.4 Karst Study Report)** and includes tables and figures detailing the type and location of the features identified.

Most of the karstification identified along the 2006 GCOB Route Option consists of a weak to well-developed zone of epikarst, ranging from approximately 1.0m to 5.2m in thickness. This epikarst zone tends to be thinner on upland areas with thin superficial deposits and thicker on low-lying areas where superficial deposits are thicker, especially in areas close to or underlying surface streams, rivers or lakes.

In a small number of areas, more intense karstification has led to deeper weathering (below the epikarst zone) and clay infilling of solutionally enlarged features (typically joints). At some of these sites, even more intense karstification has occurred, leading to the development of large closed depressions and sediment infilled cavities.

A dense cluster of karst features have been identified adjacent to embankment section E5 in Kentfield. A number of enclosed depressions (K1, K3, K4, K5, K6, K10, K11, and K12) and springs (K2, K7 and K9) where confirmed in the vicinity of the route option.

East of the River Corrib, a spring (K25) and turlough (K31) were identified in Menlough. The route traverses a number of features in Ballindooley, beside

Ballindooley Lough. Three enclosed depressions (K94, K98 and K100) and one well (K92) have been identified in this location.

The route runs adjacent to a number of features as it approaches the N6 tie-in. Four enclosed depressions (K164, K168, K169 and K174) and one confirmed well (K170) are located in Breanloughaun. Four springs (K184, K186, K189 and K192) are all located in Ballintemple.

The impact of karst on the 2006 GCOB Route Option is assessed as **Medium**.

3.3.2.4 Overview of Historical Land Use

The 2006 GCOB Route Option passes largely through a rural landscape where historical mapping indicates that the land use has typically remained unchanged. This route option is characterised as predominantly agricultural land with sporadic one-off housing along the route. The 2006 GCOB Route Option circumvents the Twomileditch Quarry to the north and does not appear to encounter any previous industrial sites or potentially contaminated sites.

The impact of historical land use along the route is **Low**.

3.3.2.5 Overview of Economic Geology

The 2006 GCOB Route Option passes to the north of the Roadstone Quarry at Twomileditch. The quarry is the closest source of aggregates and concrete to Galway City.

There is likely to be a buffer zone around this route option in which blasting is not permitted to minimise risks from flyrock. This zone typically varies between 75 – 150m and is dependent on the techniques used. Further work would be required to assess the constraints on the buffer zone. This route option is shown as encroaching as close as 40m to the boundary of the quarry. This point is approximately along the line of the existing road so no additional restrictions would be introduced. Provided that appropriate blasting restrictions on the quarrying activities are employed it is possible that this route option would not sterilise sections of the quarry.

The western extent of the route also traverses a small historical pit/quarry (HQ31) in Cappagh (**Figure 3.3.1** and **3.3.2**).

The development of a quarry or other mining activity on the remaining route option corridor is likely to be difficult to develop within the city due to environmental constraints.

The impact of the 2006 GCOB Route Option on Economic Geology is assessed as **Medium**.

3.3.2.6 Overview of Geological Heritage

The Geological Heritage constraints are shown on **Figures 3.3.1** and **3.3.2**. There are unusual rock structures called mushroom stones (GHA03) that are situated north of Menlough Village (approximately 1km north of the 2006 GCOB Route Option). These mushroom stones consist of limestone rock that has been eroded into the shape of a mushroom by previously elevated water levels that have receded over

time. This stone, and others in the vicinity, have been interpreted as marking the former lake margins of Lough Corrib. This route option would be unlikely to have any impact on these rocks.

The Twomileditch Quarry (GHA01) on the Tuam Road 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 impact of the 2006 GCOB Route Option on the attribute is assessed as minimal.

A quarry exposure of Galway Black Marble in the Upper Visean Limestone in the area of Merlin Park, Brachiopod fossils (GHA02) have been recorded, in some shell beds. The quarry was one main source of Galway Black Marble to the stone trade. The constraint is over 800m from the route and would not be impacted.

The impact on Geological Heritage is **Low**.

3.3.3 Summary Impact Assessment

The impact of the 2006 GCOB Route Option on attributes identified are summarised in **Table 3.3.3**.

Table 3.3.3 Preliminary assessment of the soil and geology impacts for the GCOB Route Option

Attribute	Attribute importance	Impact	Level of impact
Agricultural soils – western side of scheme	Low	Loss of low fertility soil over limited section of route	Minor negative
Agricultural soils – east side of scheme	Medium	Loss of medium fertility soil over limited section of route	Minor negative
Exposure of granite bedrock	Medium	Deep cuttings exposing the bedrock will increase the geological heritage	Minor positive
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
Karst limestone – scheme wide	Medium	Karst features may require additional	Moderately negative

Attribute	Attribute importance	Impact	Level of impact
		engineered solutions to ensure an acceptable risk level for the route during its design life.	
Roadstone Quarry	High	Potential sterilisation of limited portions of quarry. Modification to extraction techniques likely.	Major negative

3.4 Hydrogeology

3.4.1 Introduction

This section details the Stage 1 Hydrogeology assessment of the 2006 GCOB Route Option with respect to the hydrogeology constraints identified in **Section 4.5 Hydrogeology of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.3 Hydrogeology of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.5.1** to **4.5.2 of the Route Selection Report, Figure 3.3.11** to **3.3.12 and Figure 3.4.1** to **3.4.2** of this Report.

This route option is divided into two distinct sections in terms of hydrogeology:

- Western section (West of the N59): granite and associated rock classified by the Geological Survey of Ireland as a poor aquifer; and
- Eastern section (East of the N59): limestone, which is classified by the Geological Survey of Ireland as a regionally important karst aquifer.

The classification of granite and associated rock being a poor aquifer and the limestone being a regionally important aquifer is collaborated by previous ground investigation (2006 GCOB) as well as site walkovers and investigations as part of the N6 GCTP studies.

3.4.2 Assessment

The western section of the 2006 GCOB Route Option traverses a number of water dependant features. This route option includes embankment (fill) and cut sections, with the cut sections excavating into the undulating rock topography locally. In these cases it is likely that groundwater levels in the enclosed rock topography would be lowered or drained, with potential severe negative impacts on water dependant habitats.

There are also a number of shallow cuttings on the approach to the River Corrib. These have the potential to cause local drawdown of groundwater levels.

As the eastern section has an undulating topography the construction is composed of fill in lower lying land and cuttings through the higher ground in order to minimise the gradient changes for the route option. The main cuttings are at Menlough, Ballindooley and the Parkmore area, all of which are in limestone. The

cuttings would likely intersect groundwater and would likely result in drawdown of the local groundwater.

There is a potential risk that drawdown at Ballindooley could impact on groundwater flows to Coolagh Lakes, Ballindooley Lough. Drawdown at Ballindooley has the potential to impact on Ballindooley Lough. Monitoring of the groundwater levels would allow groundwater levels to be determined and from these a drawdown assessment could be made

The risk from run-off and accidental spills would be an important assessment for the eastern section as the groundwater has a high vulnerability. This would require assessment of sealed drainage to a discharge point, which could reduce recharge along the footprint, consideration of multiple discharge points or indeed over the edge run-off.

The cuttings and the closest water dependent habitat and groundwater abstraction wells are summarised in **Table 3.4.1** below. Refer to **Figures 3.3.11** to **3.3.12** of this report for the location of the cuttings.

Table 3.4.1 Cutting and nearby water dependent habitats and groundwater abstraction locations

Section	Name and location	Length	Max cutting depth (m)	Nearest receptor	Proximity of receptor (m)	Potential impact
1	GCOB C1 Cnoc na Greine	400	0 – 5	EC11: Bog	200	Imperceptible
1	GCOB C2 Lough Inch	80	0 – 5	EC15: Wet grassland / Heath	360	Imperceptible
				EC16: Wet grassland / Heath / bog	0	Significant
1	GCOB C3 Aille	940	11	EC16: Wet grassland / Heath / bog	0	Significant
				EC17: Heath / bog / wet grassland	300	Imperceptible
2	GCOB C4 Cappagh	1110	10	EC19: Heath / bog	0	Significant
				EC20: Heath / bog	0	Significant
2	GCOB C5 Keeraun	570	0 - 5	EC22; Moycullen Bog / heath / wet grassland	0	Significant
2	GCOB C6 Tonabrocky	190	5 - 10	EC22: Moycullen Bog / heath / wet grassland	0	Significant

Section	Name and location	Length	Max cutting depth (m)	Nearest receptor	Proximity of receptor (m)	Potential impact
				Borehole W50-09	20	Slight
2	GCOB C7 Tonabrocky	290	5 - 10	EC24: Bog/heath / wet grassland	0	Significant
				Borehole W1000-01	0	Slight
2	GCOB C8 Gortacleva	830	14	EC24: Bog / heath / wet grassland	240	Moderate
				W1000-01	0	Slight
				EC20: Kentfield / NUI Galway wetlands	270	Imperceptible
2	GCOB C9 Menlough	320	0 - 5	Coolinillaun Wetland cSAC non Annex I habitat	100	Significant
				EC35: Turlough	450	Slight
				EC36: Turlough	580	Slight
				Coolagh Lakes (Lough Corrib cSAC)	500	Slight
2	GCOB C10 Menlough	170	5 - 10	EC35: Turlough	500	Slight

Section	Name and location	Length	Max cutting depth (m)	Nearest receptor	Proximity of receptor (m)	Potential impact
				Coolagh Lakes (Lough Corrib cSAC)	65	Moderate
				EC36 Turlough	250	Moderate
2	GCOB C11	430	5 - 10	EC35: Turlough	500	Slight
				EC36 Turlough	0	Significant
				Coolagh Lakes (Lough Corrib cSAC)	0	Moderate
2	GCOB C12 Ballindooley	880	10 - 15	EC38: Turlough	270	Significant
				EC39 Ballindooley Lough Complex	300	Significant
				W50-12	900	Moderate
2	GCOB C13 Ballindooley	600	10 - 15	EC39 Ballindooley Lough Complex	200	Moderate
				EC38: Turlough	270	Significant
				Borehole W50-12	950	Moderate
2	GCOB C14 N84 Realignment	740	5 - 10	EC36: Turlough	410	Moderate
				EC39 Ballindooley Lough Complex	400	Moderate

Section	Name and location	Length	Max cutting depth (m)	Nearest receptor	Proximity of receptor (m)	Potential impact
2	GCOB C15 Ballygarraun	900	9	EC39 Ballindooley Lough Complex	50	Moderate
2	GCOB C16 Polkeen Road	280	0 - 5	W100-03	980	Imperceptible
				W100-04	900	Imperceptible
				W100-05	820	Imperceptible
				W100-06	870	Imperceptible
2	GCOB C17 Polkeen	160	0 - 5	Borehole W100-03	940	Imperceptible
				Borehole W100-04	890	Imperceptible
				Borehole W100-05	720	Imperceptible
				Borehole W100-06	790	Imperceptible
2	GCOB C18 N17 to M6	2720	15 - 20	Borehole W100-03	950	Imperceptible
				Borehole W100-06	770	Imperceptible

Section	Name and location	Length	Max cutting depth (m)	Nearest receptor	Proximity of receptor (m)	Potential impact
				Borehole W100-04	850	Imperceptible
				Borehole W100-05	730	Imperceptible
				Borehole W1000-02	700	Imperceptible

3.4.2.1 Assessment Summary

The geology of the region divides the hydrogeological characterisation between west and east of the scheme study area. In the west the underlying granite is classified as a poor aquifer but these low permeability crystalline rocks are important as they perch shallow groundwater, locally trapping them and maintaining a high water level that supports water dependant habits such as at Tonabrocky Bog. The 2006 GCOB Route Option cuts through a number of wetland habitats, including Tonabrocky, and would likely have profound impacts on the perched groundwater by the removal of rock topography that maintains the water level and supports the ecology.

The regionally important karst aquifer of the eastern section has high vulnerability groundwater and includes localised surface water features that are in seasonal continuity with groundwater. There would be a potential profound to significant risk to Coolagh Lakes and Ballindooley Lough from up gradient road cuttings and these would need to be assessed for drawdown impacts.

3.5 Hydrology

3.5.1 Introduction

This section details the Stage 1 hydrology assessment of the 2006 GCOB Route Option with respect to the hydrology constraints identified in **Section 4.6 Hydrology of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.4 Hydrology of the Route Selection Report**.

This assessment should be read in conjunction with F**igures 4.6.1** to **4.6.2 of the Route Selection Report** and **Figure 3.5.1** to **3.5.6** of this Report.

3.5.2 Assessment

3.5.2.1 Flood Risk and Watercourse Crossings

The 2006 GCOB Route Option intercepts the stream channel of the Sruthán na Liberiti and avoids the Trusky Stream taking a more northerly route close to Lough Inch and its outlet channel. The Sruthán na Liberiti stream is a minor stream having a small catchment area of only 1.5km^2 and not ecologically sensitive, it is not considered to be fishery stream and is of little ecological value. This stream is an unmaintained channel and generally overgrown and not maintained with some sporadic short term out of bank flooding adjacent to the stream channel.

Culverting and diverting of the Sruthán na Liberiti watercourse as part of the drainage works for this route option would be unlikely to give rise to any significant impacts on flood risk and ecology both locally and downstream.

This route option would not intercept Lough Inch Lake or the main river channel, but would traverse close to the outlet channel and lake with the potential for encroachment within the floodplain.

The flood risk zones for these streams are not particularly extensive given the small catchment areas that lie immediately adjacent to the stream channels and lake. This route option avoids crossing the Trusky Stream channel. The impact on flood risk and stream flows would be considered to represent a local moderate negative impact which could be reduced to minor through use of Sustainable Drainage Systems (SUDs) and appropriate culvert sizing.

Road drainage discharges to these streams would require storm water attenuation to minimise any adverse impact on downstream flooding. The overall impact on flooding and watercourse hydrology would likely represent slight negative impact on river flows and water levels.

To the west of the River Corrib this route option intercepts two further streams namely a minor stream channel at Cnoc Odhrain which discharges to the River Corrib near Baile an Bhrunaigh and the Bearna Stream to the northeast of Na hAille. These are minor streams and unlikely to result in any significant flood risk concerns or impacts as a result of this route option. Overall the watercourse crossings and floodplain encroachments are considered to represent a slight negative impact on flooding, flow hydrology and flood risk.

The minor stream at Cnoc Odhrain outfalls to the Lough Corrib cSAC and the Bearna Stream outfalls to the Galway Bay Complex cSAC and these could be classified as medium attribute value watercourses. The potential impact magnitude of these crossings and potential outfall discharges is considered to represent a permanent moderate impact that could be reduced to slight permanent impact through appropriate culvert design and implementation of Sustainable Drainage Systems (SUDs). The Bearna Stream has fishery potential and fishery friendly culvert design may be required (i.e. appropriately designed culvert/small bridge). However, at the crossing point this stream is a steep hillside channel and unlikely to be Salmonid (except at the downstream extents towards its milder gradient estuarine reach).

To the east of the River Corrib the 2006 GCOB Route Option slightly encroaches the floodplain extents of the Coolagh Lakes to the northwest of the lakes.

This option encroaches the Lough Corrib cSAC at Coolagh Lakes over a distance of *c.*280m. The Coolagh Lake system which includes its floodplain and contributing drainage channels has an extremely high attribute value given its ecology value and being part of the Lough Corrib cSAC. This route option includes a bridge crossing within the Lough Corrib cSAC with support piers only encroaching within the cSAC boundary. The potential impact of this 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 lake would be considered to represent a moderate permanent impact.

The 2006 GCOB Route Option passes to the north and within the flood zone and recharge zone of Ballindooley Lough. This lough is classified as having a high attribute value and the potential impact to this lough is rated as moderate, from road drainage runoff, encroachment within the flood zone and potential for interference with groundwater recharge. East of Ballindooley Lough there are no further surface watercourses intercepted due to the karst limestone bedrock with natural drainage via infiltration eventually discharging to groundwater.

The streams and flood risk areas encountered to the west of the River Corrib are considered to be minor and localised to immediate surrounding channel banks and present little difference in impact level in respect to flood risk and flood impact. The principal flood risk area would be the crossing of the River Corrib and encroachment of Coolagh Lakes and Ballindooley Lough basins.

The flood risk has been assessed using combination of local flood information (flood incidents), the OPW Preliminary Flood Risk Assessment (pFRA) mapping which includes coastal, fluvial, pluvial and groundwater preliminary flood risk areas and the recent more detailed Draft Catchment Flood Risk Assessment and Management (CFRAM) mapping of fluvial and coastal flood risk for the River Corrib. The impact level for this route option would be determined based on the length of the corridor that encroaches a flood risk area, the potential flood risk to the proposed route option and potential impact on existing flood risk.

The 2006 GCOB Route Option is a wide crossing length of the River Corrib floodplain and flood zones having a potential encroachment distance of almost 1.9km within the Corrib Flood Zone. This route option would encroach slightly the flood zone area surrounding the Coolagh Lakes to the northwest and 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.

Overall the impact magnitude on flood risk associated with this option allowing for the viaduct option through the Lough Corrib cSAC is a moderate negative impact. The encroachment of Ballindooley Lough would also be considered to represent a locally moderate magnitude impact on flood risk that could be mitigated to slight through appropriate bridge design.

3.5.2.2 Water Quality

The Sruthán na Liberiti encountered by the 2006 GCOB Route Option is not a Salmonid water and is not considered ecologically sensitive. They outfall to Galway Bay West of the Galway Bay Complex cSAC. The potential operational impact by this route option on this stream would be expected to represent a slight local impact with construction works expected to have the potential for causing a temporary moderate local impact. The potential water quality impact to the Galway Bay Complex cSAC given the mixing available in the receiving coastal waters off Bearna would be considered to be slight to imperceptible under construction and operational phases.

The 2006 GCOB Route Option would not intercept Lough Inch Lake or the main river channel, but would traverse close to the river channel and lough, with the potential for road drainage discharges to enter the lake and river system giving rise to potential contamination risk both during construction and operationally from routine road drainage outfall discharges. Lough Inch and river outlet are located within the Moycullen Bogs NHA complex and would be considered as an ecologically sensitive water body of county importance. The potential impact from this route option on the water quality of this waterbody would be considered to represent a moderate negative impact as a significant section of this route option to the west of Bearna to Moycullen Road would have to outfall within the Lough Inch catchment.

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 would require mitigation to avoid contaminated discharges both during construction and the operational phases of the road.

A major public water supply abstraction is present at Terryland with the abstraction point from the Jordan Island channel on the River Corrib. Such a large and important water supply which is rated as very high attribute value is highly sensitive to water quality impacts both during construction and operational phases of the road project (i.e. in the event of routine road runoff discharges and accidental spillages). There are currently plans by Irish Water to relocate the abstraction point out into the River Corrib main channel downstream of Jordan's Island. This route option falls within the source protection area of the supply. The closer an option is to the intake in the upstream direction it is considered to have the greatest potential for impact both during construction and operation given the distance, speed and mixing volume available. This would potentially represent a significant impact on a very high importance attribute both during construction and potentially during the operational phase of the road.

Lough Atalia is part of the Galway Bay Complex cSAC and is a coastal lagoon priority habitat. This route option would be 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 would be carried out, would be likely to have an imperceptible impact on the Galway Bay Complex cSAC.

The 2006 GCOB Route Option would involve works adjacent to the Coolagh Lakes which are connected directly to the River Corrib with its confluence 900m upstream of the intake. This combined with the River Corrib crossing increases the works area and road distance that could give rise to serious impact on River Corrib cSAC and on the Terryland 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 supply intake is assessed as high both for construction and operational phases. Operation phase impact could be mitigated to a slight and moderate impact through preventing direct discharge of road drainage to the River Corrib and the Coolagh Lakes area and providing spillage containment and treatment.

The impact on the smaller watercourses has been assessed and included for earlier under the assessment of watercourses. The 2006 GCOB Route Option avoids the Terryland River Basin but would pass north of Ballindooley Lough with the potential for road drainage discharge to this Lough and construction impacts caused by the proximity of the route option to the flood area of Ballindooley Lough. This is a high attribute receptor and the water quality potential impact is rated as moderate but could be reduced to slight with mitigation in respect to treatment of the road drainage.

3.5.2.3 Hydro-Ecology

Detailed Habitat mapping has been carried out for the scheme study area, based on this mapping and site walkovers an assessment of the impact to hydro-ecology of this route option 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 this route option avoiding Annex 1 habitats such as Blanket Bog [7130], Transition Mires and Quaking Bogs [7140] and Northern Atlantic wet heaths with Erica tetralix [4010] but within close proximity of such habitats. Refer to **Section 4.3 of the Route Selection Report** for ecology constraints and **Section 3.2** of this report for the ecological assessment of the 2006 GCOB Route Option.

The 2006 GCOB Route Option significantly encroaches the Moycullen Bog NHA for a distance of approximately 1.25km. This route option encroaches Annex 1 habitats of Active Blanket bog [*7130] and North Atlantic wet heath with Erica tetralix [4010] for 1.9km from south of Lough Inch westward. There is little room within the corridor of this route option to avoid these high priority habitats.

To the east of Lough Inch wet grassland and Annex 1 Wet heaths with some active Blanket bog is also encountered for a distance of 1km.

The overall impact on these habitats would be considered to represent a significant permanent impact on the Moycullen Bog NHA and on Annex 1 habitats through direct loss of the habitat and indirectly by drainage effects of the road formation and road drainage channels resulting on dewatering and lowering of the water table within the bog and Wet heaths.

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 off the River Corrib. The assessment considered the route option proximity to these habitats and whether they were upstream of downstream of them.

The River Corrib as a Salmonid water and with the downstream Galway Bay Complex cSAC were not included under this assessment as they were included under water quality.

The 2006 GCOB Route Option passes through the middle of the Tonabrocky Bog EC22 over a distance of *c.*700m. This hosts Annex 1 habitats including Active Blanket bog [*7130], Transition mires and Quaking bogs [7140] and Northern Atlantic wet heaths with Erica tetralix [4010]. The potential indirect impacts of the construction and operation of this route option could result in dewatering and drainage impacts to these habitats having a potential significant impact magnitude as the route option could potentially act as a large liner drain that over time would dry and degrade these habitats.

The 2006 GCOB Route Option would cut for a distance of *c.*750m through Annex 1 habitats of primarily Northern Atlantic wet heaths with Erica tetralix [4010] and some Active Blanket bog [*7130] associated EC19 and EC20 at Cappagh and a small section of Active Blanket bog [*7130] and Wet grassland associated with EC24 at Gort an tSleibhe. The Wet heath and Blanket bog complex is sensitive to hydrological regime change through drainage and potential dewatering and the potential impact of this route option on this receptor is classified as significant magnitude impact on an internationally important habitat.

At the River Corrib crossing the 2006 GCOB Route Option crosses through Wet grassland, Wet woodlands (oak and primarily willow), rich fen and flush habitats and in close proximity to Alkaline fens on both sides of the river. It also passes through a small section of Annex 1 Active Blanket bog [*7130] on the western side of the River Corrib. All of these habitats coincide with the riparian zone of the River Corrib over a distance of approximately 1.9km. This represents a potential significant impact to the hydrology of these habitats which could be reduced to slight if the crossing was constructed as a viaduct.

The 2006 GCOB Route Option passes through the recharge zone of the Coolagh Lakes which could impact on the Calcareous fens surrounding the lakes. This impact is dealt with and accounted for within **Section 3.4 Hydrogeology** of this report. A potential indirect impact may arise on this habitat and Coolagh Lakes complex from road drainage discharge which could enter the lakes. The impact of drainage waters on the lakes could be mitigated through appropriate storm drainage treatment and discharge control reducing impact magnitude from significant to moderate magnitude impact.

This route option also takes it across a 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. A potential indirect impact may arise on this habitat and Ballindooley complex from road drainage discharge which could be mitigated through appropriate storm drainage treatment and discharge control. The impact magnitude on Ballindooley Lough Complex EC39 is considered to be a moderate magnitude impact.

3.5.2.4 River Corrib Crossing

The River Corrib Bridge crossing, for the 2006 GCOB Route Option, represents a skewed crossing of the channel and floodplain with the road footprint encroaching the River Corrib 100 year flood area for some 1900m (based on the 100 year flood estimate from the CFRAM studies). The river channel at the crossing point is approximately 95m in width. This route option would potentially involve a 1.1km to 1.4km wide crossing of the Lough Corrib cSAC. The proposed river crossing would involve a long bridge structure to minimise direct impact to the Lough Corrib cSAC and to avoid any encroachment into the river channel. This option would be designed to provide a full span of the River Corrib channel which would avoid any in-stream constructional works associated with piers and foundations. The bridge would be designed to ensure no constraint to boat passage and therefore the soffit level of the bridge would be 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 piers would 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 bridge there would be temporary works within and close to the flood plain but with no works within the river channel associated with any pier construction.

The impact magnitude of the proposed crossing option for the 2006 GCOB 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.

3.5.3 Assessment Summary

The 2006 GCOB Route Option is considered unacceptable as it has the potential to cause significant hydrological impact on Annex 1 Active Blanket bog [*7130] and Northern Atlantic wet heaths with Erica tetralix [4010] habitat associated with the Moycullen Bog NHA.

This route is considered unacceptable from a hydrological perspective, as it has the potential to cause significant hydrological impact on the Annex 1 habitats associated with the Moycullen Bog NHA at Tonabrocky cutting through the middle of this bog over a distance of approximately 700 to 750m. It further crosses through Annex 1 aquatic sensitive habitats associated with Wet heath and Blanket bog at Coolagh (EC19, EC20) and EC24 and the riparian zone of the Lough Corrib cSAC. The route option has a long encroachment length of the River Corrib floodplain and high flood risk zone. The footprint of the design within the 100year flood zone would be approximately 1.9km.

3.6 Landscape and Visual

3.6.1 Introduction

This section details the Stage 1 landscape and visual assessment of the 2006 GCOB Route Option with respect to the landscape and visual constraints identified in **Section 4.7 Landscape and Visual of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.5 Landscape and Visual of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.7.1** to **4.7.2 of the Route Selection Report** and **Figure 3.6.1** to **3.6.2** of this Report.

3.6.2 Assessment

The principal aspects of the 2006 GCOB Route Option most likely to give rise to significant and profound negative impacts are set out in the following.

3.6.2.1 Construction Stage

The following are the principal aspects of the 2006 GCOB Route Option that would give rise to significant and profound impacts on the landscape/townscape and visual environments during construction:

- Demolition of/impact on a significant number of existing residential properties – particularly at the N59 at Kentfield/Killeen, in passing through Ballindooley and in crossing the local road at Ballintemple, see **Section 3.9 Material Assets – Non Agriculture**;
- Demolition of a number of other residential properties at dispersed locations along the route option, see **Section 3.9 Material Assets – Non Agriculture**;
- Direct take/removal of existing (retained) residential amenities, including property boundaries, portions of gardens, *etc.* – most particularly to either side of the N59; in passing through Ballindooley, as well as at dispersed locations along the length of the route option;
- Significant new bridging of the River Corrib at remote, naturally attractive setting close to the mouth of Lough Corrib. Bridge crossing also in background of view/setting of Menlo Castle;
- This route option would pass between Menlo Castle and Menlough Village, severing the access avenue;
- Direct take/removal/impact on existing/proposed open space, natural amenity, landscape character, plantings – particularly in passing Lough Inch and crossing Tonabrocky Bog, in crossing the natural setting of the River Corrib, traversing between Menlough and Ballindooley, and passing Ballindooley Lough, but also in crossing natural stream corridors north of Bearna;
- Impact on existing amenity/recreation facilities (*e.g.* Glenlo Abbey Golf Course, and general amenity along the River Corrib);
- General disturbance, excavation, earthworks, construction activity, lighting and related noise, dust effects *etc*., including removal of existing boundaries and

vegetation, soil stripping and storage, raising of embankments, cutting of slopes, and construction traffic;

- Significant level of interim local traffic management/re-allocation/diversion/ temporary works over phases of construction programme. Works would require construction of new bridging structures and local road re-alignments;
- Impact on Protected County Plan Views Numbers 73 & 74 north of Bearna Village and View Number 70 at Bushypark, as well as City Plan Scenic Views and Prospects V.10 (at N59 Bushypark) and V.19 (at N84, Ballindooley); and
- Potential impact on Greenway proposals – most especially along River Corrib towards Lough Corrib.

It is considered that the individual impacting aspects outlined above would in combination give rise to locally significant negative impacts from construction activity on the natural landscape character of the corridor of Lough Inch, Tonabrocky Bog and the River Corrib; as well as on the setting of Menlo Castle, and on the community and visual character around Ballindooley Lough.

3.6.2.2 Operation Stage

The following are the principal aspects of the 2006 GCOB Route Option that would give rise to the significant and profound landscape/townscape and visual impacts during operation:

- The direct and indirect effect of the loss of existing residences from within the communities at the N59, Ballindooley and Ballintemple;
- Significant landscape impact on areas of semi-natural / natural high landscape quality at Lough Inch, Tonabrocky Bog, the River Corrib, between Menlough and Ballindooley;
- Impact on Glenlo Abbey Golf Course;
- General impact – visual disturbance of road infrastructure, noise issues/barriers, illumination, road lighting *etc*., on residential property at disperse locations along the route option;
- Impact on Protected County Views Number 73 and 74 north of Bearna Village, and View Number 70 at Bushypark, as well as City Views V.10 and V.19 at Bushypark and Ballindooley; and
- The provision of a bridge over the River Corrib in an existing high-quality landscape close to riverside setting of Menlo Castle.

It is considered that the collective effect of impacts related to the scale of major infrastructure required to be provided – often within established residential communities – would give rise to significant and residual adverse impacts on the landscape and visual environment of the road corridor at Tonabrocky Bog, Glenlo Abbey, the River Corrib/Menlo Castle and at Ballindooley.

3.6.3 Summary

In summary, the 2006 GCOB Route Option has less incidence of significant and profound visual impacts on properties than other route options considered as part of the Stage 1 assessment of options – taking as it does a more rural alignment

through Tonabrocky, Glenlo, Menlo and around the eastern side of Parkmore. By contrast, this route option has a higher degree of landscape impact than other routes, particularly as a result of impact on Lough Inch, Tonabrocky, Glenlo Abbey and the setting of the River Corrib corridor and severs on embankment, the demesne and avenue to Menlo Castle. However, the route has less impact on the visual riverside setting of the castle itself when compared to the other route options examined during the Stage 1 assessment of options.

3.7 Archaeological, Architectural and Cultural Heritage

3.7.1 Introduction

This section details the Stage 1 archaeological, architectural and cultural heritage assessment of the 2006 GCOB Route Option with respect to the archaeological, architectural and cultural heritage constraints identified in **Section 4.11 Archaeological, Architectural and Cultural Heritage of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.6 Archaeological, Architectural and Cultural Heritage of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.11.1** to **4.11.2** of the Route Selection Report and **Figure 3.7.1** to **3.7.2** of this Report.

The assessment has been based on the footprint of the previous road scheme, with all measurements made from the designed fence to the archaeological, architectural or cultural heritage constraint (150m either side of the fenceline). Constraints identified during the initial constraints study consist of the following:

- Recorded Monuments & Places (RMP);
- Sites and Monuments Record (SMR);
- National Monuments;
- Monuments protected with a Preservation Order;
- Protected Structures;
- National Inventory of Architectural Heritage;
- Architectural Conservation Areas;
- Designed Landscapes;
- Previous Archaeological Excavations; and
- Previously unrecorded cultural heritage sites.

3.7.2 Assessment

Table 3.7.1 below identifies the archaeology, architectural and cultural heritage impacts due to the 2006 GCOB Route Option.

Table 3.7.1 Potential Impacts

ID No.:	Classification:	Statutory Protection:	Dist. From route:	Impact type:	Impact level:
AH 1	Redundant record	No	85m ENE	N/a	N/a
CH 1	Enclosure (2006 EIS)	No	85m ENE	Indirect	Slight negative
CH 2	Possible enclosure (2006 EIS)	No	10m east	Indirect	Moderate negative
AH 71	Cenotaph (Also BH 29)	Yes	150m SSE	Indirect	Imperceptible negative
BH 29	Cenotaph (Also AH 71)	No	150m SSE	Indirect	Imperceptible negative
CH 44	Vernacular building, in ruins (2006 EIS)	No	0m	Direct	Moderate negative
CH 3	Possible mound (2006 EIS)	No	0m	Direct	Significant negative
CH 4	Possible enclosure (2006 EIS)	No	35m north	Indirect	Moderate negative
CH 5	Vernacular structure, in ruins (2006 EIS)	No	0m	Direct	Significant negative
AH 2	Redundant record	No	30m SW	N/a	N/a
AH 3	Quarry	No	0m	Direct	Moderate negative
BH 28	St. Josephs School	Yes	135m west	Indirect	Slight negative
CH 6	Vernacular structure, in ruins (2006 EIS)	No	60m north	Indirect	Slight negative
CH 7	Groups of vernacular structures, in ruins (2006 EIS)	No	49m	Indirect	Slight negative
CH 8	Possible standing stone (2006 EIS)	No	0m	Direct	Significant negative
CH 9	Groups of vernacular structures, in ruins (2006 EIS)	No	0m	Direct	Significant negative
CH 10	Possible cairn (2006 EIS)	No	0m	Direct	Significant negative
CH 50	Ditches and pits? (Geophysical survey 2005)	No	0m	Direct	Significant negative
CH 11	Site of 'Albano Cottage'	No	0m	Direct	Significant negative
CH 12	Possible mill race (2006 EIS)	No	0m	Direct	Moderate negative
CH 38	New Park House	No	0m	Direct	Significant negative
AH 4	Designed landscape feature	Yes	0m	Direct	Profound negative

ID No.:	Classification:	Statutory Protection:	Dist. From route:	Impact type:	Impact level:
DL 3	River View house & demesne (including Albano Cottage)	No	0m	Direct	Moderate negative
DL 4	New Park House (now Killeen House) and demesne	No	0m	Direct	Significant negative
DL 5	Glenlo Abbey and demesne	No	0m	Direct	Significant negative
CH 14	Railway line	No	0m	Direct	Moderate negative
CH 13	Circular feature related to the adjacent railway line (2006 EIS)	No	0m	Direct	Moderate negative
AH 5	Enclosure	Yes	47m NNE	Indirect	Moderate negative
CH 15	Trapezoidal mound of gravel and earth (2006 EIS)	No	129m NNE	Indirect	Slight negative
CH 16	Medieval field? (2006 EIS)	No	12m NNE	Indirect	Moderate negative
CH 17	Medieval field system? (2006 EIS)	No	0m	Direct	Significant negative
BH 99	Remains of stone fort	Yes	0m	Direct	Profound negative
DL 8	Dangan Cottage, Dangan House, Dangan Nunnery, Mary Ville demesne	No	74m NNE	Indirect	Slight negative
AH 6	Burial ground	Yes	70m NNE	Indirect	Moderate negative
AH 7	Designed landscape feature	No	14m north	Indirect	Moderate negative
AH 8	Designed landscape feature	No	106m NNE	Indirect	Slight negative
AH 9	Gate house (also BH 3)	Yes	124m north	Indirect	Slight negative
BH 3	Gate house (also AH 9)	Yes	124m north	Indirect	Slight negative
AH 11	Cairn – clearance cairn	Yes	17m south	Indirect	Moderate negative
AH 10	House – 17th century Castle, unclassified (Also BH 2)	Yes	141m SSW	Indirect	Moderate negative
BH 2	Menlo Castle (Also AH 10)	Yes	141m SSW	Indirect	Moderate negative

ID No.:	Classification:	Statutory Protection:	Dist. From route:	Impact type:	Impact level:
DL 10	Menlo Castle demesne	House is in the RPS	0m	Direct	Profound negative
CH 18	Regular rectangular cut feature & Possible standing stone (2006 EIS)	No	0m	Direct	Significant negative
CH 19	Vernacular structure, in ruins (2006 EIS)	No	0m	Direct	Significant negative
CH 20	Consumption wall (2006 EIS)	No	0m	Direct	Significant negative
CH 21	Vernacular animal shelter (2006 EIS)	No	0m	Direct	Significant negative
CH 22	Possible prehistoric tomb (2006 EIS)	No	0m	Direct	Significant negative
CH 23	Circular feature? (2006 EIS)	No	0m	Direct	Significant negative
CH 24	Small boulder (2006 EIS)	No	16m NW	Indirect	Moderate negative
CH 25	Possible cairn (2006 EIS)	No	0m	Direct	Significant negative
CH 26	Consumption wall (2006 EIS)	No	29m WNW	Indirect	Moderate negative
AH 120	Enclosure	Yes	19m NW	Indirect	Moderate negative
CH 27	Possible corn/turf drying stand, possible ringfort, possible cairn, possible consumption wall, three possible structures (2006 EIS)	No	0m	Direct	Significant negative
CH 28	Possible *fulacht fiadh* (2006 EIS)	No	0m	Direct	Significant negative
CH 29	Possible ringfort (2006 EIS)	No	0m	Direct	Significant negative
CH 30	Rectangular feature (2006 EIS)	No	0m	Direct	Significant negative
CH 31	Vernacular buildings, in ruins (2006 EIS)	No	0m	Direct	Significant negative
CH 40	Burnt mound and ditches? (Geophysical survey 2005)	No	0m	Direct	Significant negative
AH 12	Castle – tower house (Also BH 36)	Yes	138m SSW	Indirect	Slight negative

ID No.:	Classification:	Statutory Protection:	Dist. From route:	Impact type:	Impact level:
BH 36	Castle – tower house (Also AH 12)	Yes	138m SSW	Indirect	Slight negative
AH 149	Crannog (Also BH 70)	Yes	119m south	Indirect	Slight negative
BH 70	Crannog (Also AH 149)	Yes	119m south	Indirect	Slight negative
AH 163	Castle, 17th C House, Inscribed stone	Yes	41m WNW	Indirect	Moderate negative
AH 20	Quarry	No	83m E & W	Indirect	Slight negative
AH 21	Redundant record	No	97m east	N/a	N/a
CH 32	Consumption wall (2006 EIS)	No	25m NNW	Indirect	Slight negative
CH 33	Raised natural limestone platform with possible hut (2006 EIS)	No	42m NNW	Indirect	Slight negative
AH 13	Quarry	No	143m SW	Indirect	Imperceptible negative
CH 45	Upright stone (2006 EIS)	No	12m NE	Indirect	Moderate negative
CH 48	Burnt mound? (Geophysical survey 2005)	No	0m	Direct	Significant negative
CH 34	Possible standing stone, isolated boulder, three raised areas of archaeological potential, possible cairn (2006 EIS)	No	0m	Direct	Significant negative
CH 35	Raised stone circular area (2006 EIS)	No	0m	Direct	Significant negative
CH 36	Group of vernacular buildings (2006 EIS)	No	10m west	Indirect	Significant negative
CH 37	Possible stone dump with boulders and trees (2006 EIS)	No	57m SW	Indirect	Slight negative
CH 46	Burnt mound? (Geophysical survey 2005)	No	0m	Direct	Significant negative
CH 47	Two Burnt mounds? (Geophysical survey 2005)	No	0m	Direct	Significant negative

3.7.2.1 Assessment Summary

The 2006 GCOB Route Option would impact considerably upon the cultural heritage resource. Whilst it is acknowledged that many of the sites identified in or

within the immediate vicinity of scheme were identified during the 2006 GCOB EIS and receive no specific statutory protection, this route option would impact considerably on the recorded archaeological, architectural and cultural heritage resource. Impacts are summarised below:

Table 3.7.2 Summary of Impacts on the Previous Bypass Route

Profound negative	Significant negative	Moderate negative	Slight negative	Imperceptible negative
AH 4 (DLF) **BH 99** (Remains of stone fort) **DL 10** (Menlo Castle demesne)	**CH 3** (Poss. Mound) **CH 5** (V. building) **CH 8** (Standing stone?) **CH 9** (V. buildings) **CH 10** (Poss. Cairn) **CH 50** (Ditches & pits?) **CH 11** (Site of Albano Cottage) **CH 38** (New Park House) **DL 4** (New Park demesne) **DL 5** (Glenlo Abbey demesne) **CH 17** (Medieval field system) **CH 18** (Rectangular feature, poss. Standing stone) **CH 19** (V. building) **CH 20** (Consumption wall) **CH 21** (V. animal shelter) **CH 22** (Poss. PH tomb) **CH 23** (Circular feature) **CH 25** (Poss. Cairn) **CH 27** (Multiple sites) **CH 28** (Poss. *Fulacht fiadh*) **CH 29** (Poss. Ringfort) **CH 30** (Rectangular feature) **CH 31** (V. building) **CH 40** (Burnt mound/ ditches?) **CH 48** (Burnt mound?) **CH 34** (Multiple features) **CH 35** (Raised stone area) **CH 36** (V. buildings)	**CH 2** (Poss. Enclosure) **CH 44** (V. building) **CH 4** (Poss. Enclosure) **CH 12** (Poss. Mill race) **DL 3** (River View demesne) **CH 14** (Railway line) **CH 13** (Circular feature) **AH 5** (Enclosure) **CH 16** (Medieval field?) **AH 6** (Burial ground) **AH 7** (DLF) **AH 11** (Cairn) **AH 10/ BH 2** (Menlo Castle) **CH 24** (Small boulder) **CH 26** (Consumption wall) **AH 120** (Enclosure) **AH 163** (Castle) **CH 45** (Upright stone)	**CH 1** (Enclosure) **BH 28** (School) **CH 6** (V. building) **CH 7** (V. building) **CH 15** (Mound) **DL 8** (Dangan Cottage etc demesnes) **AH 8** (DLF) **AH 9/ BH 3** (Gate house) **AH 12/ BH 36** (Tower house) **AH 149/ BH 70** (Crannog) **AH 20** (Quarry) **CH 32** (Consumption wall) **CH 33** (Platform & hut?) **CH 37** (Stone dump, boulders)	**AH 1/ BH 29** (Cenotaph) **AH 13** (Quarry)

Profound negative	Significant negative	Moderate negative	Slight negative	Imperceptible negative
	CH 46 (Burnt mound?) **CH 47** (Two burnt mounds)			
N/a: AH 1 (RR), AH 2 (RR), AH 21 (RR)				

The area that would suffer the greatest impact runs from Killeen to Menlough. This area is characterised by demesne landscapes and large houses, which were established by the landed gentry who were keen to utilise the picturesque River Corrib landscape within the settings of their houses. As such this route option directly impacts on four large demesnes, with the impact at Menlo Castle demesne considered to be profound. Here the route option runs in close proximity to the castle itself and severely truncates the principal structure from attendant features. The impact on the demesne would be profoundly negative due to the level of truncation and the nature and extent of the direct impact.

In addition to this particular impact, this route option would profoundly impact on one protected structure (BH 99) and one recorded archaeological site (AH 4). A total of 28 significant impacts are predicted upon sites identified as part of the 2006 GCOB EIS and during geophysical survey of the route.

3.8 Material Assets – Agriculture

3.8.1 Introduction

This section details the Stage 1 material assets – agriculture assessment of the 2006 GCOB Route Option with respect to the material assets –agriculture constraints identified in **Section 4.12 Material Assets –Agriculture of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.7 Material Assets –Agriculture of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.12.1** to **4.12.2 of the Route Selection Report** and **Figure 3.8.1** to **3.8.2** of this Report.

3.8.2 Assessment

Table 3.8.1 below identifies the potential agricultural impacts for the 2006 GCOB Route Options

Table 3.8.1 Potential Agricultural Impacts

	2006 GCOB Route Option
Agricultural land (ha)	207
Good quality agricultural land (ha)	62
Area of land parcels (ha)	1124
No. of farm yards / farm structures	15
No. of Equine enterprises	0

The GCOB 2006 Route Option would take approximately 207 hectares of agricultural land with approximately 62 hectares of this classified as medium – good

quality agricultural land. The quality of land at the western end is very poor from an agricultural perspective – the majority of it being blanket bog – and the sensitivity of the agricultural environment is low. The sensitivity of the agricultural environment further east is low – medium. The 2006 GCOB Route Option affects 15 farm yards/structures and affects approximately 419 land parcels[6] (with an area of approximately 1124 hectares). It would not affect any equine farm yards.

3.9 Material Assets – Non Agriculture

3.9.1 Introduction

This section details the Stage 1 material assets – non agriculture assessment of the 2006 GCOB Route Option with respect to the material assets – non agriculture constraints identified in **Section 4.13 Material Assets -Agriculture of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.8 Material Assets – Non Agriculture of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.13.1** to **4.13.4 of the Route Selection Report** and **Figure 3.9.1** to **3.9.2** of this Report.

3.9.2 Assessment

The assessment for the number of properties directly impacted by the 2006 GCOB Route Option is presented below in **Table 3.9.1**. There would be 27 direct impacts on residential properties and 3 direct impacts on commercial properties, with the full acquisition of 10 residential properties. There would be no full acquisition of a commercial property.

Table 3.9.1 Property Assessment

Location	Residential Acquisitions	Residential Partial Landtake	Commercial Acquisitions	Commercial Partial Landtake	Planning Permissions
Within the fenceline	10	3	-	1	-
Within the Corridor	-	14	-	2	-

The assessment for the number of conflicts with utilities for the 2006 GCOB Route Option is presented in **Table 3.9.2** below. These impacts range from crossing of the road footprint to significant diversions of service ducts and pipelines. There are no conflicts with, UPC, Galway City and County Council 300mm watermains, surface drainage or foul sewer.

The 2006 GCOB Route Option would have a low number of utility impacts as it is relatively far from the city and the services are more dispersed. The highest numbers of utility impacts would be from crossing Eircom and ESB services. It would also cross SSE 110kV lines at three locations.

[6] Land Registry land parcels as identified on the Property Registration Authority of Ireland Website.

Table 3.9.2 Utilities Assessment – Section 2 Utility

Utility	No. of Conflicts
E-Net	1
ESB HV OH	8
ESB HV UG	1
ESB MV OH	15
ESB MV/LV UG	1
Eircom	17
Gas Networks Ireland (Bord Gáis)	5
UPC	-
Council Watermain – 300mm	-
Council Watermain – 450mm	1
Council Watermain – 500mm	1
Foul Pipes	-
Surface Drainage	-
Trunk Sewer	1
SSE	3

In summary, the 2006 GCOB Route Option mostly impacts on non-commercial rural properties with the full acquisition of 10 residential properties in total. There would be no commercial properties to be fully acquired, however three commercial sites lie within the corridor. The 2006 GCOB Route Option would have a low number of utility impacts largely due its rural location outside densely populated city areas.

3.10 Air Quality and Climate

3.10.1 Introduction

This section details the Stage 1 air quality and climate assessment of the 2006 GCOB Route Option with respect to the air quality and climate constraints identified in **Section 4.14 Air Quality and Climate of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.9 Air Quality and Climate** of the **Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.15.1** to **4.15.2** of the **Route Selection Report** and **Figure 3.10.1** to **3.10.2** of this Report.

3.10.2 Assessment

The 2006 GCOB Route Option follows an alignment predominately towards the outskirts of the city, traversing a large number of local and regional roads all of which have clusters of residential properties in close proximity.

Pollutant concentrations recorded by the EPA are well within air quality standards and the assimilative capacity of the air within the scheme study area is considered good.

In general, the 2006 GCOB Route Option avoids large residential areas and communities but runs adjacent to clusters of houses where it crosses the local and regional roads.

Due to the expected traffic volumes and the existing assimilative capacity of the scheme study area, no air quality standards would likely be exceeded as a result of the 2006 GCOB Route Option.

3.11 Noise and Vibration

3.11.1 Introduction

This section details the Stage 1 noise and vibration assessment of the 2006 GCOB Route Option with respect to the constraints identified in **Section 4.15 Noise and Vibration of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.10 Noise and Vibration of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.15.1** to **4.15.2 of the Route Selection Report** and **Figure 3.11.1** to **3.11.2** of this Report.

3.11.2 Assessment

3.11.2.1 Existing Environment

Galway City and County Council's most recent Noise Action Plan (2013 to 2018) presents an overview of noise levels from road traffic within the city and county boundaries. All roads with traffic flows greater than 3 million vehicle trips per annum (approximately 8,000 AADT) were required to be mapped. The published noise maps present the calculated L_{den} noise contour bands along the each of the roads with traffic flows greater than 3 million vehicle trips per annum.

On review of the L_{den} noise maps for the scheme study area, the 2006 GCOB Route Option between the R336 at Bearna and the N59 passes through an area which is least affected by existing road traffic noise. Whilst there are a number of local roads in the vicinity of this area, the volumes of traffic along each is below the traffic volumes threshold for mapping (i.e. 8,000 AADT).

Similarly, the existing noise environment in the vicinity of the 2006 GCOB Route Option between the N59 and the N84 Roads passes through an area set back from heavily trafficked roads and other urban noise sources due its distance from the city centre.

To the east of the scheme study area from the N84 Road, the presence of the heavily trafficked N84, N17, R865 and N6 Roads all give rise to noise levels between 50 and 70dB L_{den} within the scheme study area, depending on the distance from the road. In this instance, the existing noise environment beyond the N84 Road Junction with the 2006 GCOB Route Option is already exposed to noise levels from road traffic, compared to the quieter pre-existing noise environment along the western section of the route option.

3.11.2.2 Potential Impact Rating (PIR)

The NRA Guidelines advise that the initial stage of a route selection assessment on noise should focus on the PIR for each route. This involves counting the number of noise sensitive properties within 300m from the centre line of each corridor, subdivided into four distance bands of 0 – 50m, 50 – 100m, 100 – 200m, and 200 – 300m. The total number of receptors within each band is multiplied by an arbitrary rating factor suggested as follows within the guidelines:

- Band 1 4
- Band 2 3
- Band 3 2
- Band 4 1

The resultant values are summed to give a single rating number for each route, the larger the PIR, the higher impact is potentially associated with the route.

Table 3.11.1 presents the PIR assessment values for this route option.

Table 3.11.1 PIR Values

Band	No of Receptors in Band (A)	Rating Factor (B)	A x B
1	6	4	24
2	34	3	102
3	121	2	242
4	175	1	175
Potential Impact Rating			**543**

The PIR value calculated is 543. The highest number of properties being counted within band 4, between 200 and 300m from the centreline.

3.11.2.3 Noise Footprint Assessment

To analyse the potential noise impacts associated with the 2006 GCOB Route Option, the potential indicative noise 'footprint' was determined using the following methodology.

- The route alignment was overlaid on OS and aerial mapping. The proposed vertical alignment was then reviewed to determine areas of grade, cuttings and embankments;
- Using guidance from the NRA's 'Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes' (March 2014), the

approximate distance to a 60dB L_{den} contour was established using the noise footprint graphs set out in Chapter 5 of the Guidance document;

- An operational speed of 100km/hr was assumed and traffic flows of 8,000 AADT were used for within Section 1 (west of Barr Aille Road) and 30,000 AADT for Section 2 (east of Barr Aille Road). A standard hot rolled asphalt road surface was used for the assessment;
- The noise contour lines were determined for individual sections of the route, taking account the vertical alignment, traffic flows, traffic speed and the road surface. In line with the Stage 1 assessments undertaken for the N6 GCTP Route Options, the route corridor under consideration was 150m wide. Given the potential for the centreline to move within the 150m wide study corridor, it was considered prudent to extend the 60dB L_{den} contour line 75m beyond each side of the road centreline and junctions to account for this potential variation. This was undertaken for the 2006 GCOB alignment in order to provide a comparative assessment against the others assessed; and
- The number of noise sensitive properties within the 60dB L_{den} contour was counted and the total number between Section 1 and 2 was established.

On review of the 2006 GCOB Route Option, there would be, of the order of 170 properties which would have the potential to fall within the 60dB L_{den} noise contour along its alignment, taking account of the extended area beyond the road edge. The majority of these properties are located along local roads or within clustered areas. In order to suitably reduce traffic noise emissions from the 2006 GCOB Route Option to within the specified design goal of 60dB L_{den} set out by the NRA, the mitigation measures available for this route option would be limited to selection of the road surface and the use of barrier screening.

3.11.3 Summary

Overall, the potential noise impact of the 2006 GCOB Route Option would affect a large number of properties due to its length and its general proximity to Galway City and outer suburban areas. Whilst this route option has the potential to affect a large number of properties, the overall PIR rating for this route option is the lowest compared to other route options assessed as part of the Stage 1 assessment of options. In addition, whilst the number of properties in the wider reaches of the route alignment is high, the number of properties counted within the indicative 60dB L_{den} contour line is also the lowest compared to the other route options assessed.

3.12 Human Beings

3.12.1 Introduction

This section details the Stage 1 human beings assessment of the 2006 GCOB Route Option with respect to the constraints identified in **Section 4.17 Human Beings of the Route Selection Report** and uses the same methodology as outlined in **Section 6.5.11 Human Beings of the Route Selection Report**.

This assessment should be read in conjunction with **Figures 4.17.1** to **4.17.2 of the Route Selection Report** and **Figure 3.12.1** to **3.12.2** of this Report.

3.12.2 Assessment

3.12.2.1 Construction

During construction, a moderate negative impact of finite duration could be anticipated on angling amenity at Lough Inch given the proximity of the works. By comparison, the impact on the pitch and putt course at this location would be permanent. Similar construction impacts on amenity would occur at the Glenlo Abbey Golf Course and during the construction of the bridge across the River Corrib. At Menlo Castle, the construction of the ramp to the bridge crossing would introduce a major negative impact on amenity and severance of the demesne and the castle from the village of Menlough. This extends to a moderate impact persisting into the operational phase.

There would be impacts on individual properties in Gortacleva, Ballindooley and Ballintemple, but these would not be of a scale to present an impact at a community level except in the case of severance at Ballindooley prior to the connection provided by the link road and overbridge (refer to **Section 3.9 Material Assets – Non-Agriculture**).

3.12.2.2 Principal Impacts

Between the R336 and Lough Inch the 2006 GCOB Route Option would have the following principal impacts:

- Direct impact on Pitch and Putt Course at Lough Inch ;
- Some relief from existing severance in Bearna Village; and
- Improved connectivity for local community north of Bearna, GAA grounds and Golf Course.

The 2006 GCOB Route Option commences on the R336 to the west of Bearna and so would have the effect of reducing severance in the centre of the village itself and along the road into Galway City. From its connection with the R336, this route option heads directly north across low intensity grazing land. It would pass the eastern end of a cul-de-sac in the vicinity of Knocknagreana and continue northwards across blanket peatlands and onwards to Na Foraí Maola Thiar.

The very minor Doire Chrith bog road branches from the northern corner of Forramoyle Road and crosses this bog towards Leckaun. It is used by very light traffic including for transportation of turf, but is crossed by this route option and would not be severed.

The first negative impact of a socio-economic nature is realised at Lough Inch where a pitch-and-putt course located behind the playing fields of Bearna GAA is severed by this route option. Although the course is not well-known outside of Bearna, it is popular with local people. As such, this would constitute a *major negative* impact, albeit of low-moderate magnitude. There were plans previously by Bearna GAA to extend the playing fields to this area, but the amenity remains in place as of 2015.

Given that the lough is surrounded by bogland, it is not easily accessible, except via the pitch and putt course. However, it is regularly fished by anglers for whom the proximity of this route option would represent a *moderate negative* impact.

Although this impact would be realised by existing anglers, this route option would potentially open the lough up to more angling activity. Only a very small part of the Bearna Golf Club reaches the northern lough shore and the impact on amenity due to noise and visual intrusion for the majority of the course is assessed as *imperceptible.*

A roundabout junction is proposed with the Bearna to Moycullen Road and would facilitate connectivity between Bearna and the surrounding scattered community, GAA club and Golf Course.

Between Lough Inch and the River Corrib the 2006 GCOB Route Option would have the following principal impacts:

Good connectivity with Western Distributor Road;

- Negative impact on river frontage and part of the Glenlo Abbey Golf Course;
- Moderate negative severance and amenity impact on Menlo Castle demesne;
- Moderate negative severance impact on Ballindooley, partly mitigated by some relief from severance due to the realignment of the N84 and safer access to this road; and
- Outer alignment presents longer journey times than other route options and lesser relevance to journeys between east and west of the city.

A link road from the 2006 GCOB Route Option is proposed from a location to the west of Cappagh Road to the Western Distributor Road. This link would have a *major positive* impact by contributing to reduced traffic and severance in Bearna Village and by providing good connectivity to the west of the city, particularly for traffic approaching from the direction of West Galway.

The Boleybeg Road would be crossed by this route option with this section of the local road diverted slightly to the south. The crossing occurs a short distance to the east of St. Joseph's National School, but without significant socio-economic impact. Similarly, to the north-east, this route option crosses the Tonabrocky Road just to the east of Rahoon Newcastle Hurling Club, but again without significant impact on amenity at these grounds.

To the north, the route skirts around linear residential development at Gortacleva before connecting with the N59. Significant direct impacts on a small number of private properties would occur within the land-take needed for the junction.

From here, the 2006 GCOB Route Option returns southwards alongside the River Corrib and along the edge of the Glenlo Abbey Golf Course where at least three holes would be affected along with the loss of the hotel and course's valuable riverside frontage. This represents a *major negative* amenity and economic impact on the course for members and the course owners respectively.

A crossing of the River Corrib is proposed just below the Menlo Graveyard which, as well as being of historic interest, is used as a local amenity for short walks. The crossing is in the vicinity of an amenity area and parking which serves the graveyard and a jetty onto the river. Bridge traffic could be audible, but not visible from this location. The ramp to the bridge crossing would also impose a moderate negative severance and amenity impact between Menlough and Menlo Castle. To the east, a short diversion of the Coolough Road is proposed to allow for this route option, but without significant socio-economic impacts at a community level.

A junction with the N84 is included at Ballindooley. The community itself is dispersed along minor roads parallel to the Headford Road with a slightly greater concentration of houses to the north. The provisional location for the interchange would have an impact on private properties and contribute to a moderate level of social severance between the two parts of the community despite the physical connection provided by the realigned N84 link road. On the other hand, the interchange and associated realignment of the N84 would reduce severance between the southern part of Ballindooley, Ballindooley Castle, Ballindooley Lough and the landscape east towards Castlegar (see also **Section 3.6 Landscape and Visual**). The realignment would also improve journey amenity by permitting safer access to the N84 from the village.

To the east, the 2006 GCOB Route Option is routed around the north of the Roadstone Quarry and so any economic impacts on the quarry are avoided. The outer alignment of this route option avoids subsequent socio-economic impacts, although there would be a direct impact on a small number of private properties constituting linear development along the Ballintemple Road before the connection with the M6.

3.12.2.3 Summary

Tables 3.12.1 and **3.12.2** provide a summary of the impacts associated with the 2006 GCOB Route Option. The principal impacts on Human Beings at a community level include the loss of the pitch-and-putt amenity at Lough Inch, amenity and economic impacts on Glenlo Abbey Golf Course, and a mixture of net new severance at Ballindooley.

The outer alignment of the 2006 GCOB Route Option avoids some of the socio-economic impacts associated with other options, but at the expense of longer journey times and lesser relevance to journeys between the east and west of the city.

Table 3.12.1 Summary of Construction Impacts (finite in duration)

Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude	Mitigation
General amenity	Lough Inch	Good angling	Proximity of works	Moderate negative	Low/ Medium	none proposed
General amenity	Glenlo Abbey Golf Course	Golf course beside the River Corrib	Works on riverside edge of course	Major negative	Medium	screen if remainder of course usable.
Severance and general amenity	Menlo Castle	Link between castle and village	Bridge ramp construction	Major negative	Medium	none proposed
Severance & general amenity	Ballindooley	n/a	Severance and amenity impacts	Major negative	Medium	see Section 3.10 Noise

Table 3.12.2 Summary of Operational Characteristics

Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude	Mitigation Measures (where relevant)
Journey time and connectivity						
Connectivity	Link to Western Distributor Road	n/a	Useful connection into western city suburbs onto suitable road	Major positive	Major positive	
Connectivity	N59	n/a	Useful connection primary road	Major positive	Major positive	
Journey time, journey amenity and severance	N6 between Kirwan Roundabout and Coolagh	Heavy traffic	Transfer of traffic to route with reductions in journey time, improvements in journey amenity and relief form severance	Moderate positive	Moderate positive	
Amenity – Journey amenity						
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	Slight positive	Very high	

Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude	Mitigation Measures (where relevant)
Reduced delay and hazard	Bodkin Roundabout	Delay and congestion for pedestrians and vehicles. No cycle facilities	Separation of local and through traffic	Moderate positive	Very high	Provide improved cycle facilities
Reduced delay and hazard	Kirwan Roundabout	Delay and congestion for pedestrians and vehicles. No cycle facilities	Separation of local and through traffic	Moderate positive	Very high	Provide improved cycle facilities
Improved Safety	Ballindooley	Hazardous connections to local road	Transfer of traffic to link road	Moderate positive	Medium	
Amenity – General Amenity						
Pitch & putt	Lough Inch, Bearna	pitch & putt course beside lough	Severance and loss of course	Major negative	Low / Medium	None available
Lough Inch	Lough Inch, Bearna	good angling lough	Proximity of road. Potentially additional access.	Moderate negative (existing users)	Low / Medium	Provide access and parking
Bearna GAA	Lough Inch,	Rather remote location	Improved access given connection with Bearna to Moycullen Road	Slight positive	Medium	
Bearna Golf Club	Aille	Rather remote location	Improved access given connection with Bearna to Moycullen Road	Slight positive	Medium	
Golf course	Glenlo Abbey	n/a	Impact on riverside edge of course	Major negative	Medium	Possible reconfiguration of course
Environmental	Menlough	Historic graveyard and riverside amenity	No direct impact, but close proximity	Moderate negative	Medium	
Relief from Severance						

Nature of Impact	Locations	Existing situation	Expected impacts	Level of Impact	Magnitude	Mitigation Measures (where relevant)
Relief from severance	Bearna centre	Congestion especially at peak times and holiday periods	Through traffic and much local traffic transferred to options	Moderate positive	High	
Relief from severance	R336 and R337 into Galway City	High traffic volumes	Transfer of proportion of traffic	Moderate positive	High	
Relief from 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	Slight positive	Very high	Complement with quality urban design
Relief from severance	Ballindooley	Social/psychological severance due to busy N84	Link with part of community improved by realignment of N84	Slight positive	Low	
New Severance						
New severance and amenity	Menlo Castle	Link between castle and village	Ramp to bridge crossing	Moderate negative	Low	
New severance	Ballindooley	Dispersed established community	Social severance introduced by route option and link roads to N84	Moderate negative	Medium	
Economic						
Bearna Golf Club (see also General Amenity)	Aille	Rather remote location	Improved access given connection with Bearna to Moycullen Road	Slight positive	One business	
Hotel and golf course (see also General Amenity)	Glenlo Abbey	n/a	Impact on riverside boundary of course and severance from hotel	Slight negative	One business	

4 Traffic Assessment

This section details the Stage 1 traffic assessment of the 2006 GCOB Route Option. The 2006 GCOB Route Option was modelled using the Galway Interim Model. The same base model was used to model the six route options for the N6 GCTP, and traffic numbers at key locations in the city were assessed to establish the traffic numbers on this route option and the relief provided for existing roads.

4.1 Assessment

The assessment carried out compared Annual Average Daily Traffic (AADT) numbers for the Do-Minimum scenario and the 2006 GCOB Route Option for 2019 as the opening year, and for 2034. The locations chosen include the existing bridge crossings of the River Corrib, as well as main roads on both sides of the river, on the periphery of the city. These figures are shown in the **Table 4.1** below.

Table 4.1 AADT Figures

Location	Do-Minimum 2019	2006 GCOB 2019	Do-Minimum 2034	2006 GCOB 2034
Quincentenary Bridge	35,000	33,200	34,800	34,100
Salmon Weir Bridge	15,100	13,300	16,700	15,400
O'Brien's Bridge	7,900	7,500	9,100	8,300
Wolfe Tone Bridge	19,200	17,600	20,800	18,200
Bearna Village	11,600	6,500	13,400	7,300
Seamus Quirke Road	11,600	8,600	11,500	8,700
Headford Road (between Bodkin Junction and Kirwan Roundabout)	28,700	30,000	29,900	31,300
Bóthar na dTreabh	31,600	24,100	33,800	25,700
Dublin Road (between Moneenageisha Junction and Skerritt Roundabout)	19,800	17,400	18,600	18,400

The implementation of the 2006 GCOB Route Option shows a reduction in traffic on all four bridge crossings in 2019 and in 2034 compared to the Do-Minimum scenario.

From a traffic perspective, the 2006 GCOB Route Option offers relief to the existing road network in Galway, especially on the river crossings.

5 Conclusion

From an engineering perspective, the 2006 GCOB Route Option is a feasible route option. The 2006 GCOB Route Option did not provide a connection with the N17, a national road, thereby providing a lesser level of connectivity than alternatives considered as part of the Stage 1 assessment of options.

The 2006 GCOB Route Option has a significant impact on Annex I habitat, Limestone pavement [* 8240] within the Lough Corrib cSAC which would impact on the integrity of the Lough Corrib cSAC. Additionally the route option would likely result in significant negative impacts to the Moycullen Bogs NHA. There would be significant impacts on plant species and other sensitive ecological receptors, many of which are listed on Annex II and/or Annex IV of the EU Habitats Directive.

The location of the River Corrib bridge crossing presents a major negative in terms of impact of soils and geology due to the presence of soft and peat soils in the area.

The 2006 GCOB Route Option has a significant impact on the Moycullen Bog Complex NHA from a hydrogeological and hydrological perspective both at Tonabrocky and in the vicinity of Lough Inch. The route option has the potential to impact on Lough Inch River which is known to contain Freshwater pearl mussels downstream. Additionally this route option has potentially a large impact on flood risk in the vicinity of the River Corrib and its floodplains.

The 2006 GCOB Route Option has a profound impact on the curtilage of Menlo Castle from a Cultural Heritage perspective. This route option also has a significant impact on the curtilage of Menlo Castle from a Landscape and Visual and Human Beings amenity value perspective.

From a socio-economic and human beings perspective, the route has less impacts on communities and amenities with an overall improvement in the level of severance experienced. However, this is at the expense of longer journey times and less relevant journey possibilities between east and west.

Whilst the traffic assessment shows a slight improvement to congestion with the implementation of the 2006 GCOB Route Option, the other route options assessed as part of the Stage 1 assessment of options have the potential to provide a greater level of relief.

As there are a number of less damaging alternatives from the perspective of the integrity of the Lough Corrib cSAC available and options which better achieves the project objectives, the 2006 GCOB Route Option was discounted from further analysis.