Ecological Assessment of Route Options with respect to the Screening and Appropriate Assessment tests of Article 6(3) of the Habitats Directive

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Appendices

Ecological Assessment of Route Options with respect to the Screening and Appropriate Assessment tests of Article 6(3) of the Habitats Directive

1 Introduction

This report details the ecological assessments undertaken in relation to each of the route options proposed for the N6 Galway City Transport Project with respect to the Screening and Appropriate Assessment tests.

The purpose of assessing the route options against the requirements of Article 6(3) of the Habitats Directive, at this early stage, is to aid the decision making process with respect to selecting the emerging preferred route corridor in consideration of whether or not any of the route options would result in adverse effects on the integrity of any European sites.

The assessments were based on the descriptions of the route options at the time of writing—as presented in **Section 7.1** of the main Route Selection Report (RSR) (and shown on the figures referenced therein)— and on the design assumptions and mitigation measures described below in **Section 3**. Changes to the route options, or to the data supporting any conclusions made herein, would necessitate the findings of this assessment being revisited to determine whether any design changes or new information could affect the conclusions or the overall ranking of route options.

The ecological assessments carried out are also predicated on the fact that none of the route options being proposed are directly connected with, or necessary to the management of any of the European sites discussed in this report.

The surveys and results referred to in this report are described in full in **Section 4.3** of the main RSR (and in the Ecological Constraints Report, which is included as **Appendix A.4.2** of the RSR). All figures referenced in this report are included in Volume 2 of the RSR with the exception of those contained in Appendix C Shading Analysis Methodology in relation to the results of the shading analysis.

2 Methodology

2.1 Guidance and Approach

This report has been prepared with regard to the following guidance documents where relevant:

- *Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities* (Department of Environment, Heritage and Local Government, 2010 revision);
- *Appropriate Assessment under Article 6 of the Habitats Directive: Guidance for Planning Authorities*. Circular NPWS 1/10 & PSSP 2/10;
- *Assessment of Plans and Projects Significantly Affecting Natura 2000 sites: Methodological Guidance on the Provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC* (European Commission Environment Directorate-General, 2001); hereafter referred to as the EC Article 6 Guidance Document. The guidance within this document provides a non-mandatory methodology for carrying out assessments required under Article 6(3) and (4) of the Habitats Directive;

- *Managing Natura 2000 Sites: The Provisions of Article 6 of the Habitat's Directive 92/43/EEC* (EC Environment Directorate-General, 2000); hereafter referred to as MN2000;
- *Guidance Document on Article 6(4) of the Habitats Directive 92/43/EEC. Clarification of the Concepts of Alternative Solutions, Imperative Reasons of Overriding Public Interest, Compensatory Measures, Overall Coherence*. Opinion of the European Commission (European Commission, January 2007); and
- *Communication from the Commission on the precautionary principle*. European Commission (2000).

Guidance which has been followed in determining magnitude and significance of impacts in relation to European sites, include:

- *Guidelines for Ecological Impact Assessment in the United Kingdom* (Chartered Institute of Ecology and Environmental Management, 2006);
- *Guidelines for assessment of Ecological Impacts of National Road Schemes* (NRA, 2009);
- *Guidelines on the information to be contained in Environmental Impact Statements* (Environmental Protection Agency, 2002);
- *Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)* (Environmental Protection Agency, 2003);
- *Environmental Guidelines Series for Planning and Construction of National Roads* (National Roads Authority, 2005-2009); and
- *Environmental Impact Assessment of National Road Schemes – A Practical Guide* (National Road Authority, 2008a).

2.2 Assessment Methodology

Each route option was assessed against the requirements of Article 6(3) of the Habitats Directive.

With regard to the screening for Appropriate Assessment test:

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

With regard to the Appropriate Assessment test:

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

the Qualifying Interest habitats and/or species[1] and therefore affect the integrity of the European site concerned?

In general terms, a site's conservation objectives are to maintain or restore the favourable conservation condition of the QI habitats and/or species. The favourable conservation condition of a European site's Qualifying Interest habitats and species are defined in the site's conservation objectives as a set of attributes, measures and targets.

Following the individual assessments for each route option below, there is a discussion of how other plans or projects could act in combination with the route options to affect European sites and the implications of this with respect to the assessment.

3 Design and Mitigation Measures Assumptions

3.1 Design Assumptions

In order to enable a comprehensive assessment of the screening and Appropriate Assessment tests at this route selection stage, the level of design and assumed mitigation measures/strategies for all route options considered are clearly set out in this section of the report. It is this level of design and assumed mitigation which has been applied in the consideration of the requirements of Article 6(3) of the Habitats Directive tests examined for each route option.

3.1.1 Red2 Route Option

An overview of the Red2 Route Option is presented in **Section 3.3.1.1**, with proposed construction methods in **Section 3.3.1.2** and proposed drainage details in **Section 3.3.1.3**.

3.1.1.1 Overview

The Red2 Route Option is presented on **Figures 7.3.1.1 to 7.3.1.9** of the Route Selection Report.

The Red2 Route Option travels from the R336 west of Galway City to the N6 at Coolagh, Briarhill. This route option predominantly involves construction in the urban environment through the provision or modification of road infrastructure. The elements of this route option are as follows:

- Off-line construction from the R336 to Cappagh Road, Knocknacarra;
- On-line widening of the Western Distributor Road from Cappagh Road to Bothar Stiofáin;
- On-line grade separated interchange at Gort Na Bró, Western Distributor Road;

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

- Cut and cover tunnel from Gort Na Bró to Browne Roundabout (N59) with the reconstruction of the at-grade road infrastructure including pedestrian and cyclist facilities post tunnel construction;
- Operational facilities for cut and cover tunnel;
- On-line grade separated interchange at Browne Roundabout, N59;
- The off-line provision of a parallel road network in the Browne Roundabout area;
- On-line from Browne Roundabout, N59 to the Newcastle Road;
- Re-use of the existing Quincentenary Bridge;
- Construction of a parallel bridge on the southern side of the Quincentenary Bridge;
- On-line grade separated interchange at the Bodkin Junction;
- On / off-line viaduct from the Bodkin Junction to the N6 east of the Kirwan Junction. This viaduct would travel across, adjacent to and along the Terryland River to the rear of Dunnes Stores, Terryland;
- On-line grade separated interchange east of the Kirwan Junction;
- Re-use of existing road infrastructure from the end of the proposed viaduct to the N17 Tuam Road;
- On-line from the N17 Tuam Road to the City East Business Park entrance with grade separated interchanges at both locations;
- The off-line provision of a parallel road from the N17 Tuam Road to the City East Business Park entrance;
- On-line widening of existing road infrastructure from the City East Business Park entrance to Briarhill;
- On-line provision of an at-grade junction at the exit to the N6 from the City East Business Park;
- Provision of a cut and cover tunnel in the Briarhill area;
- On / off-line grade separated interchange in the Briarhill area; and
- Off-line construction from the Briarhill Junction to the N6 at Coolagh, Briarhill.

3.1.1.2 Construction

The Red2 Route Option would involve construction in rural and urban environments.

The following are construction features or methodologies which would be anticipated with the construction of this route option:

- Phased delivery and extended construction period due to scale and complexity;

- Temporary site compounds adjacent to construction zones. Site compounds would not be located in areas of environmental importance;
- Extensive traffic management;
- Extensive groundwork operations including, site clearance, pre-earthwork drainage and diversions, earthmoving operations (including rock breaking or blasting) and ground improvement works;
- Use of the existing national, regional and local road networks for earthmoving operations and general construction traffic;
- Construction of temporary haulage routes within the footprint of the route option for earthmoving operations and general construction traffic. Temporary haulage routes would take cognisance of areas of environmental importance and planning restrictions shall be put in place so these areas shall not be used;
- Use of suitable or compatible construction materials in areas of environmental importance;
- Extensive utility diversions;
- Extensive preparatory works and advanced contracts such as fencing, site clearance, survey works and utility diversions; and
- Appropriate construction methodologies in areas of environmental importance (specific concerns addressed in **Section 3.2** below).

3.1.1.3 Drainage Outfalls

West of River Corrib

Road runoff would be attenuated and would undergo pollution control treatment prior to discharge to the various ditches, streams and rivers west of the River Corrib. Watercourses and water bodies west of the River Corrib which could act as outfalls for the Red2 Route Option are Galway Bay, the Bearna Stream, the existing drainage networks and the River Corrib.

The Red2 Route Option involves a cut and cover tunnel on the Seamus Quirke Road. This tunnel has two low points along its alignment in order to minimise impacts on the surrounding areas by replicating the existing vertical alignment where possible. This would require the installation of two pumping stations and associated operational, attenuation and storage areas.

Drainage outfalls shall be located by taking cognisance of areas of environmental importance.

East of River Corrib

A sealed drainage system would be utilised to the east of the River Corrib due to the karst nature of the underlying rock. This drainage system would convey the flow to attenuation ponds, where pollution control would take place, before discharge to soak-ways, natural low points or where available watercourses and water bodies. Watercourses and water bodies east of the River Corrib which could act as outfalls

for the Red2 Route Option are the Terryland River, the existing drainage networks and the River Corrib.

Drainage outfalls shall be located by taking cognisance of areas of environmental importance.

3.1.2 Orange2 Route Option

An overview of the Orange2 Route Option is presented in **Section 3.3.2.1**, with proposed construction methods in **Section 3.3.2.2** and proposed drainage details in **Section 3.3.2.3**.

3.1.2.1 Overview

The Orange2 Route Option is presented on **Figures 7.3.2.1 to 7.3.2.9 of the Route Selection Report**.

The Orange2 Route Option travels from the R336 west of Galway City to the N6 at Coolagh, Briarhill. This route option would involve construction in rural areas, subterranean construction and construction in the urban environment through the provision or modification of road infrastructure. The elements of this route option are as follows:

- Off-line construction from the R336 to the Letteragh area, Rahoon;
- Off-line grade separated interchange at Letteragh, Rahoon;
- Off-line link road from Bushypark, N59 to Bothar Stiofáin, Knocknacarra;
- Tunnel Boring Machine tunnel from Letteragh to Kirwan junction (N84);
- Operational facilities for deep bored tunnel;
- On-line grade separated interchange east of the Kirwan junction at the eastern end of the proposed tunnel;
- Re-use of existing road infrastructure from the eastern end of the proposed tunnel to the N17 Tuam Road;
- On-line from the N17 Tuam Road to the City East Business Park entrance with grade separated interchanges at both locations;
- Off-line provision of a parallel road from the N17 Tuam Road to the City East Business Park entrance;
- On-line widening of existing road infrastructure from the City East Business Park entrance to Briarhill;
- On-line provision of an at-grade junction at the exit to the N6 from the City East Business Park;
- Provision of a cut and cover tunnel in the Briarhill area;
- On / off-line grade separated interchange in the Briarhill area; and
- Off-line construction from the Briarhill area to the N6 at Coolagh, Briarhill.

3.1.2.2 Construction

The Orange2 Route Option would involve construction in rural, subterranean and urban environments.

The following are the construction features or methodologies which would be anticipated with the construction of this route option:

- Phased delivery and extended construction period due to scale and complexity;
- Temporary site compounds adjacent to construction zones. Site compounds would not be located in areas of environmental importance;
- Extensive traffic management;
- Extensive groundwork operations including, site clearance, pre-earthwork drainage and diversions, earthmoving operations (including rock breaking or blasting) and ground improvement works;
- Use of the existing national, regional and local road networks for earthmoving operations and general construction traffic;
- Construction of temporary haulage routes within the footprint of the route option for earthmoving operations and general construction traffic. Temporary haulage routes would take cognisance of areas of environmental importance;
- Use of suitable or compatible construction materials in areas of environmental importance;
- Extensive utility diversions;
- Construction of a deep tunnel via tunnel boring machine (TBM). TBM represents a mechanised form of tunnelling; the face is excavated by a rotating cutting disc and a lining consisting of precast concrete segments is put in place to stabilise the rock mass and provide the permanent lining solutions as the machine advances. TBM thrusts off the permanent pre-cast concrete segmental lining just installed as it advances ahead. TBMs can be provided with active face support in the form of earth pressure which is used in areas with a risk of voids or water ingress;
- Extensive preparatory works and advanced contracts such as fencing, site clearance, survey works and utility diversions; and
- Appropriate construction methodologies in areas of environmental importance (specific concerns addressed in **Section 3.2** below).

3.1.2.3 Drainage Outfalls

West of River Corrib

Drainage would be attenuated and undergo pollution control treatment prior to discharge to the various ditches, streams and rivers west of the River Corrib. Watercourses and water bodies west of the River Corrib which could act as outfalls for the Orange2 Route Option are Galway Bay, the Bearna Stream, the existing drainage networks and the River Corrib.

The Orange2 Route Option would involve a deep bored tunnel under the River Corrib of approximately 3.5km in length. This tunnel has a low point on its alignment as it crosses under the river. This would require the installation of a pumping station and associated operational, attenuation and storage areas.

Drainage outfalls shall be located by taking cognisance of areas of environmental importance.

East of River Corrib

A sealed drainage system would be utilised to the east of the River Corrib due to the karst nature of the underlying rock. This drainage system would convey the flow to attenuation ponds, where pollution control treatment would take place, before discharge to soak-ways, natural low points or where available watercourses and water bodies. Watercourses and water bodies east of the River Corrib which could act as outfalls for the Orange2 Route Option are the Terryland River, the existing drainage networks and the River Corrib.

Drainage outfalls shall be located by taking cognisance of areas of environmental importance.

3.1.3 Yellow2 Route Option

An overview of the Yellow2 Route Option is presented in **Section 3.3.3.1**, with proposed construction methods in **Section 3.3.3.2** and proposed drainage details in **Section 3.3.3.3**.

3.1.3.1 Overview

The Yellow2 Route Option is presented on **Figures 7.3.3.1 to 7.3.3.11 of the Route Selection Report**.

This route option travels from the R336 west of Galway City to the N6 at Coolagh, Briarhill. This route option would involve construction in rural areas and construction in the urban environment through the provision or modification of road infrastructure. The elements of this option are as follows:

- Off-line construction from the R336 to the Letteragh area, Rahoon;
- Off-line grade separated interchange at Letteragh, Rahoon;
- Off-line link road from Bushypark, N59 to Bothar Stiofáin, Knocknacarra;
- Off-line construction from the Letteragh Area to the Dangan viaduct;
- Dangan viaduct, crossing National University of Ireland, Galway lands and connecting to the River Corrib bridge;
- Bridge crossing of the River Corrib without in stream works for bridge piers;
- Off-line construction from the River Corrib bridge to the Menlough viaduct;
- Menlough viaduct, crossing areas of environmental importance in the Menlough area;

- Off-line construction from the Menlough viaduct to the N6 west of the N17 Tuam Road;
- On / off-line grade separated interchange west of the N17 Tuam Road and crossing Teryland River;
- On-line from the N17 Tuam Road to the City East Business Park entrance with grade separated interchanges at both locations;
- Off-line provision of a parallel road from the N17 Tuam Road to the City East Business Park entrance;
- On-line widening of existing road infrastructure from the City East Business Park entrance to Briarhill;
- On-line provision of an at-grade junction at the exit to the N6 from the City East Business Park;
- Provision of a cut and cover tunnel in the Briarhill area;
- On / off-line grade separated interchange in the Briarhill area; and
- Off-line construction from the Briarhill area to the N6 at Coolagh, Briarhill.

3.1.3.2 Construction

The Yellow2 Route Option would involve construction in rural and urban environments.

The following are the construction features or methodologies which would be anticipated with the construction of the Yellow2 Route Option:

- Phased delivery and extended construction period due to scale and complexity;
- Temporary site compounds adjacent to construction zones. Site compounds would not be located in areas of environmental importance;
- Extensive traffic management;
- Extensive groundwork operations including, site clearance, pre-earthwork drainage and diversions, earthmoving operations (including rock breaking or blasting) and ground improvement works;
- Use of the existing national, regional and local road networks for earthmoving and general construction traffic;
- Construction of temporary haulage routes within the footprint of the route option and in the Menlough area for earthmoving operations and general construction traffic. Temporary haulage routes would take cognisance of areas of environmental importance;
- Use of suitable or compatible construction materials in areas of environmental importance;
- Extensive utility diversions;

- Extensive preparatory works and advanced contracts such as fencing, site clearance, survey works and utility diversions; and
- Appropriate construction methodologies in areas of environmental significance (specific concerns addressed in **Section 3.2** below).

3.1.3.3 Drainage Outfalls

West of River Corrib

Drainage would be attenuated and undergo pollution control treatment prior to discharge to the various ditches, streams and rivers west of the River Corrib. Watercourses and water bodies west of the River Corrib which could act as outfalls for the Yellow2 Route Option are Galway Bay, the Bearna Stream, the existing drainage networks and the River Corrib.

Drainage outfalls shall be located by taking cognisance of areas of environmental importance.

East of River Corrib

A sealed drainage system would be utilised to the east of the River Corrib due to the karst nature of the underlying rock. This drainage system would convey the flow to attenuation ponds, where pollution control treatment would take place, before discharge to soak-ways, natural low points or where available watercourses and water bodies. Watercourses and water bodies east of the River Corrib which could act as outfalls for the Yellow2 Route Option are the Coolagh Lakes, the Terryland River, the existing drainage networks and the River Corrib.

Drainage outfalls shall be located by taking cognisance of areas of environmental importance.

3.1.4 Blue2 Route Option

An overview of the Blue2 Route Option is presented in **Section 3.3.4.1**, with proposed construction methods in **Section 3.3.4.2** and proposed drainage details in **Section 3.3.4.3**.

3.1.4.1 Overview

The Blue2 Route Option is presented on **Figures 7.3.4.1 to 7.3.2.10 of the Route Selection Report**.

This route option travels from the R336 west of Galway City to the N6 at Coolagh, Briarhill. This route option would involve construction in rural areas and construction in the urban environment through the provision or modification of road infrastructure. The elements of this route option are as follows:

- Off-line construction from the R336 to the Letteragh area, Rahoon;
- Off-line grade separated interchange at Letteragh, Rahoon;
- Off-line link road from the N59 at Bushypark to Bothar Stiofáin, Knocknacarra;
- Off-line construction from the Letteragh area to the Dangan viaduct;

- Dangan viaduct, crossing National University of Ireland, Galway lands and connecting to the River Corrib bridge;
- Bridge crossing of the River Corrib without in stream works for bridge piers;
- Off-line construction from the River Corrib bridge to the Menlough viaduct;
- Menlough viaduct, crossing areas of environmental importance in the Menlough area;
- Off-line construction from the Menlough viaduct to the deep mined tunnel entering Lackagh Quarry;
- Deep mined tunnel entering Lackagh Quarry from the Menlough area;
- Operational facilities for deep mined tunnel;
- Off-line construction from Lackagh Quarry to Galway Racecourse with grade separated interchanges at the N84, Headford road and N17, Tuam road;
- Cut and cover tunnel through Galway Racecourse lands;
- Operational facilities for cut and cover tunnel;
- On / off-line cut from the end of the Galway Racecourse lands to the N6 at Briarhill;
- Provision of a cut and cover tunnel in the Briarhill area;
- On / off-line grade separated interchange in the Briarhill area; and
- Off-line construction from the Briarhill area to the N6 at Coolagh, Briarhill.

3.1.4.2 Construction

The Blue2 Route Option would involve construction in rural and urban environments.

The following are the construction features or methodologies which would be anticipated with the construction of this route option:

- Phased delivery and extended construction period due to scale and complexity;
- Temporary site compounds adjacent to construction zones. Site compounds would not be located in areas of environmental importance;
- Extensive traffic management;
- Extensive groundwork operations including, site clearance, pre-earthwork drainage and diversions, earthmoving operations (including rock breaking or blasting) and ground improvement works;
- Use of the existing national, regional and local road networks for earthmoving and general construction traffic;

- Construction of temporary haulage routes within the footprint of the route option and in the Menlough area for earthmoving operations and general construction traffic. Temporary haulage routes would take cognisance of areas of environmental importance;
- Use of suitable or compatible construction materials in areas of environmental importance;
- Extensive utility diversions;
- Construction of a mined tunnel utilising Lackagh Quarry as the launch pit. Tunnelling in this instance would follow a slower and very controlled exercise to ensure strict monitoring and control of groundwater ingress, cavities and rock settlement. Stabilisation would be installed immediately as advance along the tunnel together with the appropriate permanent liner;
- Extensive preparatory works and advanced contracts such as fencing, site clearance, survey works and utility diversions; and
- Appropriate construction methodologies in areas of environmental significance (specific concerns addressed in **Section 3.2** below).

3.1.4.3 Drainage Outfalls

West of River Corrib

Drainage would be attenuated and undergo pollution control treatment prior to discharge to the various ditches, streams and rivers west of the River Corrib. Watercourses and water bodies west of the River Corrib which could act as outfalls for the Blue2 Route Option are Galway Bay, the Bearna Stream, the existing drainage networks and the River Corrib.

Drainage outfalls shall be located by taking cognisance of areas of environmental importance.

East of River Corrib

A sealed drainage system would be utilised to the east of the River Corrib due to the karst nature of the underlying rock. This drainage system would convey the flow to attenuation ponds, where pollution control treatment would take place, before discharge to soak-ways, natural low points or where available watercourses and water bodies. Watercourses and water bodies east of the River Corrib which could act as outfalls for the Blue2 Route Option are the Coolagh Lakes, Ballindooley Lough, the existing drainage networks and the River Corrib.

This route option would involve a deep mined tunnel under the Lough Corrib cSAC. This tunnel has a low point on its alignment as it crosses under the cSAC. This would require the installation of a pumping station and associated operational, attenuation and storage areas.

Drainage outfalls shall be located by taking cognisance of areas of environmental importance.

3.1.5 Pink2 Route Option

An overview of the Pink2 Route Option is presented in **Section 3.3.5.1**, with proposed construction methods in **Section 3.3.5.2** and proposed drainage details in **Section 3.3.5.3**.

3.1.5.1 Overview

The Pink2 Route Option is presented on **Figures 7.3.5.1 to 7.3.5.10 of the Route Selection Report**.

This route option travels from the R336 west of Galway City to the N6 at Coolagh, Briarhill. This route option would involve construction in rural areas and construction in the urban environment through the provision or modification of road infrastructure. The elements of this route option are as follows:

- Off-line construction from the R336 to the Letteragh area, Rahoon;
- Off-line grade separated interchange at Letteragh, Rahoon;
- Off-line link road from the N59 at Bushypark to Bothar Stiofáin, Knocknacarra;
- Off-line construction from the Letteragh Area to the Dangan viaduct;
- Dangan viaduct, crossing National University of Ireland, Galway lands and connecting to the River Corrib bridge;
- Bridge crossing of the River Corrib without in stream works for bridge piers;
- Off-line construction from the River Corrib Bridge to the Menlough viaduct;
- Menlough viaduct, crossing areas of environmental importance in the Menlough area;
- Off-line construction from the Menlough viaduct to the deep mined tunnel entering Lackagh Quarry;
- Deep mined tunnel entering Lackagh Quarry from the Menlough area;
- Operational facilities for deep mined tunnel;
- Off-line construction from Lackagh Quarry to Galway Racecourse with grade separated interchanges at the N84, Headford road and N17, Tuam road;
- Cut and cover tunnel through Galway Racecourse lands and to the rear of the existing stands;
- Operational facilities for cut and cover tunnel;
- On / off-line cut from the end of the Galway Racecourse lands to the N6 at Briarhill;
- Provision of a cut and cover tunnel in the Briarhill area;
- Off-line grade separated interchange in the Briarhill area; and

- Off-line construction from the Briarhill area to the N6 at Coolagh, Briarhill.

3.1.5.2 Construction

The Pink2 Route Option would involve construction in rural and urban environments.

The following are the construction features or methodologies which would be anticipated with the construction of this route option:

- Phased delivery and extended construction period due to scale and complexity;
- Temporary site compounds adjacent to construction zones. Site compounds would not be located in areas of environmental importance;
- Extensive traffic management;
- Extensive groundwork operations including, site clearance, pre-earthwork drainage and diversions, earthmoving operations (including rock breaking or blasting) and ground improvement works;
- Use of the existing national, regional and local road networks for earthmoving operations and general construction traffic.
- Construction of temporary haulage routes within the footprint of the route option and in the Menlough area for earthmoving operations and general construction traffic. Temporary haulage routes would take cognisance of areas of environmental importance;
- Use of suitable or compatible construction materials in areas of environmental importance;
- Extensive utility diversions;
- Construction of a mined tunnel utilising Lackagh Quarry as the launch pit. Tunnelling in this instance would follow a slower and very controlled exercise to ensure strict monitoring and control of groundwater ingress, cavities and rock settlement. Stabilisation would be installed immediately as advance along the tunnel together with the appropriate permanent liner;
- Extensive preparatory works and advanced contracts such as fencing, site clearance, survey works and utility diversions; and
- Appropriate construction methodologies in areas of environmental significance (specific concerns addressed in **Section 3.2** below).

3.1.5.3 Drainage Outfalls

West of River Corrib

Drainage would be attenuated and undergo pollution control treatment prior to discharge to the various ditches, streams and rivers west of the River Corrib. Watercourses and water bodies west of the River Corrib which could act as outfalls

for the Pink2 Route Option are Galway Bay, the Bearna Stream, the existing drainage networks and the River Corrib.

Drainage outfalls shall be located by taking cognisance of areas of environmental importance.

East of River Corrib

A sealed drainage system would be utilised to the east of the River Corrib due to the karst nature of the underlying rock. This drainage system would convey the flow to attenuation ponds, where pollution control treatment would take place, before discharge to soak-ways, natural low points or where available watercourses and water bodies. Watercourses and water bodies east of the River Corrib which could act as outfalls for the Blue2 Route Option are the Coolagh Lakes, Ballindooley Lough, the existing drainage networks and the River Corrib.

This route option would involve a deep mined tunnel under the Lough Corrib cSAC. This tunnel has a low point on its alignment as it crosses under the cSAC. This would require the installation of a pumping station and associated operational, attenuation and storage areas.

Drainage outfalls shall be located by taking cognisance of areas of environmental importance.

3.1.6 Green2 Route Option

An overview of the Green2 Route Option is presented in **Section 3.3.6.1**, with proposed construction methods in **Section 3.3.6.2** and proposed drainage details in **Section 3.3.6.3**.

3.1.6.1 Overview

The Green2 Route Option is presented on **Figures 7.3.6.1 to 7.3.6.10 of the Route Selection Report**.

This route option travels from the R336 west of Galway City to the N6 at Garraun North. This option would involve construction in rural areas predominantly and construction in the urban environment through the provision or modification of road infrastructure. The elements of this route option are as follows:

- Off-line construction from the R336 to the N59, Bushypark;
- On-line grade separated interchange at N59, Bushypark;
- Off-line construction from the Bushypark area to the River Corrib bridge;
- Bridge crossing of the River Corrib without in stream works for bridge piers;
- Off-line construction from River Corrib bridge to the Menlough viaduct;
- Menlough viaduct crossing areas of environmental importance in the Menlough area;
- Off-line construction from the Menlough viaduct to the Ballindooley viaduct;

- Ballindooley viaduct, crossing areas of soft ground at height;
- Off-line grade separated interchange at N84, Ballindooley;
- Off-line link road from Carrowbrowne, N84 to Ballinfoyle, N84;
- Off-line construction from the Ballindooley viaduct to the Roadstone viaduct / structure;
- Roadstone viaduct / structure crossing Roadstone Quarry;
- Off-line construction from the Roadstone viaduct to Galway Racecourse with a grade separated interchange at the N17, Tuam road;
- Cut and cover tunnel through Galway Racecourse lands and to the rear of the existing stands;
- Operational facilities for cut and cover tunnel;
- Off-line construction from the Galway Racecourse to the N6 at Garraun North; and
- On / off-line grade separated interchange at Garraun North.

3.1.6.2 Construction

The Green2 Route Option would involve construction in rural and urban environments.

The following are the construction features or methodologies which would be anticipated with the construction of this route option:

- Phased delivery and extended construction period due to scale and complexity;
- Temporary site compounds adjacent to construction zones. Site compounds would not be located in areas of environmental importance;
- Traffic management;
- Extensive groundwork operations including, site clearance, pre-earthwork drainage and diversions, earthmoving operations (including rock breaking or blasting) and ground improvement works;
- Use of existing national, regional and local road networks for earthmoving operations and general construction traffic;
- Construction of temporary haulage routes within the footprint of the route option for earthmoving operations and general construction traffic. Temporary haulage routes would take cognisance of areas of environmental importance;
- Use of suitable or compatible construction materials in areas of environmental importance;
- Utility diversions;

- Extensive preparatory works and advanced contracts such as fencing, site clearance, survey works and utility diversions; and
- Appropriate construction methodologies in areas of environmental significance (specific concerns addressed in **Section 3.2** below).

3.1.6.3 Drainage Outfalls

West of River Corrib

Drainage would be attenuated and undergo pollution control treatment prior to discharge to the various ditches, streams and rivers west of the River Corrib. Watercourses and water bodies west of the River Corrib which could act as outfalls for the Green2 Route Option are Galway Bay, the Bearna Stream, other smaller streams and existing drainage networks and the River Corrib.

Drainage outfalls shall be located by taking cognisance of areas of environmental importance.

East of River Corrib

A sealed drainage system would be utilised to the east of the River Corrib due to the karst nature of the underlying rock. This drainage system would convey the flow to attenuation ponds, where pollution control treatment would take place, before discharge to soak-ways, natural low points or where available watercourses and water bodies. Watercourses and water bodies east of the River Corrib which could act as outfalls for the Green2 Route Option are Ballindooley Lough, the existing drainage networks and the River Corrib.

Drainage outfalls shall be located by taking cognisance of areas of environmental importance.

3.2 Assumed Mitigation Measures

The following are the assumed mitigation measures/strategies applied across all route options that are considered in the assessments undertaken in this report:

- That construction compounds and any other ancillary works associated with the construction and operation of the preferred route option (including for example any drainage infrastructure, lands required for mitigation measures *etc.*), details of which cannot be known at this route selection stage, will either be located outside of European sites, or if they must be located within European sites, may be constructed and operated in such a way that they would not affect the conservation condition of any QI habitats or species resulting in an adverse effect on the integrity of any European sites;
- That sufficient pollution control measures will be implemented during construction that would ensure that silt, runoff, water pumped from excavations, cement based compounds, hydrocarbons, or any other hazardous chemicals would not significantly affect water quality in any receiving drainage features, watercourses, or waterbodies;

- That the design of pollution control and treatment measures during operation will prevent a significant reduction in water quality in receiving drainage features, watercourses, or waterbodies that could impact on QI habitats or species in affected European sites;
- That the construction of piers supporting the viaduct structures within Lough Corrib cSAC will not directly impact on any Annex I habitat and can be constructed without any direct or indirect impacts to adjacent areas of QI Annex I habitat within the cSAC that would affect their conservation objectives/condition, including any indirect effects to the existing hydrological/hydrogeological regime that supports those habitats;
- That tunnelling underneath Lough Corrib cSAC at Lackagh Quarry would not result in any impacts to the QI habitats at the surface as a result of subsidence that would affect their conservation objectives/condition;
- That the risk of the Orange2, Blue2 and Pink2 Route Option tunnels affecting the existing hydrogeological regime that supports the groundwater dependent QI habitats within Lough Corrib cSAC is as low as reasonably practical by the application of modern tunnelling techniques and construction controls. Therefore the tunnel would be unlikely to affect any European site's conservation objectives and would not adversely affect the integrity of Lough Corrib cSAC. Detailed geotechnical investigations would be required to fully quantify the associated risks if any;
- That bridge construction on the Red2 Route Option could be carried out in such a manner so as not to affect water quality in the River Corrib to the extent that there would be any effect on QI aquatic species or QI habitats downstream, and that fish passage would be maintained along the River Corrib;
- That mammal fencing would be installed to prevent Otter gaining access to the road carriageway;
- That dust emissions can be controlled during construction by employing mitigation measures such as watering of the construction site/access roads, road cleaning, vehicle speed restrictions, and barriers to prevent wind-blown dust; and
- That any proposed landscape and planting measures will be designed and implemented in such as way so as not to have any direct or indirect impacts on the QIs of European sites, nor on any non-QI features which provide a supporting role to the achievement of the QIs conservation objectives.

4 Ecological Assessment

European sites are only at risk from significant effects where a source-pathway-receptor link exists between any of the proposed route options and a European site(s). This can take the form of a direct impact (e.g. where a route option physically crosses the boundary of a European site) or an indirect impact where impacts outside of the European site boundary affect ecological receptors within (e.g. impacts to water quality which can affect wetland habitats at a distance from the impact source).

Considering the European sites present in the region, their QIs and conservation objectives, and any potential impact pathways that could link those sites to the scheme study area, a distance of 15km was considered appropriate to encompass all European sites potentially within the Zone of Influence (ZoI)[2] of the route options being proposed (Figure 4.3.1 of the main RSR).

All of the route options cross Lough Corrib cSAC between Coolanillaun and the existing N6/Quincentenary Bridge. Therefore, only those QI Annex I habitats which are present within this part of the cSAC and within the footprint of the route options could potentially be directly impacted. Indirect impacts could only affect those QI habitat types which are within the ZoI of effects from the route options; for example, effects on the existing hydrogeological/hydrological regimes that may support wetland habitats, or the risk of an accidental pollution event during construction affecting water quality in receiving watercourses that can in turn affect QI habitats present downstream. Similarly, only those QI Annex II species which are present (either on a permanent or transient basis) or where, in the case of some aquatic species such as Atlantic salmon, the river corridor also acts as an important ecological corridor, can be affected by direct or indirect impacts associated with the route options.

Based on the descriptions of the route options provided in **Section 7.1** of the RSR, and **Section 3** above the results of the habitat and species surveys undertaken within the scheme study area (for more information refer to **Chapter 4 Constraints Study**, **Section 4.3 Ecology** of the RSR and **Figures 4.3.1 to 4.3.23**), and consideration of how these habitats and species could be affected, the ZoI for indirect impacts on QI habitats and species within Lough Corrib cSAC could potentially extend from Coolanillaun to the southernmost point of the cSAC boundary, at Wolf Tone Bridge in Galway City.

Galway Bay Complex cSAC is downstream of all of the route options. As all route options must either cross the River Corrib or will discharge drainage to Galway Bay via the watercourses crossed within the scheme study area, Galway Bay Complex cSAC is within the ZoI of all route options.

Given the proximity of both Lough Corrib SPA and Inner Galway Bay SPA to the route options, and given that Special Conservation Interest (SCI) bird species from both sites were recorded within the scheme study area[3], both SPAs are potentially within the ZoI of all route options.

[2] The zone of influence is a distance within which route options could potentially affect the conservation condition of QI habitats or species. There is no set recommended distance for which European sites are considered as being relevant for AA. Available guidance (NPWS, 2010) recommends that 'the distance should be evaluated on a case-by-case basis with reference to the nature, size and location of the project, and the sensitivities of the ecological receptors, and the potential for in combination effects'. As a general rule of thumb, it is often considered appropriate to examine all European sites within 15km as a starting point. In some instances where there are hydrological connections, a whole river catchment or a groundwater aquifer may need to be included. Taking this into account, as a starting point all European sites within 15km of the route options were examined. This distance was considered to be sufficient for the purposes of this assessment as any European sites outside of the 15km distance either do not have any hydrological or any other linkages to the scheme study area, or are located at such distance from the scheme study area that no significant effects would occur.

[3] The need to consider use of habitat areas outside of an SPA by SCI bird species is set out in Section 3.1 and 5.2 of the Inner Galway Bay Special Protection Area (Site Code 4031), Conservation Objectives Supporting Document, VERSION 1 (National Parks & Wildlife Service, 2013). These areas are termed 'ex-situ' sites and are defined as Areas of habitat situated within the immediate hinterland of the SPA, or in areas ecologically connected to it, which support SCI bird species.

The ecological assessment carried out concluded that a source-pathway-receptor link existed between route option(s) and the following European sites (the full assessment is provided in **Appendix A** of this report):

- Lough Corrib cSAC – as all route options must cross Lough Corrib cSAC and/or drainage from all route options is likely to discharge to the River Corrib;
- Galway Bay Complex cSAC – as all route options will cross watercourses, and/or road drainage is likely to discharge to watercourses, which drain to Galway Bay;
- Lough Corrib SPA – although not directly impacted by any of the route options, sites remote from the SPA used by its Special Conservation Interest (SCI) bird species are affected by route options. Impacts to SCI bird species at these "*ex-situ*" sites[4] could affect bird numbers in the SPA itself; and,
- Inner Galway Bay SPA – although not directly impacted by any of the route options, sites remote from the SPA used by its Special Conservation Interest (SCI) bird species are affected by route options. Impacts to SCI bird species at these "*ex-situ*" sites could affect bird numbers in the SPA itself.

Following this, the assessment then considered which of the affected European site's QI habitats and species or SCI bird species were potentially at risk via the identified impact pathways[5], and if so (considering any mitigation measures that could be implemented – refer to **Section 3.2**), would the impacts be expected to result in adverse effects on the integrity of those European sites. The results of this stage of the assessment are detailed in **Appendix B** of this report as follows:

- Tables B.1 – B.4 assesses whether or not the QIs of Lough Corrib cSAC, Galway Bay Complex cSAC, Lough Corrib SPA, or Inner Galway Bay SPA are likely to be subject to significant effects as a result of the route options and whether those effects would adversely affect site integrity; and
- Tables B.5 – B.9 follow on from this, and outline how route options would impact on the conservation objectives of affected QIs where, even considering mitigation measures, adverse effects on site integrity would be expected.

There is potential for impacts on the Coolagh Lakes (which correspond to the Annex I habitat Hard water lakes [3140]), as a result of the tunnel associated with the Blue2 and Pink2 Route Options affecting their groundwater supply. There are many mitigation strategies that could be employed to maintain hydrogeological connectivity through the tunnelling zone both during construction and operation and on this basis, and taking the view that it is reasonable to assume that any such measures would be successful, it is considered at this Route Selection stage of the assessment, that the Blue2 and Pink2 Route Options are not likely to adversely affect the integrity of Lough Corrib cSAC in this regard. However, this conclusion

[4] See footnote 9 above for definition of 'ex-situ' sites.

[5] It should be noted that in relation to Lough Corrib cSAC and Galway Bay Complex cSAC, the conservation objectives of all of the sites' Qualifying Interests (QIs) are not at risk of significant impacts either due to their absence from the scheme study area or, where present, that they are not affected by some or all of the route options. Similarly in relation to Lough Corrib SPA and Inner Galway Bay SPA, not all winter bird sites where SCI bird species were recorded are affected by all route options; and, affected winter bird sites all supported a different suite of bird species in differing frequencies and numbers over the survey period (September 2014 to March 2015).

is based on the level of hydrogeological baseline data available at the time of writing and if further geotechnical and hydrogeological investigations cannot adequately qualify or quantify the risk and/or resulting effects on the existing hydrogeological regime that supports the Coolagh Lakes, then based on the precautionary principle, it may need to be concluded that the conservation condition of this habitat type could be affected and there may therefore be a risk of adverse effects on the integrity of Lough Corrib cSAC.

Similarly, the view that the Orange2 Route Option tunnel would not affect the integrity of Lough Corrib cSAC through impacting on the existing hydrogeological regime, could change if further geotechnical and hydrogeological investigations/assessments identified a currently unknown impact pathway.

The results of the ecological assessment and how they relate to each of the route options are discussed below.

4.1 Red2 Route Option

Is the Red2 Route Option likely to have a significant effect on any European site(s) in view of its/their conservation objectives?

Yes.

Although it avoids any direct or indirect impacts to QI habitats (see **Figure 7.6.1.3** of the RSR), the Red2 Route Option has the potential to result in significant effects on Lough Corrib cSAC as the bridge design proposed to cross the River Corrib would require the construction of two in-stream piers within the cSAC boundary, and road drainage would likely discharge to the River Corrib. The total footprint of the Red2 Route Option within the cSAC boundary is c.0.27Ha (area covered by proposed new bridge). This would pose a potential risk of significant effects to the conservation condition of the following QI Annex II species: Otter, Atlantic salmon, Brook lamprey, Sea lamprey, and the Freshwater pearl mussel. There is potential for significant effects to occur as a result of some (or all) of the following impact sources: disturbance during construction/operation, habitat loss during construction (both permanent and temporary – although there is no Annex I habitat directly affected by this route option in the cSAC the affected habitat provides a supporting role to QI species), habitat severance/barrier effects during construction or operation, a reduction in surface water quality, and/or faunal collisions with road traffic.

The Red2 Route Option has the potential to result in significant effects on Galway Bay Complex cSAC as drainage from the proposed road would discharge to watercourses that drain to Galway Bay. This would pose a potential risk to any of the QI coastal habitats, and QI species (Otter and Harbour seal) that could be indirectly affected by a reduction in marine water quality.

The Red2 Route Option has the potential to result in significant effects on Lough Corrib SPA as it would affect a number of sites[6] (WB01, WB12, WB14, WB41, WB43 and WB48) which support wintering bird species listed as SCIs of this

[6] Sites surveyed as part of the wintering bird surveys carried out between September 2014 and March 2015 – see Figures 7.6.1.19-20

European site: Black-headed Gull, Common Gull, Coot, Hen harrier and Common tern[7].

The Red2 Route Option has the potential to result in significant effects on Inner Galway Bay SPA as it would affect a number of sites (see above) which support wintering bird species listed as SCIs of this European site: Black-headed Gull, Common Gull, Cormorant, Curlew, Grey heron, Light-bellied Brent goose, Red-breasted merganser, Lapwing, Dunlin, Common tern, Redshank and Teal.

Would the likely significant effects identified, despite the implementation of mitigation measures, adversely affect the integrity of any European site(s)?

No.

With the implementation of mitigation measures none of the potentially significant effects identified are likely to affect the conservation condition of QI habitats/species or SCI bird species and therefore, the Red2 Route Option would not adversely affect the integrity of any European sites (refer to Tables B.1-B.9 in **Appendix B** for full assessment).

4.2 Orange2 Route Option

Is the Orange2 Route Option likely to have a significant effect on any European site(s) in view of its/their conservation objectives?

Yes.

Despite the fact that this route option tunnels underneath the Lough Corrib cSAC (see **Figure 7.6.1.3** of the RSR), the Orange2 Route Option has the potential to result in significant effects on the cSAC as road drainage would discharge to the River Corrib. The total footprint of the Orange2 Route Option underneath the cSAC boundary is c.1.45Ha. This would pose a potential risk of affecting the conservation condition of the following QI Annex II species: Otter, Atlantic salmon, Brook lamprey, Sea lamprey, and the Freshwater pearl mussel. There is potential for significant effects to occur as a result of a reduction in water quality during construction or operation. The use of a tunnel to cross underneath the River Corrib removes many of the potential impact pathways that could affect QI habitats and species. Tunnelling in a karst substrate does carry a potential risk of both construction and operation impacts to the movement of groundwater with the potential to indirectly affect QI Annex I wetland habitats within the cSAC. However, all QI Annex I habitats are upstream of known groundwater movements. In addition, modern tunnelling techniques and technology would minimise risk as low as reasonably practical so that there would not be any significant long-term effects to the functioning of the existing hydrogeological regime, and no effects on QI Annex I wetland habitats within the cSAC would be expected.

The Orange2 Route Option has the potential to result in significant effects on Galway Bay Complex cSAC as drainage from the road would discharge to watercourses that drain to Galway Bay. This would pose a potential risk to any of the QI coastal habitats, and QI species (Otter and Harbour seal) that could be affected by a reduction in marine water quality.

[7] The full results of the winter bird surveys are provided in the Ecological Constraints Report (Appendix M of the RSR)

The Orange2 Route Option has the potential to result in significant effects on Lough Corrib SPA as it would affect a number of winter bird sites (WB01, WB14 and WB44) which have records for the following SCI bird species: Black-headed gull and Common Gull.

The Orange2 Route Option has the potential to result in significant effects on Inner Galway Bay SPA as it would affect a number of winter bird sites (see above) which have records for the following SCI bird species: Black-headed gull, Common Gull, Cormorant, Curlew, Grey heron, Light-bellied brent goose, Red-breasted merganser, Lapwing, Dunlin, Common tern, Redshank and Teal.

Would the likely significant effects identified, despite the implementation of mitigation measures, adversely affect the integrity of any European site(s)?

No.

With the implementation of mitigation measures, none of the potential impacts identified are likely to affect the conservation condition of QI habitats/species or SCI bird species and therefore, the Orange2 Route Option would not adversely affect the integrity of any European sites (refer to Tables B.1-B.9 in **Appendix B** for full assessment).

However, further geotechnical and hydrogeological investigations may uncover an unquantifiable risk to wetland habitats in Lough Corrib cSAC hydrogeologically connected to the tunnel location. In that case, a view would have to be taken whether, based on the precautionary principle, the risk of adverse effects on the integrity of Lough Corrib cSAC could not be ruled out.

4.3 Yellow2 Route Option

Is the Yellow2 Route Option likely to have a significant effect on any European site(s) in view of its/their conservation objectives?

Yes.

The Yellow2 Route Option has the potential to result in significant effects on Lough Corrib cSAC. The total footprint of the Yellow2 Route Option within the cSAC boundary is c.4.33Ha. Within this area, part of the Yellow2 Route Option passes over areas of Cladium fen [*7210], Limestone pavement [*8240], and Calcareous grassland [6210] to the north and north-west of the Coolagh Lakes (0.27Ha, 0.6Ha, and 0.26Ha respectively) - see Figure 7.6.1.17 of the RSR; all of which are QI Annex I habitats of the cSAC. Although not directly impacted by the viaduct structure – as all piers are located outside of Annex I habitat areas – the viaduct deck is likely to affect the vegetation beneath as a result of the effects of shading, and possible as a result of a reduction in direct precipitation. Vegetation cutting/removal would likely be required to facilitate the construction works and on an ongoing basis to avoid any impact to the proposed road infrastructure during operation, also affecting these habitat areas. Drainage from the road will discharge to the River Corrib, and possibly the Coolagh Lakes, posing a potential risk to water quality during construction and operation which could affect QI habitats and QI aquatic species such Otter, Brook lamprey, Sea lamprey, and the Freshwater pearl mussel. Aquatic species could also potentially be displaced due to construction/operational disturbance effects with Otter also at potential risk of mortality from road traffic and effects associated with changes to riparian habitat.

The Yellow2 Route Option has the potential to result in significant effects on Galway Bay Complex cSAC as drainage from the road would discharge to watercourses that drain to Galway Bay. This would pose a potential risk to any of the QI coastal habitats, and QI species (Otter and Harbour seal) that could be affected by a reduction in marine water quality.

The Yellow2 Route Option has the potential to result in significant effects on Lough Corrib SPA as it would affect a number of winter bird sites (WB01, WB03, WB04, WB07, WB12, WB14, WB16, WB36 and WB45) which have records for the following SCI bird species: Black-headed gull, Common gull, and Coot.

The Yellow2 Route Option has the potential to result in significant effects on Inner Galway Bay SPA as it would affect a number of winter bird sites (see above) which have records for the following SCI bird species: Black-headed gull, Cormorant, Common gull, Curlew, Grey heron, Light-bellied brent goose, Red-breasted merganser, Lapwing, Dunlin, Common tern, Redshank and Teal.

Would the likely significant effects identified, despite the implementation of mitigation measures, adversely affect the integrity of any European site(s)?

Yes.

This route option would directly impact on areas of Limestone pavement, Orchid-rich calcareous grassland, and Cladium fen in Lough Corrib cSAC which would affect the conservation condition of these QI habitats. Therefore, it is deemed that the Yellow2 Route Option would adversely affect the integrity of Lough Corrib cSAC (refer to Tables B.1-B.9 in **Appendix B** for full assessment).

4.4 Blue2 Route Option

Is the Blue2 Route Option likely to have a significant effect on any European site(s) in view of its/their conservation objectives?

Yes.

The Blue2 Route Option has the potential to result in significant effects on Lough Corrib cSAC. The total footprint of the Blue2 Route Option within the cSAC boundary is c.0.41Ha at the River Corrib crossing and c.0.51Ha underneath the cSAC boundary at Lackagh Quarry. Although the Blue2 Route Option passes through the cSAC (see **Figure 7.6.1.17** and **7.6.1.18** of the RSR), it does not impact directly on any Annex I habitat, nor do any sections of the viaduct pass over any areas of Annex I habitat within the cSAC. Drainage from the road however, will discharge to the River Corrib, and possibly the Coolagh Lakes, posing a risk to water quality during construction and operation which could affect QI habitats and QI aquatic species such Otter, Brook lamprey, Sea lamprey, and the Freshwater pearl mussel. Aquatic species could also be displaced due to construction/operational disturbance effects with Otter also at risk of mortality from road traffic and effects associated with changes to riparian habitat.

To the west of Lackagh Quarry, the Blue2 Route Option tunnels underneath an area of Limestone pavement [*8240] and Calcareous grassland [*6210/6210] in the Lough Corrib cSAC (**Figures 7.6.17-18**). These habitat types are not groundwater dependent and are not likely to be affected in any way by a tunnel excavated underneath, in that regard. The fractured nature of karst limestone does pose some level of risk of subsidence at the surface as a result of tunnelling works. However,

given the tunnelling methodology proposed it is expected, with the level of information available at this Route Selection stage that the magnitude of any such impact would be extremely low and it can be confidently predicted that any subsidence would not manifest itself at the surface as any perceptible change to the structure or functioning of these habitat types. The tunnel does also carry a risk of both construction and operation impacts to the movement of groundwater and therefore, the potential for indirect effects to wetland habitats within the Lough Corrib cSAC boundary surrounding the Coolagh Lakes. However, given what is currently known at this Route Selection stage about the movement of groundwater in this area, particularly in relation to interactions with water levels in the Coolagh Lakes, the risk of the tunnel affecting the existing hydrogeological regime is as low as reasonably practical by the application of modern tunnelling techniques and construction controls. Therefore the tunnel is unlikely to result in any effects to the conservation condition of the qualifying interest habitats within Lough Corrib cSAC, and would not adversely affect the integrity of this European site.

The Blue2 Route Option has the potential to result in significant effects on Galway Bay Complex cSAC as drainage from the road would discharge to watercourses that drain to Galway Bay. This would pose a potential risk to any of the QI coastal habitats, and QI species (Otter and Harbour seal) that could be affected by a reduction in marine water quality.

The Blue2 Route Option has the potential to result in significant effects on Lough Corrib SPA as it would affect a number of winter bird sites (WB01, WB02, WB03, WB05, WB10, WB12, WB16, WB23 and WB45) which have records for the following SCI bird species: Black-headed gull, Common gull, Coot, Shoveler and Tufted duck.

The Blue2 Route Option has the potential to result in significant effects on Inner Galway Bay SPA as it would affect a number of winter bird sites (see above) which have records for the following SCI bird species: Bar-tailed godwit, Black-headed gull, Cormorant, Common gull, Curlew, Grey heron, Light-bellied brent goose, Red-breasted merganser, Lapwing, Dunlin, Common tern, Redshank, Shoveler, Teal and Wigeon.

Would the likely significant effects identified, despite the implementation of mitigation measures, adversely affect the integrity of any European site(s)?

No.

With the implementation of mitigation, none of the potentially significant effects identified are likely to effect the conservation condition of QI habitats/species or SCI bird species and therefore, the Blue2 Route Option would not adversely affect the integrity of any European sites (refer to Tables B.1-B.9 in **Appendix B** for full assessment).

However, further geotechnical and hydrogeological investigations may uncover an unquantifiable risk to the habitats above the tunnel and to the existing hydrogeological regime that supports the Coolagh Lakes. In that case, a view would have to be taken whether, based on the precautionary principle, the risk of adverse effects on the integrity of Lough Corrib cSAC could not be ruled out.

4.5 Pink2 Route Option

Is the Pink2 Route Option likely to have a significant effect on any European site(s) in view of its/their conservation objectives?

Yes.

The Pink2 Route Option has the potential to result in significant effects on Lough Corrib cSAC. The total footprint of the Pink2 Route Option within the Lough Corrib cSAC boundary is c.0.56Ha at the River Corrib crossing and c.0.51Ha underneath the cSAC boundary at Lackagh Quarry. Although the Pink2 Route Option passes through the cSAC, it does not impact directly on any Annex I habitat (see **Figure 7.6.1.17** and **7.6.1.18** of the RSR), nor do any sections of viaduct pass over any areas of Annex I habitat within the cSAC. Drainage from the road however, will discharge to the River Corrib, and possibly the Coolagh Lakes, posing a potential risk to water quality during construction and operation which could affect QI habitats and QI aquatic species such Otter, Brook lamprey, Sea lamprey, and the Freshwater pearl mussel. Aquatic species could also potentially be displaced due to construction/operational disturbance effects with Otter also at risk of mortality from road traffic and potential effects associated with changes to riparian habitat.

As the Pink2 Route Option includes the same tunnel under the Lough Corrib cSAC at Lackagh Quarry as the Blue2 Route Option, the potential for significant effects is as described for that route option above.

The Pink2 Route Option has the potential to result in significant effects on Galway Bay Complex cSAC as drainage from the road would discharge to watercourses that drain to Galway Bay. This would pose a potential risk to any of the QI coastal habitats, and QI species (Otter and Harbour seal) that could be affected by a reduction in marine water quality.

The Pink2 Route Option has the potential to result in significant effects on Lough Corrib SPA as it would affect a number of winter bird sites (WB01, WB02, WB03, WB12, WB16, WB23 and WB45) which have records for the following SCI bird species: Black-headed gull, Common gull, Coot, Shoveler and Tufted duck.

The Pink2 Route Option has the potential to result in significant effects on Inner Galway Bay SPA as it would affect a number of winter bird sites (see above) which have records for the following SCI bird species: Bar-tailed godwit, Black-headed gull, Cormorant, Common gull, Curlew, Grey heron, Lapwing, Light-bellied brent goose, Red-breasted merganser, Dunlin, Common tern, Redshank, Shoveler, Teal and Wigeon.

Would the likely significant effects identified, despite the implementation of mitigation measures, adversely affect the integrity of any European site(s)?

No.

With the implementation of mitigation, none of the potentially significant effects identified are likely to effect the conservation condition of QI habitats/species or SCI bird species and therefore, the Pink2 Route Option would not adversely affect the integrity of any European sites (refer to Tables B.1-B.9 in Appendix B for full assessment).

However, further geotechnical and hydrogeological investigations may uncover an unquantifiable risk to the habitats above the tunnel and to the existing hydrogeological regime that supports the Coolagh Lakes. In that case, a view would have to be taken whether, based on the precautionary principle, the risk of adverse effects on the integrity of Lough Corrib cSAC could not be ruled out.

4.6 Green2 Route Option

Is the Green2 Route Option likely to have a significant effect on any European site(s) in view of its/their conservation objectives?

Yes.

The Green2 Route Option has the potential to result in significant effects on Lough Corrib cSAC. The total footprint of the Green2 Route Option within the cSAC boundary is c.1.81Ha. Within this area, part of the Green2 Route Option passes over an area of c.725m^2 of Alkaline fen [7230] at Kentfield; a QI Annex I habitat of the cSAC (see **Figure 7.6.1.17** and **7.6.1.18** of the RSR). Although not directly impacted by the viaduct structure during construction – as all piers are located outside of Annex I habitat areas – the viaduct deck is likely to affect the vegetation beneath as a result of the effects of shading, and possibly as a result of a reduction in direct precipitation. Vegetation cutting/removal would likely be required to facilitate the construction works and on an ongoing basis to avoid any impact to the proposed road infrastructure during operation, also affecting these habitat areas. The area underneath the bridge is subject to existing grazing pressures and during operation this area would likely be fenced off. This could also affect the vegetation composition underneath the viaduct deck. Drainage from the road will discharge to the River Corrib, posing a potential risk to water quality during construction and operation which could affect QI habitats and QI aquatic species such Otter, Brook lamprey, Sea lamprey, and the Freshwater pearl mussel. Aquatic species could also potentially be displaced due to construction/operational disturbance effects with Otter also at risk of mortality from road traffic and potential effects associated with changes to riparian habitat.

The Green2 Route Option has the potential to result in significant effects on Galway Bay Complex cSAC as drainage from the road would discharge to watercourses that drain to Galway Bay. This would pose a potential risk to any of the QI coastal habitats, and QI species (Otter and Harbour seal) that could be affected by a reduction in marine water quality.

The Green2 Route Option has the potential to result in significant effects on Lough Corrib SPA as it would affect a number of winter bird sites (WB01, WB02, WB03, WB07, WB10, WB12, WB17, and WB23) which have records for the following SCI bird species: Black-headed gull, Common gull, Coot, Shoveler and Tufted duck.

The Green2 Route Option has the potential to result in significant effects on Inner Galway Bay SPA as it would affect a number of winter bird sites (see above) which have records for the following SCI bird species: Bar-tailed godwit, Black-headed gull, Cormorant, Common gull, Curlew, Grey heron, Lapwing, Light-bellied brent goose, Red-breasted merganser, Dunlin, Common tern, Redshank, Shoveler, Teal and Wigeon.

Would the likely significant effects identified, despite the implementation of mitigation measures, adversely affect the integrity of any European site(s)?

Yes.

As this route option would directly impact on an area of Alkaline fen in Lough Corrib cSAC which would affect the conservation condition of this QI habitat, the Green2 Route Option would adversely affect the integrity of Lough Corrib cSAC (refer to Tables B.1-B.9 in **Appendix B** for full assessment).

4.7 In-Combination Plans/Projects

This section of the report considers how other plans or projects could act in-combination with the route options to affect European sites.

There are many projects/plans in place, under consideration, or proposed, in Galway City and environs which could potentially have significant effects on European sites and therefore potentially act in-combination with any of the route options to adversely affect the integrity of European sites. Relevant plans include *Galway County Development Plan 2015-2021* (Galway County Council, 2015), *Biodiversity Action Plan for County Galway 2008-2013* (Galway County Council, 2008), *Galway City Draft Biodiversity Action Plan 2014-2024* (Galway City Council, 2013), *Galway City Development Plan 2011-2017* (Galway City Council, 2011), and the *Bearna Local Area Plan 2007 – 2017* (Galway County Council, 2007). Examples of relevant projects, some of which will form part of the overall Integrated Transport Management Programme (ITMP) for Galway City, include road infrastructure upgrade projects in Galway City and environs (e.g.R336 Bearna to Scríob scheme), public transport schemes which include bus corridors in Galway City and connecting surrounding towns and urban/regional cycleways and greenways (e.g. Galway City to Moycullen Greenway), residential, commercial and industrial development, and redeveloping Galway Harbour.

The assessment carried out with respect to the potential for the route options to affect European sites found that the proposed route options were likely to have significant effects (in the absence of mitigation measures) on four European sites: Lough Corrib cSAC, Galway Bay Complex cSAC, Lough Corrib SPA, and Inner Galway Bay SPA.

However, of the six route options being considered in this assessment and with the implementation of mitigation measures, the only route options which would adversely affect the integrity of any European sites are the Green2 Route Option and the Yellow2 Route Option - and only in relation to Lough Corrib cSAC. Therefore, Lough Corrib cSAC is the only European site where any significant in-combination impacts would be likely to arise and only in relation to those particular route options. Of particular note in this regard is the proposed Galway City to Moycullen Greenway which would interact with these route options along the route of the old Connemara railway line - a feature that forms the western boundary of Lough Corrib cSAC in the vicinity of where the Green2 and Yellow2 Route Options cross the River Corrib.

Although none of the route options would be likely to result in adverse effects on the integrity of Lough Corrib SPA, Inner Galway Bay SPA, and Galway Bay Complex cSAC, this conclusion was based on considering the likelihood of route options affecting water quality in Galway Bay and how route options could affect

"*ex-situ*" sites used by SCI bird species - as a result of habitat impacts and disturbance/displacement effects affecting bird numbers, distribution and population trends in the SPAs. There is therefore the possibility that other plans or projects which could affect water quality or any "*ex-situ*" bird site(s) affected by route options, could result in more significant in-combination impacts. However such in-combination impacts would not likely affect the order of preference with respect to European sites as all route options impact on winter bird sites that support SCI bird species of Lough Corrib and Inner Galway SPAs to some degree, and the drainage from all route options will discharge to watercourses that drain to Galway Bay.

Nevertheless, the final design of the route option that is selected as the emerging preferred will be subject to Appropriate Assessment (AA) screening and Appropriate Assessment which must consider, in detail, the potential for all plans and projects relevant at that time to act in-combination with it to result in adverse effects on the integrity of European sites, whether that is the case for the emerging preferred route in isolation, or not.

If, at the time the final design is subject to AA screening/AA, the assessment of relevant plans or projects with regard to in-combination impacts would change the route option assessment with respect to European sites set out in this report, and the Route Selection Report, they should be revisited to ensure that the assessments and conclusions therein would still be valid.

5 Conclusion

This ecological assessment was undertaken with respect to each of the route options proposed for the N6 Galway City Transport Project with respect to the Screening and Appropriate Assessment tests of Article 6(3) of the EU Habitats Directive.

With regard to the screening for Appropriate Assessment test: all six route options have the potential to result in significant effects on four European sites: Lough Corrib cSAC, Galway Bay Complex cSAC, Lough Corrib SPA, and Inner Galway Bay cSAC.

With regard to the Appropriate Assessment test: with the implementation of mitigation measures, four route options (Red2, Orange2, Pink2 and Blue2 Route Options) were found not to likely result in adverse effects on the integrity of the four European sites listed above. Two route options (Yellow2 and Green2 Route Options) were found to likely to result in adverse effects on the integrity of the Lough Corrib cSAC European site, and only as a result of direct impacts to QI habitats.

Therefore four route options (Red2, Orange2, Pink2 and Blue2 Route Options) are considered equal with respect to their potential to adversely affect the integrity of European sites *i.e.* that there will be no adverse effects from these routes on the integrity of any European sites.

Two route options (Yellow 2 and Green2 Route Options) are likely to have adverse effects on the integrity of one European site; Lough Corrib cSAC. Of these two route options, the Yellow2 Route Option is likely to result in a higher degree of potential impact on site integrity when compared to the Green2 Route Option.

6 References

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7 Glossary of terms

On-line Construction

On-line construction involves the reuse, regeneration or enhancement of existing road infrastructure. On-line construction typically involves working adjacent to and managing live traffic, extensive utility diversions and working within confined areas employing the use of restrictive construction methods. On-line construction increases the complexity of construction and the construction period.

On-line construction includes the provision of additional junctions both at grade (priority junctions, roundabouts etc.) and grade separated. On-line construction also includes the provision of over or underpasses to maintain connectivity as required.

Off-line Construction

Off-line construction involves the provision of new road infrastructure, the provision of connectivity to the existing network and the modification of the existing network resultant from the new road infrastructure.

Off-line construction includes the provision of additional junctions both at grade (priority junctions, roundabouts etc.) and grade separated. Off-line construction also includes the provision of over or underpasses to maintain connectivity as required.

Grade Separated Interchange

A grade separated interchange provides access from a road network at one level to a road network at a different level(s).

Drainage

Drainage includes surface drainage, sub surface drainage and overland drainage. Mitigation measures would be implemented to target potential impacts during construction, to reduce and treat site runoff, to reduce the risk of contaminant spillage and, in the event of a spillage, increase the ability to contain it or otherwise minimise the impact.

Mitigation measures would include the provision of spillage containment, silt traps, settlement ponds and the monitoring of water quality.

River Bridge

A bridge structure crossing rivers and water courses which can be designed to meet restrictions imposed by location, site conditions or other.

Appendix A

Article 6(3) Screening Test and Description of European Sites within 15km of the scheme study area

A1

Table A.1: Article 6(3) Screening Test **Description of European Sites within 15km of the scheme study area and the AA Screening Test -** **Is a given route option, either individually or in combination with other plans or projects, likely to have a significant effect on any European site(s) – *i.e.* in view of the sites' conservation objectives and in the absence of mitigation measures, is there a source-pathway-receptor relationship by which a given route option could potentially result in a significant effect on a European site in view of its conservation objectives**		
Site Name & Code	**Qualifying Interests (QI)** (*Priority Annex I habitats/$^{+}$ species also listed on Annex IV)	**Are the proposed route options likely to have a significant effect on the European site, in view of its conservation objectives?**
candidate Special Areas of Conservation (cSACs)		
Lough Corrib cSAC (000297)	<u>Annex I Habitats:</u> • [3110] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflora*e) • [3130] Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*[8] • [3140] Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp • [3260] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation • [6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites) • [6410] *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) • [7110] Active raised bogs * • [7120] Degraded raised bogs still capable of natural regeneration	Yes As all route options must cross Lough Corrib cSAC and/or drainage from all route options is likely to discharge to the River Corrib/Coolagh Lakes. In crossing the cSAC there will be direct impacts to habitats within the European site associated with all route options, except the Orange2 Route Option which tunnels underneath. All route options have the potential for indirect effects to other habitat types and aquatic species, such as: ▪ Effects on the existing hydrogeological/hydrological regimes that support wetland habitats; ▪ Effects on water quality which in turn could affect QI wetland/aquatic habitats and species in the cSAC

[8] Although not yet listed on the version of the site's conservation objectives available from the NPWS, *Conservation objectives for Lough Corrib SAC [000297]. Generic Version 4.0.* (NPWS, 2015), the NPWS have advised that this Annex I habitat has been approved for inclusion as a qualifying interest of Lough Corrib cSAC.

	• [7150] Depressions on peat substrates of the *Rhynchosporion* • [7210] Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* * • [7220] Petrifying springs with tufa formation (*Cratoneurion*) * • [7230] Alkaline fens • [8240] Limestone pavements * • [91A0] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles • [91D0] Bog woodland * <u>Annex II Species:</u> • [1029] Freshwater Pearl Mussel - *Margaritifera margaritifera* • [1092] White-clawed Crayfish - *Austropotamobius pallipes* • [1095] Sea Lamprey - *Petromyzon marinus* • [1096] Brook Lamprey - *Lampetra planeri* • [1106] Atlantic Salmon - *Salmo salar* (only in fresh water) • [1303] Lesser Horseshoe Bat - *Rhinolophus hipposideros* + • [1355] Otter - *Lutra lutra* + • [1393] Slender green feather-moss - *Drepanocladus* (*Hamatocaulis*) *vernicosus*	(i.e., or the risk of an accidental pollution event during construction); ▪ Barrier effect to aquatic species as a result of construction/installation of bridge structure; ▪ Disturbance/displacement effects during construction and operation affecting QI species and their breeding/resting places (e.g. Lesser horseshoe bat roosts); ▪ Habitat loss and degradation affecting QI species; and, ▪ Risk of mortality to Otter posed by road traffic near watercourses/waterbodies. Effects to air quality that would affect the conservation condition/conservation objectives of QI habitats are not likely to be associated with any of the route options[9].

[9] Emissions from car exhausts, and the deposition of particulate matter and heavy metals produced by engine, brake and tyre wear, can contribute to increased deposition of pollutants such as oxides of nitrogen (NO_x), particulate matter (PM) and heavy metals (HM) in the vicinity of a road carriageway. This can affect the ecosystems and vegetation present, influencing plant growth rates and species composition, diversity, and abundance. It is considered unlikely that any of the route options proposed would lead to an increase in NO_x concentration levels that would be above the limit value of 30 µg/m^3 for the protection of vegetation set out in *Guidelines for the Treatment of Air Quality during the Planning and Construction of National Road Schemes* (National Roads Authority, 2011) or result in any significant effects on qualifying interest habitats, or habitats supporting qualifying interest species, within European sites. Similarly, the dry deposition rate of nitrogen would not be expected to be above the critical load of 5 KG(N)/ha/yr defined in those guidelines and any values would be expected to drop off rapidly at increased distance from a road.

In terms of PM and HM, concentrations would be expected to be below the ambient air quality standards. There is likely to be some increases on soil concentrations of elements of PM and HM within the immediate vicinity of the road side that would result in some localised effects to vegetation. However, it is unlikely to result in any significant changes to species composition or diversity, to adversely affect the conservation objectives of qualifying interest habitats, or to adversely affect habitats supporting qualifying interest species, within European sites.

Dust emissions associated with construction works could, in extreme circumstances, affect adjoining habitats (potentially burying sensitive habitats or plant species) but using best practice construction methodologies and mitigation measures significant effects over the long-term would not be expected. Typical mitigation measures could include watering of the construction site/access roads, road cleaning, vehicle speed restrictions, and barriers to prevent wind-blown dust.

	• [1833] Slender Naiad - *Najas flexilis* + NPWS (2015) Conservation objectives for Lough Corrib SAC [000297]. Generic Version 4.0. Department of Arts, Heritage and the Gaeltacht.	
Galway Bay Complex cSAC (000268)	<u>Annex I Habitats:</u> • [1140] Mudflats and sandflats not covered by seawater at low tide • [1150] Coastal lagoons * • [1160] Large shallow inlets and bays • [1170] Reefs • [1220] Perennial vegetation of stony banks • [1310] *Salicornia* and other annuals colonising mud and sand • [1330] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) • [1410] Mediterranean salt meadows (*Juncetalia maritimi*) • [3180] Turloughs * • [5130] *Juniperus communis* formations on heaths or calcareous grasslands • [6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites) • [7210] Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* * • [7230] Alkaline fens <u>Annex II Species:</u> • [1355] Otter *Lutra lutra*+ • [1365] Harbour seal *Phoca vitulina* NPWS (2013) Conservation Objectives: Galway Bay Complex SAC 000268. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	Yes As all route options will cross watercourses, and/or road drainage is likely to discharge to watercourses, which drain to Galway Bay. A reduction in water quality in Galway Bay could affect the conservation condition /conservation objectives of QI habitats and species.
Kiltiernan Turlough cSAC	<u>Annex I Habitats:</u> • [3180] Turloughs *	No

(001285)	NPWS (2015) Conservation objectives for Kiltiernan Turlough SAC [001285]. Generic Version 4.0. Department of Arts, Heritage and the Gaeltacht.	This European site is approximately 14km from the nearest route option and therefore there is no risk of direct impacts to the QI habitat. Kiltiernan Turlough is situated in a different surface water catchment to the route options and therefore there are no hydrological impact pathways. Although the route options lie within the same groundwater body as Kiltiernan Turlough, there are no known hydrogeological pathways that would pose a risk of indirect impacts to the QI habitat. There are also no hydrological pathways and no known hydrogeological pathways that connect the route options with Kiltiernan Turlough and therefore, no risk of indirect impacts to the QI habitat.
Rahasane Turlough cSAC (000322)	<u>Annex I Habitats:</u> • [3180] Turloughs * NPWS (2015) Conservation objectives for Rahasane Turlough SAC [000322]. Generic Version 4.0. Department of Arts, Heritage and the Gaeltacht.	No This European site is approximately 13.5km from the nearest route option and therefore there is no risk of direct impacts to the QI habitat. The cSAC is situated in a different surface water and groundwater body subcatchement to the route options. There are no hydrological/hydrogeological pathways that connect the route options with the cSAC and therefore, no risk of indirect impacts to the QI habitat.
Lough Fingall Complex cSAC (000606)	<u>Annex I Habitats:</u> • [3180] Turloughs * • [4060] Alpine and Boreal heaths • [5130] *Juniperus communis* formations on heaths or calcareous grasslands • [6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites)	No This European site is approximately 11.5km from the nearest route option and therefore there is no risk of direct impacts to QI habitats or to habitats that support the Lesser horseshoe bat within the cSAC. Lough Fingall lies in a different groundwater and surface water sub-catchment to the route options. There are no

	• [7210] Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* * • [8240] Limestone pavements * <u>Annex II Species:</u> • [1303] Lesser horseshoe bat *Rhinolophus hipposideros*+ NPWS (2015) Conservation objectives for Lough Fingall Complex SAC [000606]. Generic Version 4.0. Department of Arts, Heritage and the Gaeltacht.	hydrological/hydrogeological pathways that connect the route options with this European site and therefore, no risk of indirect impacts to the QI habitats or species. With regard to the Lesser horseshoe bat, the roost that forms the QI population for this European site (Cloghballymore House) is more than 13km from the nearest route option. This distance would be regarded to be beyond the normal core foraging range of the Cloghballymore House population and beyond the normal commuting range of this species except on exceptional occasions or over long periods of time – for example, bats dispersing and moving between areas in the wider landscape over a period of many years/generations. Furthermore, radio-tracking surveys of the Menlough population of bats (which were located within the scheme study area) undertaken for this project in 2014 and 2015 did not indicate any evidence of linkage between that population and the Cloghballymore House roost. Therefore the lack of a significant linkage between the scheme study area and the roosts that are the reason for designation of this European site means that it is reasonable to rule out any effects on the species' conservation condition/conservation objectives.
Connemara Bog Complex cSAC (002034)	<u>Annex I Habitats:</u> • [1150] Coastal lagoons * • [1170] Reefs • [3110] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*) • [3160] Natural dystrophic lakes and ponds • [3260] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation • [4010] Northern Atlantic wet heaths with *Erica tetralix* • [4030] European dry heaths	No This European site is approximately 6.5km from the nearest route option and therefore there is no risk of direct impacts to QI habitats or to habitats that support the QI species within the cSAC. As the cSAC overlies a poorly productive aquifer and the distance offset from the route options is substantial there is, no risk of indirect hydrogeological impacts.

	• [6410] *Molinia* meadows on calcareous, peaty or clavey-silt-laden soils (*Molinion caeruleae*) • [7130] Blanket bog (*active only) • [7140] Transition mires and quaking bogs [7140] • [7150] Depressions on peat substrates of the *Rhynchosporion* • [7230] Alkaline fens • [91A0] Old sessile oak woods with *Ilex* and *Blechnum* in British Isles <u>Annex II Species:</u> • [1065] Marsh fritillary *Euphydryas aurinia* • [1106] Salmon *Salmo salar* • [1355] Otter *Lutra lutra*$^{+}$ • [1833] Slender naiad *Najas flexilis* NPWS (2015) Conservation objectives for Connemara Bog Complex SAC [002034]. Generic Version 4.0. Department of Arts, Heritage and the Gaeltacht.	As the cSAC overlies a poorly productive aquifer and the distance offset from the route options is substantial there is, no risk of indirect hydrogeological impacts. The proposed route options pass over catchments that are not hydrologically linked to the cSAC and therefore will not have any direct or indirect impacts on the hydrological functioning of the Connemara Bog Complex cSAC. Due to the natural population dynamics of the Marsh fritillary butterfly, it is a species that requires a network of suitable habitat patches within its range to sustain the local metapopulation. Although long distance movements have been recorded (i.e. up to 20km), the species is generally relatively sedentary and 6.5km would be beyond the normal dispersal range of the species (Lavery, 1993; Hula *et al.*2004; Betzholtz *et al.* 2007; Junker & Schmitt, 2010; Botham *et al.*, 2011; and, Zimmermann *et al.*, 2011). Even over the longer term, the loss of suitable Marsh fritillary habitat associated with route options is at the south-eastern limit of any possible future expansion from this European site in the direction of Galway City, given the barrier imposed by urban development. Therefore, none of the route options would be expected to influence the existing population dynamic in any way or result in any effects on the conservation condition/conservation objectives for this species in the SAC.
Ross Lake and Woods cSAC (001312)	<u>Annex I Habitats:</u> • [3140] Hard oligo-mesotrophic waters with benthic vegetation of *Chara spp*. • [6410] *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) • [7230] Alkaline fens	No This European site is approximately 9.5km from the nearest route option. The cSAC is located within a separate groundwater and surface water sub-catchment. As it is significantly up-

	• [91E0] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) * Annex II Species: • [1303] Lesser horseshoe bat *Rhinolophus hipposideros*+ • [1355] Otter *Lutra lutra*+ NPWS (2015) Conservation objectives for Ross Lake and Woods SAC [001312]. Generic Version 4.0. Department of Arts, Heritage and the Gaeltacht.	gradient of the route options there is no risk of direct or indirect impacts to QI habitats or QI species. With regard to the Lesser horseshoe bat, the roost that forms the QI population for this European site (buildings at Ross House) is more than 12km from the nearest route option. This distance would be regarded to be beyond the normal core foraging range of the Ross House population and beyond the normal commuting range of this species except on exceptional occasions or over long periods of time – for example, bats dispersing and moving between areas in the wider landscape over a period of many years/generations. Furthermore, radio-tracking surveys of the Menlough population of bats (which were located within the scheme study area) undertaken for this project in 2014 and 2015 did not indicate any evidence of linkage between that population and the Ross House roost. Therefore the lack of a significant linkage between the scheme study area and the roosts that are the reason for designation of this European site means that it is reasonable to rule out any effects on the species' conservation condition/conservation objectives.
Gortnandarragh Limestone Pavement cSAC (001271)	Annex I Habitats: • [8240] Limestone pavements * NPWS (2015) Conservation objectives for Gortnandarragh Limestone Pavement SAC [001271]. Generic Version 4.0. Department of Arts, Heritage and the Gaeltacht.	No This European site is approximately 12.5km from the nearest route option. The cSAC is located within a separate groundwater and surface water sub-catchment. As it is significantly up-gradient of the route options there is no risk of direct or indirect impacts to QI habitats or QI species.
Castletaylor Complex cSAC	Annex I Habitats: • [3180] Turloughs * • [4060] Alpine and Boreal heaths	No

(000242)	• [5130] *Juniperus communis* formations on heaths or calcareous grasslands • [6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites) • [8240] Limestone pavements * NPWS (2015) Conservation objectives for Castletaylor Complex SAC [000242]. Generic Version 4.0. Department of Arts, Heritage and the Gaeltacht.	This European site is approximately 14km from the nearest route option. The cSAC is located within a separate groundwater and surface water sub-catchment. There are no hydrological/hydrogeological pathways connecting the route options with this European site that could affect groundwater conditions in the cSAC and therefore, no risk of direct or indirect impacts to QI habitats.
Black Head-Poulsallagh cSAC (000020)	<u>Annex I Habitats:</u> • [1170] Reefs • [1220] Perennial vegetation of stony banks • [3260] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation • [4060] Alpine and Boreal heaths • [5130] *Juniperus communis* formations on heaths or calcareous grasslands • [6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites) • [6510] Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*) • [7220] Petrifying springs with tufa formation (*Cratoneurion*) * • [8240] Limestone pavements * • [8330] Submerged or partly submerged sea caves <u>Annex II Species:</u> • [1395] Petalwort *Petalophyllum ralfsii* NPWS (2014) Conservation Objectives: Black Head-Poulsallagh Complex SAC 000020. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	No This European site is approximately 11km from the nearest route option. The cSAC is located within a separate groundwater and surface water catchment. There is, no risk of direct or indirect hydrological or hydrogeological impacts to QI habitats or QI species.

Moneen Mountain cSAC (000054)	Annex I Habitats: • [3180] Turloughs * • [4060] Alpine and Boreal heaths • [5130] *Juniperus communis* formations on heaths or calcareous grasslands • [6130] Calaminarian grasslands of the *Violetalia calaminariae* • [6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites) • [7220] Petrifying springs with tufa formation (*Cratoneurion*) * • [8240] Limestone pavements * Annex II Species: • [1065] Marsh fritillary *Euphydryas aurinia* • [1303] Lesser horseshoe bat *Rhinolophus hipposideros*+ NPWS (2015) Conservation objectives for Moneen Mountain SAC [000054]. Generic Version 4.0. Department of Arts, Heritage and the Gaeltacht.	No This European site is approximately 13km from the nearest route option. The cSAC is located within a separate groundwater and surface water catchment. There is no risk of direct or indirect hydrological or hydrogeological impacts to QI habitats or QI species. With regard to the Lesser horseshoe bat, the roost site that forms the QI population for this European site is more than 17km from the nearest route option. This distance would be regarded to be beyond the normal core foraging range of this roost's population and beyond the normal commuting range of this species except on exceptional occasions or over long periods of time – for example, bats dispersing and moving between areas in the wider landscape over a period of many years/generations. Furthermore, radio-tracking surveys of the Menlough population of bats (which were located within the scheme study area) undertaken for this project in 2014 and 2015 did not indicate any evidence of linkage between that population and the Moneen Mountain cSAC roost. Therefore the lack of a significant linkage between the scheme study area and the roosts that are the reason for designation of this European site means that it is reasonable to rule out any effects on the species' conservation condition/conservation objectives. Due to the natural population dynamics of the Marsh fritillary butterfly, it is a species that requires a network of suitable habitat patches within its range to sustain the local metapopulation. Although long distance movements have been recorded (i.e. up to 20km), the species is generally relatively sedentary and 13km would be beyond the normal

		dispersal range of the species (Lavery, 1993; Hula *et al.*2004; Betzholtz *et al.* 2007; Junker & Schmitt, 2010; Botham *et al.*, 2011; and, Zimmermann *et al.*, 2011) – if measured overland, the distance between the scheme study area and the European site is closer to 30km. Even over the longer term, the loss of suitable Marsh fritillary habitat associated with route options is at the south-eastern limit of any possible future expansion from this European site, given the barrier imposed by urban development around Galway City. Therefore, none of the route options would be expected to influence the existing population dynamic in any way or result in any effects on the conservation condition/conservation objectives for this species in the SAC.
East Burren Complex cSAC (001926)	Annex I Habitats: • [3140] Hard oligo-mesotrophic waters with benthic vegetation of *Chara spp*. • [3180] Turloughs • [3260] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation • [4060] Alpine and Boreal heaths • [5130] *Juniperus communis* formations on heaths or calcareous grasslands • [6210] Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites) • [6510] Lowland hay meadows (*Alopecurus pratensis, Sanguisorba officinalis*) • [7210] Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* * • [7220] Petrifying springs with tufa formation (*Cratoneurion*) * • [7230] Alkaline fens • [8240] Limestone pavements * • [8310] Caves not open to the public • [91E0] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) *	No This European site is approximately 13.5km from the nearest route option. The cSAC is located within a separate groundwater and surface water catchment. There is, no risk of direct or indirect hydrological or hydrogeological impacts to QI habitats or QI species. With regard to the Lesser horseshoe bat, the known roost site that forms the QI population for this European site is more than 24km from the nearest route option. This distance would be regarded to be beyond the normal core foraging range of this roost's population and beyond the normal commuting range of this species except on exceptional occasions or over long periods of time – for example, bats dispersing and moving between areas in the wider landscape over a period of many years/generations. Furthermore, radio-tracking surveys of the Menlough population of bats (which were located within the scheme study area) undertaken for this project in

	Annex II Species: • [1065] Marsh fritillary *Euphydryas aurinia* • [1303] Lesser horseshoe bat *Rhinolophus hipposideros*+ • [1355] Otter *Lutra lutra*+ NPWS (2015) Conservation objectives for East Burren Complex SAC [001926]. Generic Version 4.0. Department of Arts, Heritage and the Gaeltacht.	2014 and 2015 did not indicate any evidence of linkage between that population and the Moneen Mountain cSAC roost. Therefore the lack of a significant linkage between the scheme study area and the roosts that are the reason for designation of this European site means that it is reasonable to rule out any effects on the species' conservation condition/conservation objectives. Due to the natural population dynamics of the Marsh fritillary butterfly, it is a species that requires a network of suitable habitat patches within its range to sustain the local metapopulation. Although long distance movements have been recorded (i.e. up to 20km), the species is generally relatively sedentary and 13.5km would be beyond the normal dispersal range of the species (Lavery, 1993; Hula *et al.*2004; Betzholtz *et al.* 2007; Junker & Schmitt, 2010; Botham *et al.*, 2011; and, Zimmermann *et al.*, 2011) – if measured overland, the distance between the scheme study area and the European site is closer to 25km. Even over the longer term, the loss of suitable Marsh fritillary habitat associated with route options is at the south-eastern limit of any possible future expansion from this European site, given the barrier imposed by urban development around Galway City. Therefore, none of the route options would be expected to influence the existing population dynamic in any way or result in any effects on the conservation condition/conservation objectives for this species in the cSAC.
Special Protection Areas (SPAs)		
Inner Galway Bay SPA (004031)	Special Conservation Interest (SCI) Bird Species: • Great northern diver *Gavia immer* [A003] – Wintering • Cormorant *Phalacrocorax carbo* [A017] – Breeding/Wintering	Yes As many of the wintering and breeding bird species for which the SPA has been selected use habitats situated within the immediate hinterland of the SPA, or in areas ecologically

	• Grey heron *Ardea cinerea* [A028] – Wintering • Light-bellied brent goose *Branta bernicla hrota* [A046] – Wintering • Wigeon *Anas penelope* [A050] – Wintering • Teal *Anas crecca* [A052] – Wintering • Shoveler *Anas clypeata* [A056] – Wintering • Red-breasted merganser *Mergus serrator* [A069] – Wintering • Ringed plover *Charadrius hiaticula* [A137] – Wintering • Golden plover *Pluvialis apricaria* [A140] – Wintering • Lapwing *Vanellus vanellus* [A142] – Wintering • Dunlin *Calidris alpina* [A149] – Wintering • Bar-tailed godwit *Limosa lapponica* [A157] – Wintering • Curlew *Numenius arquata* [A160] – Wintering • Redshank *Tringa totanus* [A162] – Wintering • Turnstone *Arenaria interpres* [A169] – Wintering • Black-headed gull *Chroicocephalus ridibundus* [A179] – Wintering • Common gull *Larus canus* [A182] – Wintering • Sandwich tern *Sterna sandvicensis* [A191] – Breeding • Common tern *Sterna hirundo* [A193] – Breeding • Wetlands habitats NPWS (2013) Conservation Objectives: Inner Galway Bay SPA 004031. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.	connected to it, displacement of SCI birds from these '*ex-situ*' habitat areas[10] has the potential, for certain bird species, to have an indirect effect on numbers within the SPA and therefore affect the site's conservation objectives. The Red2, Yellow2, Blue2, Pink2 and Green2 Route Options will require the construction of a new bridge over the River Corrib, and the bridge structures associated with these route options could pose a collision risk to SCI bird species that commute or forage along the river corridor.
Lough Corrib SPA (004042)	<u>Special Conservation Interest (SCI) Bird Species</u>**:** • Greenland white-fronted goose *Anser albifrons flavirostris* [A395] – Wintering • Gadwall *Anas strepera* [A051] – Wintering • Shoveler *Anas clypeata* [A056] – Wintering	Yes As many of the wintering and breeding bird species for which the SPA has been selected use habitats situated within the immediate hinterland of the SPA, or in areas ecologically connected to it, displacement of SCI birds from these '*ex-situ*'

[10] The Conservation Objectives Supporting Document for Inner Galway Bay defines ex-situ habitats as "habitats situated within the immediate hinterland of the SPA or in areas ecologically connected to it" (NPWS, 2013)

	• Pochard *Aythya ferina* [A059] – Wintering • Tufted duck *Aythya fuligula* [A061] – Wintering • Common scoter *Melanitta nigra* [A065] – Breeding • Hen harrier *Circus cyaneus* [A082] – Wintering • Coot *Fulica atra* [A125] – Wintering • Golden plover *Pluvialis apricaria* [A140] – Wintering • Black-headed gull *Chroicocephalus ridibundus* [A179] – Breeding/Wintering • Common gull *Larus canus* [A182] – Breeding/Wintering • Common tern *Sterna hirundo* [A193] – Breeding • Arctic tern *Sterna paradisaea* [A194] – Breeding • Wetland habitats NPWS (2015) Conservation objectives for Lough Corrib SPA [004042]. Generic Version 4.0. Department of Arts, Heritage and the Gaeltacht.	habitat areas[11] has the potential, for certain bird species, to have an indirect effect on numbers within the SPA and therefore affect the site's conservation objectives. The Red2, Yellow2, Blue2, Pink2 and Green2 Route Options will require the construction of a new bridge over the River Corrib, and the bridge structures associated with these route options could pose a collision risk to SCI bird species that commute or forage along the river corridor.
Connemara Bog Complex SPA (004181)	<u>Special Conservation Interest (SCI) Bird Species:</u> • Cormorant *Phalacrocorax carbo* [A017] – Breeding • Merlin *Falco columbarius* [A098] – Breeding • Golden plover *Pluvialis apricaria* [A140] – Breeding • Common gull *Larus canus* [A182] – Breeding NPWS (2015) Conservation objectives for Connemara Bog Complex SPA [004181]. Generic Version 4.0. Department of Arts, Heritage and the Gaeltacht.	No This European site is approximately 9km from the nearest route option. As the SPA overlies a poorly productive aquifer and the distance offset from the route options is substantial there is, no risk of indirect hydrogeological impacts to the SCI bird species. The proposed route options pass over catchments that are either not hydrologically linked to the SPA and therefore will not have any direct or indirect impacts on the hydrological functioning of the Connemara Bog Complex SPA.

[11] Although a similar document is not available for this SPA, the Conservation Objectives Supporting Document for Inner Galway Bay defines ex-situ habitats as "habitats situated within the immediate hinterland of the SPA or in areas ecologically connected to it" (NPWS, 2013) and the same definition is applied in this case.

		There is also no risk of disturbance or displacement at breeding sites due to the construction or operation of a road development at this distance. Therefore, the proposed route options would not affect the conservation condition of the sites SCI bird species, affect the site's conservation objectives, or result in an adverse effect on site integrity.
Cregganna Marsh SPA (004142)	<u>Special Conservation Interest (SCI) Bird Species:</u> • Greenland white-fronted goose *Anser albifrons flavirostris* [A395] – Wintering NPWS (2015) Conservation objectives for Cregganna Marsh SPA [004142]. Generic Version 4.0. Department of Arts, Heritage and the Gaeltacht.	No There were no records of Greenland white-fronted geese from any of the winter bird sites surveyed in 2014/2015. This European site is approximately 4.3km from the nearest route option. There are also no hydrological/hydrogeological pathways connecting the route options with this European site that could affect surface and groundwater conditions in the SPA and therefore, no risk of direct or indirect impacts to SCI bird species or to habitats that support the wintering population of these species within the SPA. There is also no risk of disturbance or displacement at breeding sites due to the construction or operation of a road development at this distance. Therefore, the proposed route options would not affect the conservation condition of the sites SCI bird species, affect the site's conservation objectives, or result in an adverse effect on site integrity.

Rahasane Turlough SPA (004089)	Special Conservation Interest (SCI) Bird Species: • Whooper swan *Cygnus cygnus* [A038] – Wintering • Wigeon *Anas penelope* [A050] – Wintering • Golden plover *Pluvialis apricaria* [A140] – Wintering • Black-tailed godwit *Limosa limosa* [A156] – Wintering • Greenland white-fronted goose *Anser albifrons flavirostris* [A395] – Wintering • Wetland habitats NPWS (2015) Conservation objectives for Rahasane Turlough SPA [004089]. Generic Version 4.0. Department of Arts, Heritage and the Gaeltacht.	No This European site is approximately 13.5km from the nearest route option. The SPA is situated in a different surface water and groundwater body catchment to the route options. There are no hydrological/hydrogeological pathways that connect the route options with the SPA and therefore, no risk of indirect impacts to the SCI bird species. There is also no risk of disturbance or displacement at breeding sites due to the construction or operation of a road development at this distance. The winter bird surveys carried out within the N6 GCTP scheme study area over the winter of 2014/2015 only recorded two of this SPA's SCI bird species within survey sites potentially affected by route options: Wigeon and Golden plover. At such a distance from the SPA, there is a very low probability that these birds were part of the SPA population as this would be beyond the range of normal routine daily movements for these species in the winter period. Therefore, the proposed route options would not affect the conservation condition of the sites SCI bird species, affect the site's conservation objectives, or result in an adverse effect on site integrity.

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Appendix B

Article 6(3) Appropriate Assessment Test

Assessment of the likelihood of route options adversely affecting the integrity of identified relevant European sites

B1

This appendix includes an assessment of the likelihood of route options adversely affecting the integrity of identified, relevant European sites—i.e. the Appropriate Assessment Test.

The presence/absence of impact pathways of individual route options with respect to the ecological receptors listed as QI habitat/species of the cSACs or SCI bird species of the SPAs are discussed in detail below in Tables B.1 to B.4.

Where there is a likelihood of significant effects in view of the European site's conservation objectives and in consideration of mitigation measures, and those effects could result in an adverse effect on site integrity, the potential interactions/effects of the route options on the specific attributes and targets relating to the maintenance/restoration of favourable conservation condition of the QIs/SCIs are outlined in Tables B.5 to B.9.

The locations of Annex I habitats in Lough Corrib cSAC and the winter bird survey sites referred to below are shown on **Figures 7.6.1.17-18** and **Figures 7.6.1.19-20** of the route selection report. All other survey results relating to the route selection study are provided in **Chapter 4 Constraints Study**, **Section 4.3 Ecology** of the Route Selection Report and **Figures 4.3.1 to 4.3.23**.

Table B. 1: Lough Corrib cSAC
Qualifying Interests (QI) (*Priority Annex I habitats/$^{+}$ species also listed on Annex IV) **Are the potential effects of the route options, despite the implementation of mitigation measures, likely to be significant and adversely affect the integrity of the European site?**
Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflora*e) [3110] This habitat type was not present in Lough Corrib cSAC within the Zone of Influence (ZoI) of any of the proposed route options. Therefore with respect to this QI Annex I habitat type, there is no impact pathway by which the proposed route options would result in any adverse effects on the integrity of the cSAC, in view of the site's conservation objectives.
Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*[12] [3130] This habitat type was not present in Lough Corrib cSAC within the ZoI of any of the proposed route options. Therefore with respect to this QI Annex I habitat type, there is no impact pathway by which the proposed route options would result in any adverse effects on the integrity of the cSAC, in view of the site's conservation objectives.
Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. [3140] The Coolagh Lakes correspond with this habitat type in Lough Corrib cSAC and are within the ZoI of the Yellow2, Blue2 and Pink2 Route Options. These route options could affect the conservation objectives relating to the Coolagh Lakes as a result of impacts to the existing hydrogeological regime and/or a reduction in water quality during construction or operation. *Hydrogeology* The Coolagh Lakes are fed by groundwater that arises from two main spring sites: one to the north-west of the lakes at Menlough, and a second at Coolagh, in the vicinity of Lackagh Quarry (see K25 and K43 on Figure 4.5.2). The groundwater catchment for the Coolagh Lakes extends east and north from the lakes to topographic high points that form a divide with catchments of the River Corrib and Ballindooley Lough. The geology of the catchment is entirely limestone and, as there are no surface water features on the higher ground of the catchment, this aquifer is recharged from incident rainfall. Due to the exposed bedrock, recharge in the catchment is high and all effective rainfall is assumed to infiltrate to the water table. The presence of an underlying impermeable chert layer directs the recharge flow within this catchment towards the two main springs that feed the Coolagh Lakes via flow paths that are likely to occur in a branching network above this chert layer. Therefore, those route options passing through this zone (i.e. Yellow2, Blue2, and Pink2) have the potential to affect the groundwater supply to the lakes. Both the Blue2 and Pink2 Route Options tunnel underneath the Limestone pavement west of Lackagh Quarry and there is therefore a risk that during construction and/or operation the existing hydrogeological regime would be affected. However, given what is currently known about the movement of groundwater in this area, particularly in relation to interactions with water levels in the Coolagh Lakes, the risk of the tunnel affecting the existing hydrogeological regime is as low as reasonably practical by the application of modern tunnelling techniques and construction controls. Based upon these appropriate engineering tunnelling techniques and construction controls, the tunnel is unlikely to result in any significant long-term effects to the functioning of the existing hydrological regime that supports the wetland habitats within Lough Corrib cSAC, or adversely affect the integrity of the cSAC.

[12] Although not yet listed on the version of the site's conservation objectives available from the NPWS, *Conservation objectives for Lough Corrib SAC [000297]*, the NPWS have advised that this Annex I habitat has been approved for inclusion as a qualifying interest of the Lough Corrib cSAC.

However, if further hydrogeological investigations at Lackagh Quarry cannot adequately qualify or quantify the risk and/or resulting effects on the existing hydrogeological regime that supports the Coolagh Lakes, then based on the precautionary principle it must be concluded that the conservation condition of this habitat type could be affected and there would therefore be a risk of adverse effects on the integrity of Lough Corrib cSAC (see Table B.5).

As the Yellow2 Route Option is down-gradient of both of the spring sites and does not have any tunnel elements to the design, it is not likely to have any significant effects on the Coolagh Lakes in this regard.

Reduction in Water Quality

As the Yellow2, Blue2 and Pink2 Route Options are within the catchment of the Coolagh Lakes (Figure 4.6.2) during construction, contaminated surface water runoff and/or an accidental spillage or pollution event affecting any surface water feature/drainage feature has the potential to have a significant negative impact on water quality.

It is considered unlikely that a pollution event of such a magnitude would occur during construction, or be any more than temporary in nature. Nevertheless, a precautionary approach is being taken in assuming a level of risk of water quality impacts during construction and a mitigation strategy would be required to minimise the risk of the route options having any perceptible effect on water quality. With such a strategy in place (as outlined in **Section 2.4**), there are not likely to be any significant effects on water quality in the Coolagh Lakes during construction.

There will be outfall points to surface water features from the road drainage network during operation for all route options. In the absence of a detailed drainage design, for the purposes of this assessment it is assumed that some element of the road drainage would discharge to surface water/drainage features that drain to the Coolagh Lakes. However, given the drainage design as described in **Section 2.2** (which includes attenuation and pollution control measures) it is extremely unlikely that the normal operating water quality of the drainage outfalls, even in the unlikely event of a pollution incident, would have any perceptible impact on water quality in receiving watercourses or waterbodies. Similarly, in the event of a flood, particularly given the increased dilution factor and flow rates associated with such events, the predicted impact on water quality would also likely be imperceptible. Therefore, there are not likely to be any significant effects on water quality in the Coolagh Lakes during operation.

Therefore the route options are not likely to affect the conservation condition/conservation objectives of this habitat type as a result of a reduction in water quality and therefore, would not affect the integrity of Lough Corrib cSAC.

Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]

This habitat type was not present in Lough Corrib cSAC within the ZoI of any of the proposed route options.

Therefore with respect to this QI Annex I habitat type, there is no impact pathway by which the proposed route options would result in any adverse effects on the integrity of the cSAC, in view of the site's conservation objectives.

Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites) [6210]

This habitat type was recorded throughout Lough Corrib cSAC but is only within the ZoI of route options at two locations: where the Yellow2 Route Option passes to the north of the Coolagh Lakes, and above the tunnel associated with the Blue2 and Pink2 Route Options as they exit Lackagh Quarry to the west. In both locations it occurs in a mosaic with Limestone pavement. There is potential for the Yellow2 Route Option to affect this habitat type within the cSAC as a result of shading from the viaduct deck structure. There is potential for the Blue2 and Pink2 Route Options to affect this habitat type outside the cSAC as a result of impacts to the structure of the Limestone pavement supporting the Calcareous grassland on the surface above the tunnel works.

Shading

This habitat polygon covered an area of c.0.26Ha and was described as a mosaic of Limestone pavement and Calcareous grassland (*8240/6210) comprised of scrub (WS1), calcareous grassland (GS1), and exposed calcareous rock (ER2); percentage cover of each habitat within that mosaic was 45%, 35% and 20% respectively. The area of Calcareous grassland corresponded with the vegetation community type GS1_3a (as described in O'Neill *et al*., 2013).

Table A below, lists the plant species recorded at the relevé surveyed in the Calcareous grassland in question (see Barron *et al.*, 2014) and their relative percentage cover in the sward, highlighting those species which are considered high quality positive/positive indicator species for this Annex I habitat type.

Table A: Positive plant indicator species for Calcareous grassland [6210], after O'Neill et al. (2013), recorded in the affected habitat polygon (Barron *et al.*, 2014) and their relative abundance in the sward. High quality positive indicator species are in bold red font.

Species	%
Sesleria caerulea	45
Ctenidium molluscum	7
Lotus corniculatus	5
Thymus polytrichus	5
Carlina vulgaris	2
Briza media	1
Pilosella officinarum	1
Carex flacca	0.5

Bunce *et al.* (1999), presents Ellenberg indicator values[13] for British and Irish vascular plant species – these are values which indicate the environmental conditions that would be expected if a given plant species is present (e.g. light or shade loving species, indicator of dry/wet conditions). For seven of the eight indicator species present, the light indicator values recorded are as follows[14]: *Carlina vulgaris* (8), *Briza media* (8), *Sesleria caerulea* (7), *Lotus corniculatus* (7), *Thymus polytrichus* (8), *Pilosella officinarum* (8), and *Carex flacca* (7). The majority of the other species present in the sward also have values of seven or eight on the light indicator scale. Values of eight indicate "a light loving plant rarely found where relative illumination in summer is less than 40%" and values of 7 "plant generally in well-lit places, but also occurring in partial shade". Therefore, it is reasonable to conclude that any significant reduction in light levels as a result of bridge shading would affect the habitat in an adverse way; particularly given that one of the "light loving" plant species, *Sesleria caerulea*, made up 45% of the vegetation community composition.

Broome *et al.* (2005) carried out research as to the effects of shading from bridge structures on estuarine marsh vegetation in North Carolina, U.S.A. The results of this study found a significant correlation between light levels under bridges and the height to width ratio (HW ratio) of the structure, and concluded that those bridges with a HW ratio of <0.5 significantly affected plant growth and productivity underneath. HW ratios of between 0.5 and 0.68 resulted in measurable effects but with a reduced significance. Complete loss of vegetation was noted at a single bridge with a HW ratio of 0.28.

For the Yellow2 Route Option, the current viaduct design has a HW ratio of 0.14 (height of 3.5m and deck width of 25m); with a deck height of 10m the HW ratio would be 0.4. The results of a shading study carried out on sections of the Green2 and Blue2 Route Options[15] found that with the

[13] Ellenberg values are derived from data on a restricted range of habitats (and may not hold true over a species full range) and are only intended to give an indication of the environmental conditions present, on what is an arbitrary scale

[14] As the Ellenberg indicator values apply to vascular plant species only, the moss species *Ctenidium molluscum* is not included.

[15] The modelling methodology and assumptions are as follows –
A series of computer simulations have been carried out in order to calculate the effect of the proposed construction on solar exposure for the adjacent land. The computer simulations are based on a 3d computer

bridge at a height of c.3.5m, and with a deck width of *c*.25m, there would be a significant reduction in ambient light levels during the summer months; reduced from >12 to an equivalent of <4 hours of sunlight. This would indicate that there would certainly be significant effects on the vegetation composition as a result of shading and consequently on some of the conservation objective attributes and targets that support the conservation condition of calcareous grassland in Lough Corrib cSAC and therefore, would adversely affect the integrity of this European site (see Table B.6).

There are a number of factors and limitations to consider in interpreting the findings of the North Carolina (NC) study with regard to the impacts of a bridge over the Lough Corrib cSAC: the NC study assessed the impacts on estuarine wetlands, a very different habitat type to the calcareous grassland habitat in question in Galway; due to the significant difference in latitude between both locations (in the region of 18°) the effects of shading would be expected to be different; and, the small sample size of the NC study. However, based on the evidence put forward in that study, and adopting the precautionary principle, it is considered that the conclusions reached in this report in relation to the potential shading impacts of the Yellow2 Route Option viaduct over the area of Calcareous grassland are reasonable.

Other potential impacts to consider in relation to the Calcareous grassland underneath the proposed bridge structure are a reduction in direct precipitation and, assuming that the area underneath the bridge would be fenced off, the effect of removing any existing influence of grazing on the vegetation sward. Both of these impact pathways could also result in significant effects on the vegetation composition and consequently on the conservation objective for this habitat in the Lough Corrib cSAC.

Effects of Tunnelling on the Structure of the Calcareous Grassland Habitats at Surface Level.

The fractured nature of karst limestone does pose some level of risk of subsidence at the surface as a result of tunnelling works associated with the Blue2 and Pink2 Route Options beneath the Limestone pavement/Calcareous grassland at Lackagh Quarry. However, given the tunnelling methodology proposed (see Sections 2.3.4.2 and 2.3.5.2) the magnitude of any such impact would be extremely low and it can be confidently predicted that any subsidence would not manifest itself at the surface as any perceptible change to the structure or this area of Calcareous grassland. Therefore the tunnel construction is not likely to affect the conservation condition/conservation objectives of this habitat type and therefore, would not affect the integrity of Lough Corrib cSAC.

<u>*Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) [6410]</u>

This habitat type is present in Lough Corrib cSAC within scheme study area but is outside of the footprint of any of the route options and would not be directly impacted.

Where it is present in Lough Corrib cSAC within the scheme study area, the locations are sufficiently far removed from the route options that they are not at risk of indirect impacts during construction or operation.

Therefore with respect to this QI Annex I habitat type, there is no impact pathway by which the proposed route options would result in any adverse effects on the integrity of the cSAC, in view of the site's conservation objectives.

<u>Active raised bogs * [7110]</u>

This habitat type was not present in Lough Corrib cSAC within the ZoI of any of the proposed route options.

model for the proposed construction and associated design options. The sunlight exposure is calculated by ray racing and the software use is Radiance. Points on the ground can either receive or not direct sunlight. The cumulative number of hours that a point can see direct sunlight is used as the measure of solar exposure. Solar exposure has been calculated for equinoxes and solstices. The latitude and longitude used to determine the solar geometry are: 53.3°N and 9°W. The information is presented on a sample series of falsecolor diagrams in Appendix C1 that show the distribution of solar exposure on the ground for a section of the Green2 Route Option (in the vicinity of the proposed River Corrib crossing) and a section of the Blue2 Route Option viaduct at Coolagh. The colour scale indicate the number of hours that sunlight is received at a given point, throughout the day considered.

Therefore with respect to this QI Annex I habitat type, there is no impact pathway by which the proposed route options would result in any adverse effects on the integrity of the cSAC, in view of the site's conservation objectives.

Degraded raised bogs still capable of natural regeneration [7120]

This habitat type was not present in Lough Corrib cSAC within the ZoI of any of the proposed route options.

Therefore with respect to this QI Annex I habitat type, there is no impact pathway by which the proposed route options would result in any adverse effects on the integrity of the cSAC, in view of the site's conservation objectives.

Depressions on peat substrates of the *Rhynchosporion* [7150]

This habitat type was not present in Lough Corrib cSAC within the ZoI of any of the proposed route options.

Therefore with respect to this QI Annex I habitat type, there is no impact pathway by which the proposed route options would result in any adverse effects on the integrity of the cSAC, in view of the site's conservation objectives.

Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* * [7210]

There were extensive areas of this habitat type recorded in Lough Corrib cSAC around the margins of the Coolagh Lakes. This habitat type is within the ZoI of the Yellow2, Blue2 and Pink2 Route Options and these route options could affect the Coolagh Lakes as a result of direct impacts to the existing hydrogeological regime, shading of vegetation underneath the viaduct structure associated with the Yellow2 Route Option and/or a reduction in water quality during construction or operation.

Hydrogeology

As discussed above under Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. [3140], the tunnel associated with the Blue2 and Pink2 Route Options could significantly affect some of the conservation objective attributes and targets that support the conservation condition of this Annex I habitat in Lough Corrib cSAC (see Table B.8) and therefore, result in adverse effects on the integrity of this European site. However, given what is currently known about the movement of groundwater in this area, particularly in relation to interactions with water levels in the Coolagh Lakes, the risk of the tunnel affecting the existing hydrogeological regime is as low as reasonably practical by the application of modern tunnelling techniques and construction controls. Based upon these appropriate engineering tunnelling techniques and construction controls, the tunnel is unlikely to result in any significant long-term effects to the functioning of the existing hydrological regime that supports this habitat type within Lough Corrib cSAC, or adversely affect the integrity of the cSAC.

As the Yellow2 Route Option is down-gradient of both of the spring sites and does not have any tunnel elements to the design, it is not likely to have any significant effects on the Coolagh Lakes in this regard.

Reduction in Water Quality

As discussed above under Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. [3140], with the mitigation measures outlined in Section 2.4 implemented and given the drainage design described in **Section 2.3** (which includes attenuation and pollution control measures), the route options are not likely to affect the conservation condition/conservation objectives of this habitat type as a result of a reduction in water quality during construction or operation and therefore, would not affect the integrity of Lough Corrib cSAC.

Shading

The viaduct associated with the Yellow2 Route Option passes over an area of c. 0.27Ha of this habitat type on the northern shore of the lakes. This habitat polygon was described as reed swamp (FS1) and corresponding with the vegetation community FS1_*7210 described in Barron *et al.*, 2014.

Five plant species were recorded in this habitat polygon (Barron *et al.*, 2014) with their relative percentage cover in parenthesis: *Cladium mariscus* (7%), *Menyanthes trifoliata* (4%), *Phragmites australis* (3%), *Carex lasiocarpa* (3%), and *Carex viridula s. brachyrrhyncha* (1%).

The Ellenberg indicator values for these plant species are as follows: *Cladium mariscus* (8), *Menyanthes trifoliata* (8), *Phragmites australis* (7), *Carex lasiocarpa* (8), and *Carex viridula s. brachyrrhyncha* (8+). Values of eight indicate "a light loving plant rarely found where relative illumination in summer is less than 40%" and values of 7 "plant generally in well-lit places, but also occurring in partial shade". Therefore, it would be reasonable to conclude that any significant reduction in light levels as a result of bridge shading would affect the habitat in an adverse way.

As discussed under Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites) [6210], bridges with a height width ratio of <0.5 are likely to significantly affected plant growth and productivity underneath with HW ratios between 0.5 and 0.68 likely to result in measurable effects but with a reduced significance.

For the Yellow2 Route Option, the current viaduct design has a HW ratio of 0.14 (height of 3.5m and deck width of 25m); with a deck height of 10m the HW ratio would be 0.4. The results of the shading study carried out for the bridge crossings over the River Corrib (see Appendix C1) found that with the bridge at a height of 3.5m, and with a deck width of *c*.25m, there would be a significant reduction in ambient light levels during the summer months; reduced from >12 to an equivalent of <4 hours of sunlight. This would indicate that there would certainly be significant effects on the vegetation composition as a result of shading and consequently on some of the conservation objective attributes and targets that support the conservation condition of calcareous grassland in Lough Corrib cSAC and therefore, would adversely affect the integrity of this European site (see Table B.7).

Petrifying springs with tufa formation (*Cratoneurion*) * [7220]

This habitat type was not present in Lough Corrib cSAC within the ZoI of any of the proposed route options.

Therefore, with respect to this QI Annex I habitat type there is no impact pathway by which the proposed route options would result in any adverse effects on the integrity of the cSAC in view of the site's conservation objectives.

Alkaline fens [7230]

The Green2 Route Option is the only route option which has the potential to impact on Alkaline fen within Lough Corrib cSAC; on the west bank of the River Corrib at the proposed bridge crossing point (c.725m^2), and potentially on the east bank where there is an area of fen (c.1130m^2) to the north of the approach to the proposed River Corrib bridge on the Green2 Route Option.

Although the bridge structure is on piers on the west bank, and all of the pier sites avoid any direct impacts on the Alkaline fen, there are two impact pathways by which the bridge structure could result in direct effects: construction of the piers adjacent to the fen could affect the existing groundwater regime and water quality that supports the fen vegetation, and the shading effect associated with the bridge deck could affect the vegetation beneath. Construction of the embankment and bridge abutment on the east bank also has the potential to affect the existing groundwater regime and water quality that supports the fen vegetation, given its close proximity.

Construction works

In relation to construction works on the west bank, there is a high risk that both the excavation/installation of the supporting piers and the compaction of soils could lead to some level of adverse effect to the existing hydrological regime, water quality (if even only at a local scale), and the vegetation structure and composition. It is not possible to accurately qualify or quantify the magnitude of such effects to the fen vegetation in the absence of detailed hydrogeological/hydrological baseline data. However, based on the precautionary principle and considering the difficulties that would be expected in trying to construct a bridge in a wetland peat based habitat, some of the conservation objective attributes and targets that support the conservation condition of Alkaline fen in Lough Corrib cSAC are likely to be significantly affected and therefore, result in adverse effects on the integrity of this European site (see Table B.8).

On the east bank, there is also the risk that construction would affect the existing hydrological regime and water quality in the fen.

Shading

This area of fen was described as a mosaic of fen (PF1), wet grassland (GS4), and dry calcareous and neutral grassland (GS1); percentage cover of each habitat within that mosaic was 96.5%, 3% and 0.5% respectively. The area of fen corresponded with the Alkaline fen rich fen flush community

RFLU1a (as described in Perrin *et al*., 2013); although it was noted in the relevé data recorded that it was a poor example of that habitat type at this location.

Table B below, lists the plant species recorded at the relevés surveyed in Lough Corrib cSAC (Barron *et al.*, 2014) and their relative percentage cover in the sward, highlighting those species which are considered positive indicator species for this Annex I habitat type.

Table B: Positive plant indicator species for Alkaline fen [7230], after Perrin *et al.* (2014), and their relative abundance in the sward.

Species	%
Carex viridula	30
Carex panicea	25
Anagallis tenella	7
Juncus bulbosus	1
Fissidens adianthoides	0.1

The Ellenberg indicator values for four of the five indicator species present, are as follows[16]: *Carex viridula* (8+), *Carex panicea* (8), *Juncus bulbosus* (7), and *Anagallis tenella* (8). The majority of the other species present in the sward also have values of seven or eight on the light indicator scale. Values of eight indicate "a light loving plant rarely found where relative illumination in summer is less than 40%" and values of 7 "plant generally in well-lit places, but also occurring in partial shade". Therefore, it is reasonable to conclude that any significant reduction in light levels as a result of bridge shading would affect the habitat in an adverse way.

As discussed under Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites) [6210], bridges with a HW ratio of <0.5 are likely to significantly affect plant growth and productivity underneath with HW ratios between 0.5 and 0.68 likely to result in measurable effects but with a reduced significance.

For the Green2 Route Option, the current bridge design has a HW ratio of 0.14 (height of 3.5m and deck width of 25m); with a deck height of 10m the HW ratio would be 0.4. The results of the shading study carried out (see Appendix C1) found that with the bridge at a height of 3.5m, and with a deck width of *c*.25m, there would be a significant reduction in ambient light levels during the summer months; reduced from >12 to an equivalent of <4 hours of sunlight. This would indicate that there would certainly be significant effects on the vegetation composition as a result of shading and consequently on some of the conservation objective attributes and targets that support the conservation condition of Alkaline fen in Lough Corrib cSAC and therefore, adversely affect the integrity of this European site (see Table B.8).

Other potential impacts to consider in relation to the Alkaline fen underneath the proposed bridge structure are a reduction in direct precipitation and, assuming that the area underneath the bridge would be fenced off, the effect of removing the existing influence of grazing on the vegetation sward. Both of these impact pathways could also result in significant effects on the vegetation composition and consequently on the conservation objective for this habitat in the Lough Corrib cSAC.

Limestone pavements * [8240]

This habitat type was recorded throughout Lough Corrib cSAC but is only within the ZoI of route options at two locations: where the Yellow2 Route Option passes to the north of the Coolagh Lakes, and above the tunnel associated with the Blue2 and Pink2 Route Options as they exit Lackagh Quarry to the west. The Yellow2 Route Option could affect this habitat type as a result of shading from the viaduct deck structure and the Blue2 and Pink2 Route Options as a result of impacts to the structure of the Limestone pavement supporting the Calcareous grassland on the surface above the tunnel works.

[16] As the Ellenberg indicator values apply to vascular plant species only, the moss species *Fissidens adianthoides* is not included.

Shading

This area of Limestone pavement (c. 0.6Ha) was described as a mosaic of calcareous grassland (GS1), Exposed calcareous rock (ER2), scrub (WS1) and hazel woodland (WN2), corresponding with the wooded and exposed Annex I Limestone pavement habitat types (as described in Wilson & Fernández, 2013). Table C below, lists the indicator plant species recorded at the two relevés surveyed at this location in 2014 (Barron *et al.*, 2014) and their relative percentage cover in the sward.

Table C: Positive indicator plant species for Limestone pavement [*8240], after Wilson & Fernández (2014), and their relative abundance

Exposed Limestone Pavement		**Wooded Limestone Pavement**			
Species	**%**	**Species**	**%**	**Species**	**%**
Hedera helix	70	*Corylus avellana*	30	*Fragaria vesca*	0.1
Neckera crispa	15	*Hedera helix*	25	*Fraxinus excelsior*	0.1
Ctenidium molluscum	15	*Ctenidium molluscum*	20	*Ilex aquifolium*	0.1
Sesleria caerulea	7	*Rubus fruticosus agg.*	10	*Neckera complanata*	0.1
Phyllitis scolopendrium	1	*Sesleria caerulea*	10	*Potentilla sterilis*	0.1
Rosa spinosissima	0.3	*Neckera crispa*	7		
Geranium robertianum	0.1	*Tortella tortuosa*	5		
Fissidens dubius	0.1	*Lonicera periclymenum*	3		
Asplenium trichomanes	0.1	*Geranium robertianum*	0.3		

The Ellenberg indicator values for the majority of these species are between 4 and 6, indicating semi-shade plant species. Therefore, it is reasonable to conclude that any reduction in light levels as a result of bridge shading would need to be significant to affect the habitat in an adverse way.

As discussed under Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites) [6210], bridges with a HW ratio of <0.5 are likely to significantly affected plant growth and productivity underneath with HW ratios between 0.5 and 0.68 likely to result in measurable effects but with a reduced significance.

For the Yellow2 Route Option, the current bridge design has a HW ratio of 0.14 (height of 3.5m and deck width of 25m); with a deck height of 10m the HW ratio would be 0.4. The results of the shading study carried out (see Appendix C1) found that with the bridge at a height of 3.5m, and with a deck width of *c*.25m, there would be a significant reduction in ambient light levels during the summer months; reduced from >12 to an equivalent of <4 hours of sunlight. This would indicate that there would certainly be significant effects on the vegetation composition as a result of shading and consequently on some of the conservation objective attributes and targets that support the conservation condition of Limestone pavement in Lough Corrib cSAC and therefore, adversely affect the integrity of this European site (see Table B.9).

Other potential impacts to consider in relation to the Limestone underneath the proposed bridge structure are a reduction in direct precipitation and, assuming that the area underneath the bridge would be fenced off, the effect of removing the existing influence of grazing on the vegetation sward. Both of these impact pathways could also result in significant effects on the vegetation

composition and consequently on the conservation objective for this habitat in the Lough Corrib cSAC.

Effects of Tunnelling on the Structure of Limestone pavement habitat at Surface Level.

The area of Limestone pavement above the Blue2/Pink2 tunnel (c. 0.4Ha) comprises a mosaic of calcareous grassland (GS1), Exposed calcareous rock (ER2), scrub (WS1) and hazel woodland (WN2). The fractured nature of karst limestone does pose some level of risk of subsidence at the surface as a result of tunnelling works associated with the Blue2 and Pink2 Route Options beneath the Limestone pavement. However, given the tunnelling methodology proposed (see Sections 2.3.4.2 and 2.3.5.2) the magnitude of any such impact would be extremely low and it can be confidently predicted that any subsidence would not manifest itself at the surface as any perceptible change to the structure or functioning of this area of Limestone pavement. Therefore the tunnel construction is not likely to affect the conservation condition/conservation objectives of this habitat type and therefore, would not affect the integrity of Lough Corrib cSAC.

Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0]

This habitat type was not present in Lough Corrib cSAC within the ZoI of any of the proposed route options.

Therefore with respect to this QI Annex I habitat type, there is no impact pathway by which the proposed route options would result in any adverse effects on the integrity of the cSAC, in view of the site's conservation objectives.

Bog woodland * [91D0]

This habitat type was not present in Lough Corrib cSAC within the ZoI of any of the proposed route options.

Therefore with respect to this QI Annex I habitat type, there is no impact pathway by which the proposed route options would result in any adverse effects on the integrity of the cSAC, in view of the site's conservation objectives.

Freshwater pearl mussel - *Margaritifera margaritifera* [1029]

Although there are no Freshwater pearl mussel populations present within the Lough Corrib cSAC within the ZoI of the route options, there are records of populations in the upper part of the catchment. The Freshwater pearl mussel would not be affected in any way by the route options as a result of habitat loss or habitat degradation as those populations are upstream of all of the route options. There is however, a pathway by which the proposed route options could have indirect impacts on this species within the River Corrib catchment by virtue of the fact that the larval stage of the mussels life-cycle relies upon salmonid fish as a host species; any potential adverse effects on salmonid fish species could therefore potentially affect Freshwater pearl mussel recruitment in the catchment.

The potential for impacts to Atlantic salmon (and by association any other host salmonid fish species) are discussed under the heading of Atlantic salmon and Lamprey species and none of these impact sources would result in adverse effects to Atlantic salmon (or by inference, any other salmonid fish species) and therefore, would not result in adverse effects on the integrity of the cSAC, in view of the site's conservation objectives for this QI Annex II species.

White-clawed crayfish - *Austropotamobius pallipes* [1092]

This Annex II species was not present in Lough Corrib cSAC within the ZoI of any of the proposed route options.

Therefore, there is no impact pathway by which the proposed route options would result in any adverse effects on the integrity of the cSAC with respect to this QI Annex II species.

Atlantic salmon - *Salmo salar* (only in fresh water) [1106]

Sea lamprey - *Petromyzon marinus* [1095]

Brook lamprey - *Lampetra planeri* [1096]

Based on the findings of the desk review and consultations with Inland Fisheries Ireland (IFI) at the time of writing, Atlantic salmon, Sea lamprey, and Brook lamprey are known to be present in the River Corrib within the ZoI of all of the route options.

Atlantic salmon and lamprey species are considered together as the potential for the proposed route options to affect these species relates to the same factors: habitat loss, habitat degradation, the risk of a reduction in water quality, and the risk of a barrier effect associated with the installation of bridges and other structures on watercourses. There is the potential for those route options which bridge the River Corrib valley (the Red2, Yellow2, Blue2, Pink2 and Green2 Route Options) to affect the existing hydrological regime and floodplain connectivity. However, as this issue can be readily mitigated by introducing additional flood relief culverts into the supporting structure or embankment, there is not likely to be any adverse effects to site integrity in this regard.

Habitat loss/habitat degradation

All of the route options, bar the Red2 and Orange2 tunnel Route Options, use a clear span bridge design to cross the River Corrib, avoiding any loss of river substrate habitat that would affect fish species. In tunnelling underneath the river, the Orange2 Route Option also avoids this potential impact. The Red2 Route Option would require the construction of two piers within the river channel. This would result in the loss of an area of river substrate habitat, requiring the installation of a temporary platform out from each bank to allow access to the pier sites – and also likely to result in some level of temporary habitat degradation in the immediate vicinity. The loss of habitat associated with the piers themselves would not affect the site's conservation objectives/ conservation condition of these species[17], neither would the temporary impact associated with the construction methodology, and therefore would not result in adverse effects on the integrity of the site in this regard.

Aquatic habitat degradation could also result from significant/prolonged pollution and/or siltation events during construction and operation. Although significant effects on Atlantic salmon or lamprey species in this regard are unlikely during operation, there is a risk of pollution events occurring during construction; this is discussed in more detail below under *Reduction in Water Quality.*

The removal/management of bankside riparian vegetation that may be associated with the construction of bridge structures would not affect the site's conservation objectives or result in any adverse effects on site integrity with regard to Atlantic salmon or lamprey species.

Disturbance to fish species during construction

Increased human presence, and noise and vibration associated with the construction works (including the installation of any temporary piles required to construct bridge abutments) could result in the displacement of fish species from the area. Given the absence of any in-stream works associated with the Blue2/Pink2/Green2/Yellow2 Route Options, the temporary nature of any vibration associated with the pile driving, and the short-term nature of general construction works (which if carried out during normal working hours, would be of a limited duration each day), significant disturbance/displacement effects would not be expected.

There would also be some level of vibration impact associated with the Orange2 Route Option's tunnel underneath the River Corrib. The magnitude of any effects would be dependent on the tunnel construction methodology and depth under the river bed. However, it would not be expected to result in any significant disturbance/displacement effects to fish species.

The instream works associated with the Red2 Route Option are likely to result in some level of disturbance to fish species in the river, which could potentially be significant if undertaken at the time that salmon are moving upstream from the coast to spawning grounds further up in the catchment. If works were restricted to outside of this period (i.e. between the months of May and September) the likelihood of the works having any significant effects in this regard would be avoided.

Therefore, disturbance to fish species would not affect the site's conservation objectives/ conservation condition of these species, or result in adverse effects on the integrity of Lough Corrib cSAC.

Reduction in Water Quality

[17] In the absence of site specific conservation objectives for Lough Corrib cSAC, and based on such documents available for other European sites, the conservation objectives relating to fish species are likely to be as follows: accessibility of the river channel to fish, number of adult spawning fish/salmon fry/smolts, number/extent and distribution of spawning habitat, water quality, population structure and density (in suitable habitat) of juvenile lamprey, and availability of juvenile lamprey habitat.

During construction, contaminated surface water runoff and/or an accidental spillage or pollution event affecting any surface water feature has the potential to have a significant negative impact on water quality and may consequently impact on the fish species present downstream – a significant reduction in water quality can cause stress and/or mortality in adult and juvenile fish. The effects of frequent and/or prolonged siltation or pollution events in a river system have the potential to be extensive and far-reaching and can have long lasting effects; e.g. prolonged siltation events can damage spawning habitat present downstream by clogging up the interstitial spaces in the gravel beds.

It is considered unlikely that a pollution event of such a magnitude would occur during construction, or be any more than temporary in nature, and given that the route options are within the lower reaches of the catchment in an area where the river substrate is muds and silts, is unlikely to have far-reaching effects within the River Corrib catchment, particularly in relation to siltation. Nevertheless, a precautionary approach is being taken in assuming a level of risk of water quality impacts during construction and a mitigation strategy would be required to minimise the risk of the route options having any perceptible effect on water quality. With such a strategy in place (as outlined in **Section 2.4**), there are not likely to be any significant effects on fish species as a result of a reduction in water quality during construction.

There will be outfall points to surface water features from the road drainage network during operation for all route options. However, given the drainage design as described in **Section 2.3** (which includes attenuation and pollution control measures) it is extremely unlikely that the normal operating water quality of the drainage outfalls, even in the unlikely event of a pollution incident, would have any perceptible impact on water quality in receiving watercourses. Similarly, in the event of a flood, particularly given the increased dilution factor and flow rates associated with such events, the predicted impact on water quality would also likely be imperceptible and not likely to result in any significant effects on fish species as a result of a reduction in water quality during operation.

Therefore, any effects on water quality would not affect the site's conservation objectives/ conservation condition of these species, or result in adverse effects on the integrity of Lough Corrib cSAC.

Barrier Effect

The use of a clear span bridge design over the River Corrib for the Yellow2, Blue2, Pink2 and Green2 Route Options, or a tunnel under it as with the Orange2 Route Option, avoids the potential for any barrier effect to fish passage during construction or operation. Although the same applies in relation to the Red2 Route Option during operation but during construction the construction methodology proposed would create a temporary barrier across a part of the river channel during construction. Provided that a sufficient proportion of the channel cross section remained passible by fish species during the construction period, fish passage would not be inhibited to a degree that would significantly barrier effect in the River Corrib.

Therefore, the route options are not likely to result in a barrier effect to fish species and would not affect the site's conservation objectives/ conservation condition, or result in adverse effects on the integrity of Lough Corrib cSAC in this regard.

Lesser horseshoe bat - *Rhinolophus hipposideros*$^{+}$ [1303]

Although the Lesser horseshoe bat was present within the scheme study area, the roost that forms the QI population for this European site (Eberhall House) is more than 30km away from the nearest route option, on the northern shore of Lough Corrib. This distance would be regarded to be beyond the normal core foraging range of the Eberhall House population and beyond the normal commuting range of this species except on exceptional occasions or over long periods of time – for example, bats dispersing and moving between areas in the wider landscape over a period of many years/generations. Furthermore, radio-tracking surveys of the Menlough population of bats (which were identified within the scheme study area) undertaken for this project in 2014 and 2015 did not suggest any evidence of movement between that population and the Eberhall House roost.

Given the lack of a significant linkage between the scheme study area and the roosts that are the reason for designation of this European site, it is reasonable to rule out any likely significant effects on the cSAC's Lesser horseshoe bat population. Therefore, none of the route options would result in adverse effects on the integrity of the cSAC, in view of the sites conservation objectives for this QI Annex II species.

Otter - *Lutra lutra* [+] [1355]

Based on the findings of the surveys undertaken in 2014 and 2015 within the Lough Corrib cSAC, Otter are present along the entire stretch of the River Corrib (including the Coolagh lakes) within the scheme study area, regularly using the River Corrib Corridor in the vicinity of all route options. With all route options either crossing the River Corrib (as is the case for the Red2, Yellow2, Blue2, Pink2 and Green2 Route Options) and/or having drainage outfalls which will discharge to the river, Otter could potentially be subject to significant impacts as a result of the following impact pathways:

Disturbance to breeding or resting places during construction

Based on the distance bands outlined in the National Roads Authority's *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes* (National Roads Authority, 2008) the ZoI for construction disturbance affecting Otter holts/couches is a distance of 20m for holts or couches generally, increasing to 150m for any breeding holt sites.

There were no confirmed or active Otter breeding or resting places directly impacted by any of the route options. There is only one couch site (Otter resting place) within close proximity to any route option – on Jordan's Island, 50m from the existing Quincentenary Bridge which is the proposed crossing point for the Red2 Route Option (the proposed new bridge would be on the southern side of the existing structure). At this distance it would not be expected to be negatively affected by construction works associated with the Red2 Route Option.

Disturbance to Otter breeding or resting places during construction would not affect the site's conservation objectives/ conservation condition of this species[18] or result in adverse effects on the integrity of Lough Corrib cSAC.

Disturbance to Otter during construction or operation

Any disturbance due to increased human presence, and noise and vibration associated with the construction works (including the installation of the temporary piles required to construct the bridge abutments in isolation from the river (either on the river bank or in the river channel as the case in relation to the Red2 Route Option) is unlikely to result in any significant disturbance/displacement of Otter from watercourses crossed by the proposed development as; the species is generally nocturnal in habit and therefore, would not be affected by works during normal daylight working hours; and, Otter are known to tolerate human disturbance under certain circumstances (Bailey & Rochford, 2006, The Environment Agency, 2010, Irish Wildlife Trust, 2012, and also as evidence by the presence of Otter signs along the River Corrib in the vicinity of the NUI Galway Recreational Facilities) and would be expected to habituate to any construction disturbance.

Similarly, Otter would not be adversely affected by disturbance during operation given that, based on the findings of the Otter surveys carried out in 2014/15, they are currently using habitat in the vicinity of the NUI Galway Campus and the existing Quincentenary Bridge.

Disturbance to Otter breeding or resting places during operation would not affect the site's conservation objectives/ conservation condition of the species, or result in adverse effects on the integrity of Lough Corrib cSAC.

Habitat loss/loss of breeding or resting places and habitat severance/barrier effects during construction

As there were no active and/or confirmed holts or couch sites within the ZoI of any of the proposed route options there would be no decline in the number of available holt or couch sites within the cSAC.

The use of a clear span bridge design for the Yellow2, Blue2, Pink2 and Green2 Route Options over the River Corrib, and the tunnel under the river associated with the Orange2 Route Option, would ensure that the proposed development would not result in any reduction in the extent of freshwater (river) habitat for Otter within the cSAC. There would be temporary habitat loss associated with the construction of the instream piers associated with the Red2 Route Option, and a small area of habitat loss associated with the pier sites themselves, however, neither of these

[18] In the absence of site specific conservation objectives for Lough Corrib cSAC, and based on such documents available for other European sites, the conservation objectives relating to Otter are likely to be as follows: distribution of Otter; extent of terrestrial, freshwater and marine habitat; number of couching sites and holts; amount of fish biomass available; and no increase in barriers to Otter movement.

impacts are likely to have any perceptible effect on the local Otter population or affect how they use the River Corrib corridor.

Also as a result of the construction works, it is probable that the physical disturbance to the existing landscape in constructing the watercourse crossings could result in some initial severance along watercourses used by Otter caused by the displacement effects of construction activities on the river banks – and in the case of the Red2 Route Option, within the river channel. However Otter would be expected to habituate to the modified landscape quite quickly.

Habitat/loss, habitat severance or barrier effects during construction would not affect the site's conservation objectives/ conservation condition of the species, or result in adverse effects on the integrity of Lough Corrib cSAC.

Habitat severance/barrier effect during operation

The clear span bridge designs over the River Corrib associated with the Red2, Yellow2, Blue2, Pink2 and Green2 Route options, and the tunnel under the river associated with the Orange2 Route Option, would ensure that there is no physical severance along this river corridor during operation.

In the context of river systems, the Threat Response Plan Otter *Lutra lutra* 2009-2011 document (Department of the Environment, Heritage and the Gaeltacht, 2011) defines Otter habitat as a 10m zone of riparian habitat along the river banks. By tunnelling underneath the river the Orange2 Route Option would avoid this impact. The bankside piers associated with the Red2, Yellow2, Blue2, Pink2 and Green2 Route Options are set back so as to maintain this zone. However, some vegetation cutting/removal would likely be required to facilitate the construction works and on an ongoing basis to avoid any impact to the proposed road infrastructure during operation, and some effects to any remaining vegetation underneath the bridge structure would be expected as a result of shading. This type of change to any terrestrial Otter habitat within the cSAC is not considered to be significant, even in a case where it could be partially converted to hard surfaces as Otter will routinely use habitat underneath bridges which is highly modified, and would not constitute a significant decline in the extent of available terrestrial Otter habitat within the European site.

Habitat severance or barrier effects during operation would not affect the site's conservation objectives/ conservation condition of the species, or result in adverse effects on the integrity of Lough Corrib cSAC.

Reduction in Water Quality

During construction, contaminated surface water runoff and/or an accidental spillage or pollution event into any surface water feature has the potential to have a significant negative impact on water quality and consequently an impact on Otter; either directly (e.g. acute or sub-lethal toxicity from pollutants) or indirectly (e.g. affecting their food supply or supporting habitats). The effects of frequent and/or prolonged pollution events in a river system have the potential to be extensive and far-reaching and could potentially have significant long-term effects.

However, it is considered unlikely that a pollution event of such a magnitude would occur during construction, or be any more than temporary in nature, and given that the proposed development is within the lower reaches of the catchment, is unlikely to have far-reaching effects within the River Corrib system. Nevertheless, a precautionary approach is being taken in assuming a level of risk of water quality impacts and detailed mitigation measures would need to be proposed to further minimise the risk of a route option having any perceptible effect on water quality during construction.

There will be outfall points to surface water features from the road drainage network during operation. However, given the drainage design as described in **Section 2.3** (which includes attenuation and pollution control measures) it is extremely unlikely that the normal operating water quality of the drainage outfalls, even in the unlikely event of a pollution incident, would have any perceptible impact on water quality in receiving watercourses.

With a comprehensive mitigation strategy in place to deal with the risk of construction impacts to water quality in receiving watercourses, it is unlikely that the proposed route options would result in any significant effects to the local Otter population as a result of a reduction in water quality in receiving watercourses during construction or operation.

Any effects on water quality would not affect the site's conservation objectives/ conservation condition of the species, or result in adverse effects on the integrity of Lough Corrib cSAC.

Road Traffic Collisions

The introduction of new bridges and structures along watercourses crossed by the route options could increase the risk of road traffic collisions with Otter. This risk would be reduced for the Red2, Yellow2, Blue2, Pink2 and Green2 Route Options River Corrib crossings given that they are elevated structures on piers within the 10m riparian zone defined as Otter habitat (Department of the Environment, Heritage and the Gaeltacht, 2011); this risk is eliminated for the Orange2 Route Option as it tunnels underneath the river. Where embankments are present, Otter fencing will be installed to prevent Otter gaining access to the carriageway, redirecting them to dedicated underpass facilities sited along watercourses (National Roads Authority, 2008).

With Otter fencing in place at identified impact zones, road traffic collisions would not affect the site's conservation objectives/conservation condition of the species, or result in adverse effects on the integrity of Lough Corrib cSAC.

Light Spill

Nocturnal mammals, such as the Otter, are likely to be disturbed by the introduction of artificial light into established breeding and foraging areas (Rich & Longcore, 2005). However, lighting is not proposed at any of the proposed bridges crossing the River Corrib and there are not likely to be any effects in this regard.

Lighting associated with the route options_would not affect the site's conservation objectives/ conservation condition of the species, or result in adverse effects on the integrity of Lough Corrib cSAC.

Slender green feather-moss - *Drepanocladus* (*Hamatocaulis*) *vernicosus* [1393]

This Annex II species was not present in Lough Corrib cSAC within the ZoI of any of the proposed route options.

Therefore with respect to this QI Annex II species, there is no impact pathway by which the proposed route options would result in any adverse effects on the integrity of the cSAC, in view of the site's conservation objectives.

Slender Naiad - *Najas flexilis* [1833]

This Annex II species was not present in Lough Corrib cSAC within the ZoI of any of the proposed route options.

Therefore with respect to this QI Annex II species, there is no impact pathway by which the proposed route options would result in any adverse effects on the integrity of the cSAC, in view of the site's conservation objectives.

Table B.2: Galway Bay Complex cSAC
Qualifying Interests (QI) (*Priority Annex I habitats/$^{+}$ species also listed on Annex IV) **Are the potential effects of the route options, despite the implementation of mitigation measures, likely to be significant and adversely affect the integrity of the European site?**
Mudflats and sandflats not covered by seawater at low tide [1140] Coastal lagoons * [1150] Large shallow inlets and bays [1160] Reefs [1170] Perennial vegetation of stony banks [1220] *Salicornia* and other annuals colonising mud and sand [1310] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] Mediterranean salt meadows (*Juncetalia maritimi*) [1410] Turloughs * [3180] *Juniperus communis* formations on heaths or calcareous grasslands [5130] Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*) (*important orchid sites) [6210] Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* * [7210] Alkaline fens [7230] Otter *Lutra* [1355]$^{+}$ Harbour seal *Phoca vitulina* [1365] As none of these habitat types are directly impacted by any of the route options, the only impact pathway with the potential to significantly affect the marine, estuarine and coastal QI habitats, and the aquatic/marine habitats of Otter and the Harbour seal, is a reduction in water quality in the receiving watercourses and hence, Galway Bay. There is no impact pathway by which the route options could affect the QI terrestrial or wetland habitats Turloughs, Juniper scrub, Calcareous grassland, *Cladium* fens, and Alkaline fen. *Reduction in Water Quality* During construction, contaminated surface water runoff and/or an accidental spillage or pollution event into any surface water feature has the potential to have a significant negative impact on water quality in receiving watercourses and consequently in Galway Bay. The effects of frequent and/or prolonged pollution events in a river system have the potential to be extensive and far-reaching and could potentially have significant long-term effects. In an extreme scenario, with a pollution event of sufficient magnitude, the marine environment could also be affected. However, it is considered extremely unlikely that a pollution event of such a magnitude would occur during construction. Any pollution events that may occur would be expected to be relatively minor in comparison to the dilution factor and assimilative capacity of a coastal water body the size of Galway Bay, or to be any more than temporary in nature, and therefore is unlikely to have any perceptible or far-reaching effects within the bay. Nevertheless, a precautionary approach is being taken in assuming a level of risk of water quality impacts and detailed mitigation measures would need to be proposed to further minimise the risk of a route option having any perceptible effect on water quality during construction. There will be outfall points to surface water features from the road drainage network during operation. However, given the drainage design as described in **Section 2.3** (which includes attenuation and pollution control measures) it is extremely unlikely that the normal operating water

quality of the drainage outfalls, even in the unlikely event of a pollution incident, would have any perceptible impact on water quality in receiving watercourses.

With a mitigation strategy in place to deal with the risk of construction impacts to water quality in receiving watercourses, it is unlikely that the proposed route options would result in any significant impacts to water quality in Galway Bay during construction or operation. Therefore, the route options would not affect the site's conservation objectives/conservation condition of the habitats and species, or result in adverse effects on the integrity of Galway Bay Complex cSAC.

Table B.3: Lough Corrib SPA
Special Conservation Interests (SCIs) **Are the potential effects of the route options, despite the implementation of mitigation measures, likely to be significant and adversely affect the integrity of the European site?[19]**
Greenland white-fronted goose *Anser albifrons flavirostris* [A395] – Wintering Greenland white-fronted geese were not recorded at any of the winter bird survey sites within the scheme study area and therefore the proposed route options would not affect the species' conservation condition/site's conservation objectives for the species (maintain the numbers, distribution, and the existing population trend for this species in the SPA[20]) and would not affect the integrity of the SPA.
Gadwall *Anas strepera* [A051] – Wintering Gadwall were not recorded at any of the winter bird survey sites within the scheme study area and therefore the proposed route options would not affect the species' conservation condition/site's conservation objectives for the species (maintain the numbers, distribution, and the existing population trend for this species in the SPA) and would not affect the integrity of the SPA.
Shoveler *Anas clypeata* [A056] – Wintering Shoveler were recorded on, or flying into, only one of the winter bird survey sites in 2014/15: Ballindooley Lough (WB02). They were recorded in five of the seven survey visits in numbers ranging from 10 to 144. A flock of 144 birds is a significant number and is in excess of the SPA's baseline winter population of 88 (see Table 2.1 in National Parks and Wildlife Service, 2013). As would be expected for a diving duck species, the principle habitat used by the species in this site was the main body of the lake. The Blue2 and Pink2 Route Options pass 300m to the south of

[19] With all route options (bar the Orange2 Route Option) having a new bridge crossing the River Corrib, there is a risk of birds commuting along the river corridor colliding with the bridge structure. The risk of birds colliding with a bridge is dependent on many factors such as bridge design, visibility (bridge strikes are more likely during poor weather conditions or at night), the structure of the surrounding habitat, the bird species present, their frequency of occurrence within the impact zone (and flight height relative to the bridge structure), and their relative susceptibility to colliding with structures. Collision risk would be expected to be higher for larger, less manoeuvrable species such as geese, swans, Cormorant etc. (particularly in relation to the risk of colliding with supporting cables) however, some studies have found that passerines make up the vast majority of dead birds recovered from studies to assess collision risk with man-made structures (Kahlert *et al.*, 2005).

The bridge structures associated with the Yellow2, Blue2, Pink2 and Green2 Route Options are likely to require cable stays as part of their design, increasing the risk of bird collision over a design without. Surveys carried out in 2005/2006 as part of the Galway City Outer Bypass scheme (RPS, 2006) recorded the following SCI species flying through the proposed bridge site for that scheme over the survey period (52 surveys encompassing 104 hours of observations): Hen harrier, Coot, Black-headed gull, Common gull, and Common tern. The most frequently recorded of these were Black-headed gull, Common gull and Cormorant; Hen harrier and Coot were only recorded once, Common tern were observed crossing the bridge site on only 43 occasions and generally low over the water (<5m). Although a full assessment of bird collision risk cannot be carried out until the details of the bridge structure are known, given the number of individuals recorded (particularly in the context of the SPA populations for those species) and the crossing frequencies observed a bridge such as those proposed in the preliminary designs (Ref) would not be expected to pose a collision risk of a magnitude that it would significantly affect the numbers, distribution, or the existing population trend for these species in the SPA.

Nor would the presence of a road outside of the River Corrib corridor be expected to pose any significant collision risk to winter birds moving between the coast, Lough Corrib or any of the other winter bird survey sites at which they were recorded, particularly given that to move between sites outside of the river corridor at present birds must fly over the existing road network and urban infrastructure in Galway City.

Therefore, given that all route options are remote from the SPA the discussions below are focused on the potential for disturbance/displacement of birds from affected habitats within the N6 GCTP scheme study area.

[20] In the absence of a Conservation Objectives Supporting Document for Lough Corrib SPA, the populations trends for SCI species in the SPA are not known (current data on the species' population trend in the SPA is not currently published on the NPWS website).

the lake; the Green2 Route Option approximately 70m to the north. There is therefore s risk of disturbance associated with construction works displacing birds from this area.

In a report prepared for Humber INCA, Cutts *et al.* (2009) investigated disturbance effects on foraging and roosting waterbirds. In terms of a response to third party disturbance, a minimal effect would be expected beyond a distance of 300m. In terms of construction noise, levels below 50dB would not be expected to result in any response from foraging or roosting birds. Noise levels between 50dB and 70dB could provoke a moderate effect/level of response from birds – i.e. birds becoming alert and some behavioural changes (e.g. reduced feeding activity) – but birds would be expected to habituate to noise levels in this band. Noise levels above those levels would likely result in birds moving out of the affected zone, or leave the site altogether.

Noise levels associated with typical construction activity have been calculated in accordance with the methodology set out in BS 5228: Part 1. This standard sets out sound power levels for plant items normally encountered on construction sites, which in turn enables the prediction of noise levels at selected locations.

A variety of items of plant will be in use during the construction works. These will include breakers, excavators, dump trucks, and generators in addition to general road surfacing and levelling equipment. The key phases of works will involve ground breaking, excavation works, fill works, piling of structures, and general road works.

The following tables present calculations of indicative noise levels for typical noise sources associated with road construction works at set distances from the construction activity using the source data from BS 5228:2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1 Noise.

The calculations assume that plant items are operating for 66% of the time to obtain an LAeq,1 hour value. Noise level are presented below for the individual items of plant at specific distances in addition to a cumulative level assuming all plant items associated with the individual phases are operating simultaneously and at the same distance for any one scenario. The calculations do not take account of any screening afforded by intervening structures, construction site hoarding etc.

Site Clearance & Preparation	**Calculated $L_{Aeq,T}$ at distance from works (m)**							
	50m	100m	150m	200m	250m	300m	350m	400m
Pneumatic breaker C.1.6	67	61	58	55	53	52	50	49
Wheeled loader C2-26	63	57	54	51	49	48	46	45
Tracked excavator (loading dump truck) C1-10	69	63	60	57	55	54	52	51
Dozer C.2.10	64	58	55	52	50	49	47	46
Dump Truck (C2.30)	63	57	54	51	49	48	46	45
Combined L_{Aeq} from all works	**73**	**67**	**64**	**61**	**59**	**58**	**56**	**55**

Fill Works	**Calculated $L_{Aeq,T}$ at distance from works (m)**							
	50m	100m	150m	200m	250m	300m	350m	400m
Tracked excavator (loading dump truck) C1-10	69	63	60	57	55	54	52	51
Articulated dump truck (dumping rubble) C1-11	64	58	55	52	50	49	47	46
Wheeled loader C2-26	63	57	54	51	49	48	46	45
Dozer C.2.10	64	58	55	52	50	49	47	46
Dump Truck Tipping fill (C2.30)	63	57	54	51	49	48	46	45
Combined L_{Aeq} from all works	73	**66**	**63**	**60**	**59**	**57**	**56**	**54**

Piling Works	**Calculated $L_{Aeq,T}$ at distance from works (m)**							
	50m	100m	150m	200m	250m	300m	350m	400m
Crawler Mounted Rig (C3.22)	64	58	55	52	50	49	47	46
Tracked Excavator inserting metal cage, (C3.24)	58	52	49	46	44	43	41	40
Concrete Pump & Cement Mixer Truck (C4.24)	51	45	42	39	37	36	34	33
Diesel Generator (C4.76)	45	39	36	33	31	30	28	27
Angle Grinder (C4.93)	64	58	55	52	50	49	47	46
Combined L_{Aeq} from all works	**68**	**62**	**58**	**56**	**54**	**52**	**51**	**50**

Road Works	**Calculated $L_{Aeq,T}$ at distance from works (m)**							
	50m	100m	150m	200m	250m	300m	350m	400m
Tracked excavator (C2.21)	55	49	46	43	41	40	38	37
Dump Truck (C2.30)	63	57	54	51	49	48	46	45
vibration rollers (C5.20)	59	53	50	47	45	44	42	41
Asphalt Paver & Tipping Lorry (C.5.31)	61	55	52	49	47	46	44	43
Diesel Generator (C4.76)	45	39	36	33	31	30	28	27
Road Rollers (C5.19)	64	58	55	52	50	49	47	46
Combined L_{Aeq} from all works	**69**	**63**	**59**	**57**	**55**	**53**	**52**	**51**

None of the construction activities listed above would be expected to result in any more than a moderate level of effect to waterbirds at distances beyond 100m. At a distance of 300m, beyond which third party disturbance would not be expected to have a significant effect, ambient noise levels are approaching the 50dB threshold at which low, or no, effects would be expected – noting that birds would be likely to habituate to noise levels within this noise level band. Therefore for the purposes of this assessment, 300m is considered the distance beyond which route options would not affect winter bird sites.

As acknowledged above, any landscape features, vegetation cover or buildings between the noise source and the receptor would serve to further reduce the ambient noise at a given distance.

At a distance of 300m, any disturbance or displacement effects associated with either construction or operation of the Blue2 or Pink2 Route Options would not be expected to affect usage of the lake by wintering Shoveler (in places, the existing N84 is half this distance from the lake). Given the closer proximity of the Green2 Route Option to the lake shore, some level of construction disturbance/displacement would be expected but would be limited to the northern most end of the lake. Similar to the Blue2 and Pink2 Route Options, given the close proximity of the existing N84 to much of the lake shore the long-term usage of the site by this species during operation is not likely to be significantly affected.

Considering all of the factors discussed above, overall the route options proposed are not likely to affect Shoveler usage of Ballindooley Lough in the long-term and hence would not affect the species' conservation condition/site's conservation objectives for the species (maintain the numbers, distribution, and the existing population trend for this species in the SPA) and would not affect the integrity of the SPA, if indeed the birds recorded within affected winter bird sites within the scheme study area form part of the SPA population[21].

Pochard *Aythya ferina* [A059] – Wintering

Pochard were not recorded at any of the winter bird survey sites within the scheme study area and therefore the proposed route options would not affect the species' conservation condition/site's conservation objectives for the species (maintain the numbers, distribution, and the existing population trend for this species in the SPA) and would not affect the integrity of the SPA.

Tufted duck *Aythya fuligula* [A061] – Wintering

Tufted duck were recorded at one of the winter bird sites surveyed in 2014/2015: Ballindooley Lough (WB02), where the species was recorded on four occasions over the winter (November, January, February and March). The maximum number recorded was a count of 26 in January 2015 - corresponding with <0.5% of the SPA's baseline winter population[22].

As would be expected for a diving duck species, the principle habitat used by the species in this site was the main body of the lough. The Blue2 and Pink2 Route Options pass 300m to the south of the lough; the Green2 Route Option approximately 70m to the north. At a distance of 300m, any disturbance or displacement effects associated with either construction or operation of the Blue2 or Pink2 Route Options would not be expected to affect usage of the lake by wintering Tufted duck (in places, the existing N84 is half this distance from the lough). Given the closer proximity of the Green2 Route Option to the lake shore, some level of construction disturbance/displacement would be expected but would be limited to the northern most end of the lough. Similar to the Blue2 and Pink2 Route Options, given the close proximity of the existing N84 to much of the lake shore the long-term usage of the site by this species during operation is not likely to be affected.

Considering all of the factors discussed above, overall the route options proposed are not likely to affect Tufted duck usage of Ballindooley Lough in the long-term and hence would not affect the species' conservation condition/site's conservation objectives for the species (maintain the numbers, distribution, and the existing population trend for this species in the SPA) and would not affect the integrity of the SPA, if indeed the birds recorded within affected winter bird sites within the scheme study area form part of the SPA population.

Common scoter *Melanitta nigra* [A065] – Breeding

Lough Corrib is a nationally important site for Common Scoter; supporting more than half of the national breeding population (Hunt *et al.*, 2013). According to Hunt *et al.* (2013), during the breeding season the Lough Corrib Common scoter breeding population use that part of the lake to the north of Carrowmoreknock (which is c. 9km south-east of Oranmore).

This is more than 14km form the scheme study area and beyond the ZoI of any of the route options and therefore, the proposed route options would not affect the species' conservation condition/site's conservation objectives for the species and would not affect the integrity of the SPA.

Hen harrier *Circus cyaneus* [A082] – Wintering

A Hen harrier (a single individual) was recorded in the vicinity of Lough Inch in January 2015. This location is more than 1km from any of the route options and at that distance would not be expected to be subject to any disturbance/displacement effects associated with either construction or operation of any of the route options. Internationally important numbers of Hen harrier are also known to communally roost within the SPA[23] and there are existing records of the species from

[21] For the purposes of the assessment it is assumed that all birds form part of the SPA population, in the absence of any evidence to the contrary.

[22] Based on data presented in Table 3.2 of the European sites Standard Data Form available at http://www.npws.ie/sites/default/files/protected-sites/natura2000/NF004042.pdf

[23] Information from the current version of the Site Synopsis for the SPA (not yet available on the NPWS website) and from consultation with NPWS staff members – due to the sensitive nature of the locations of Hen harrier roosting sites the winter roost locations were provided in confidence and are not therefore mapped nor are distances to the winter roost sites published.

Tonacurragh, Coolanillaun and Angliham (RPS, 2006); however, none of the route options are in such close proximity to the winter roosts that significant disturbance/displacement effects would be likely to be associated with either construction or operation of any of the route options.

The proposed bridge structures over the River Corrib, or traffic on any of the proposed route options, is not likely to pose a significant collision risk to Hen harrier.

None of the route options proposed are likely to affect Hen harrier usage of the winter roost site in the SPA and hence would not affect the species' conservation condition/site's conservation objectives for the species and would not affect the integrity of the SPA.

Coot *Fulica atra* [A125] – Wintering

Coot were recorded at three of the winter bird sites surveyed in 2014/15: Ballindooley Lough (WB02), the Coolagh Lakes (WB04), and along the River Corrib corridor (WB12 and also recorded in RPS, 2006). Although Coot were regularly recorded at all of these sites, the numbers were low with a maximum of 11 recorded at Ballindooley Lough in February/March 2015 (corresponding with <0.08% of the SPA's baseline winter population[24]).

Coot were recorded either on open water or amongst the fringing aquatic vegetation. In terms of the proximity of the route options to the affected winter bird sites, all cross the River Corrib, the Blue2 and Pink2 Route Options pass 300m to the south of Ballindooley Lough, the Green2 Route Option approximately 70m to the north of Ballindooley Lough, and the Yellow2 Route Option passes over part of the reed swamp along the northern fringes of the Coolagh Lakes. Given the close proximity of the Green2 and Yellow2 Route Options to the lake shores and that all routes cross the River Corrib, some level of construction disturbance/displacement would be expected at these locations but would be expected to be confined to the immediate vicinity of the construction works, be short-term (i.e. limited to the construction period), would only affect relatively low numbers of Coot in the context of the SPA population, and would not affect the usage of these sites by Coot in the long-term. Given the close proximity of the existing N84 to Ballindooley Lough, and that the River Corrib bridge and the viaduct structure associated with the Yellow2 Route Option, winter birds are not likely to be displaced from these locations.

Considering all of the factors discussed above, overall the route options proposed are not likely to affect Coot usage of Ballindooley Lough, the Coolagh Lakes, or the River Corrib in the long-term and hence would not affect the species' conservation condition/site's conservation objectives for the species (maintain the numbers, distribution, and the existing population trend for this species in the SPA) and would not affect the integrity of the SPA, if indeed the birds recorded within affected winter bird sites within the scheme study area form part of the SPA population..

Golden plover *Pluvialis apricaria* [A140] – Wintering

Golden plover were recorded at two of the winter bird sites surveyed in 2014/15: to the east and west of Lough Inch (WB06 and WB08 respectively). The survey site east of Lough Inch is 500m from the nearest route option (Blue2), a distance at which disturbance or displacement effects associated with either construction or operation of the route options would not be expected to affect usage of the area by Golden plover. Golden plover were recorded frequently at WB08 (on four out of seven survey visits) but, on all but one occasion when a flock of 73 were recorded (November 2014), in relatively low numbers (maximum of 9 birds, which corresponds with 0.5% of the SPA's baseline winter population[25]). The route options only clip the southernmost edges of this winter bird site, in an area with a relatively high density of residential dwellings for an upland area, far removed (more than 700m away) from the peatlands west of Lough Inch where the birds were observed. At this distance, disturbance or displacement effects associated with either construction or operation of the route options would not be expected to affect usage of the area by Golden plover.

Considering all of the factors discussed above, overall the route options proposed are not likely to affect Golden plover usage within the scheme study area and therefore, would not affect the species' conservation condition/site's conservation objectives for the species (maintain the numbers, distribution, and the existing population trend for this species in the SPA) and would not affect the

[24] Based on data presented in Table 3.2 of the European sites Standard Data Form available at http://www.npws.ie/sites/default/files/protected-sites/natura2000/NF004042.pdf

[25] Based on data presented in Table 3.2 of the European sites Standard Data Form available at http://www.npws.ie/sites/default/files/protected-sites/natura2000/NF004042.pdf

integrity of the SPA , if indeed the birds recorded within affected winter bird sites in the scheme study area form part of the SPA population.

Black-headed gull *Chroicocephalus ridibundus* [A179] – Breeding/Wintering

In relation to breeding Black-headed gulls, there are many islands in Lough Corrib traditionally used as breeding sites (Hunt & Heffernan, 2007; and, NPWS, 2014). The nearest of these sites was Angliham Quarry (250m to the north of the nearest route option, Green2, where 11 of 431 recorded nest sites were located). At this distance, Angliham Quarry would be beyond the ZoI of any disturbance/displacement effects during construction or operation. All other breeding sites are further north in Lough Corrib, beyond Walsh's Island which is c.8km north of the scheme study area; also beyond the ZoI of any disturbance/displacement effects during construction or operation.

In winter, Black-headed gull were recorded widely across the scheme study area (from 39 out of the 60 winter bird sites surveyed in 2014/2015) and in numbers ranging from single individuals to a flock of 130 birds; the average count per surveyed site per month was 20. Those sites which recorded the larger flocks of over 40 individuals were the River Corrib corridor (WB12), several urban parks within Galway City (WB28, 31, 38, and 44), fields along the northern shore of Oranmore Bay (WB71, where 130 were recorded in October 2014; the highest single record during the surveys), and NUI Galway Recreational Facilities (WB45). Black-headed gull were also frequently recorded along the River Corrib corridor during surveys undertaken in 2006 (RPS, 2006). Of these, and accounting for the fact that along the River Corrib corridor the majority of birds were recorded in the area immediately upstream of the Salmon Weir, only the NUI Galway Recreational Facilities are likely to be subject to significant disturbance/displacement effects during construction by a route option (in this location, the Blue2, Pink2 and Yellow2 Route Options). Operational displacement is not considered to be a significant risk at this site given that birds recorded in parks throughout Galway City have habituated to the proximity of existing roads and that the carriageway for all route options through NUIG would be elevated above ground level, visually screening habitats used by the gulls from traffic. It was also noted during the surveys that birds were regularly disturbed and temporarily displaced from playing fields by users of the sports facilities; returning to the same field or to another nearby. Black-headed gull were recorded in four of the seven survey visits to NUI Galway with 47 the maximum number recorded on any one visit (February 2015), which represents approximately 23.9% of the SPA's baseline population (if indeed the recorded birds form part of that population only), and an average of 30 over the survey period which accounts for approximately 15.2%. Despite the percentage of the baseline population that could potentially be displaced during construction at NUI Galway, it is considered that this impact would not significantly affect numbers, distribution, or the existing population trend for the species in the SPA (current data on the species' population trend in the SPA is not currently published on the NPWS website) given the abundance of alternative suitable habitat both within the NUI Galway grounds and in the wider area (as evidenced by the 39 sites at which the species was recorded throughout the scheme study area), and the transient usage by Black-headed gulls of the majority of the surveyed sites used within the N6 GCTP scheme study area[26].

Therefore, none of the route options would affect the species' conservation condition/site's conservation objectives for the species and would not affect the integrity of the SPA, if indeed the birds recorded within affected winter bird sites in the scheme study area form part of the SPA population.

Common gull *Larus canus* [A182] – Breeding/Wintering

In relation to breeding Common gulls, there are many islands in Lough Corrib traditionally used as breeding sites (Hunt & Heffernan, 2007; and, NPWS, 2014). The nearest of these sites was at Walsh's Island, c.8km to the north of the scheme study area At this distance and beyond, the breeding sites would be beyond the ZoI of any disturbance/displacement effects during construction or operation.

In winter, Common gull were recorded widely across the scheme study area (from 27 out of the 60 winter bird sites surveyed in 2014/2015) and in numbers ranging in size from single individuals to a flock of 120 birds. However, the species was generally recorded infrequently at individual sites and in relatively low numbers; at 23 of the 27 surveyed sites this species was only recorded on one

[26] 77% of positive survey sites (i.e. where Black-headed gull were recorded at least once) only had the species present on three or fewer of the seven survey visits; only one surveyed site, the River Corrib corridor, had records of the species from all survey visits

or two of the seven survey visits and at 21 surveyed sites fewer than ten birds were recorded during all survey visits. The largest flocks were recorded along the north shore of Oranmore Bay (WB71), where 120 were recorded in October 2014, and along the River Corrib corridor (WB12) where flocks of 48 and 78 were recorded in the area immediately upstream of the Salmon Weir in September and November 2014, respectively. Common gull were also frequently recorded along the River Corrib corridor during surveys undertaken in 2006 (RPS, 2006). Neither of these locations would be affected by construction or operation disturbance/displacement associated with any of the route options.

Overall, the potential displacement of relatively significant numbers of Common gull during construction or operation (a record of 21 corresponds with what could be <43.8% of the SPA's baseline winter population of 48) will not affect numbers, distribution, or the existing population trend for the species in the SPA[27] given the transient usage by Common gulls of the majority of the surveyed sites at which they were present, given that the majority of positive sites are not directly affected and any potential disturbance effects at many of those are buffered from the route options by urban development, and the abundance of suitable alternative habitat available (i.e. the majority of the 27 sites used by the species locally comprised managed amenity grassland or managed agricultural fields along the coastline).

Therefore, none of the route options are would affect the species' conservation condition/site's conservation objectives and would not affect the integrity of the SPA, if indeed the birds recorded within affected winter bird sites in the scheme study area form part of the SPA population.

Common tern *Sterna hirundo* [A193] – Breeding

In relation to breeding Common terns in Lough Corrib SPA, there are many bays, islands and section of shoreline in Lough Corrib traditionally used as breeding sites (Hunt & Heffernan, 2007; and, NPWS, 2014). The nearest of these sites is near Walsh's Island, c.8km to the north of the scheme study area At this distance and beyond, the breeding sites would be beyond the ZoI of any disturbance/displacement effects during construction or operation.

There were also records for the species along the River Corrib corridor (RPS, 2006) but given the low numbers recorded over the survey period on the River Corrib (43 individuals recorded over 104 hours of observation) any disturbance would not result in any significant effect on the breeding population.

Therefore, there is no risk of construction or operational disturbance/displacement effects to this SCI species and none of the route options would affect the species' conservation condition/site's conservation objectives for the species (numbers, distribution or the existing population trend for this species in the SPA) and would not affect the integrity of the SPA.

Arctic tern *Sterna paradisaea* [A194] – Breeding

In relation to breeding Arctic terns in Lough Corrib SPA, there are many bays, islands and section of shoreline in Lough Corrib traditionally used as breeding sites (Hunt & Heffernan, 2007; and, NPWS, 2014). The nearest of these sites is Ballinduff Bay, c.10km to the north of the scheme study area At this distance and beyond, the breeding sites would be beyond the ZoI of any disturbance/displacement effects during construction or operation.

Therefore, there is no risk of construction or operational disturbance/displacement effects to this SCI species and none of the route options would affect the species' conservation condition/site's conservation objectives for the species (numbers, distribution or the existing population trend for this species in the SPA) and would not affect the integrity of the SPA.

Wetland habitats

As all wetland habitat within the SPA are upstream of all of the route options, they are beyond the ZoI of any significant impacts during construction or operation and none of the route options would affect the integrity of the SPA in this regard.

[27] Current data on the species' population trend in the SPA is not currently published on the NPWS website

Table B.4: Inner Galway Bay SPA
Special Conservation Interests (SCIs) **Are the potential effects of the route options, despite the implementation of mitigation measures, likely to be significant and adversely affect the integrity of the European site?**[28]
Great northern diver *Gavia immer* [A003] – Wintering Great northern diver were only recorded at one of the winter bird sites surveyed in 2014/15; an area of coastal grasslands at Ballyloughaun (WB30) where a single bird was recorded in January 2015. This site is buffered from any disturbance associated with construction or operation by more than 1.5km of urban development and the proposed route options would therefore not affect species' conservation condition/site's conservation objectives for the species (numbers, distribution, or the existing population trend for this species in the SPA[29]) and would not affect the integrity of the SPA.
Cormorant *Phalacrocorax carbo* [A017] – Breeding/Wintering Cormorant were recorded at six winter bird survey sites across the scheme study area (WB02, WB04, WB07, WB08, WB12, and WB31) but in all instances the numbers recorded were low; generally one or two individuals with the exception of a record for four in February along the River Corrib (WB12). Cormorant were also frequently recorded along the River Corrib corridor during surveys undertaken in 2006 (RPS, 2006). Records of one or two individuals would correspond with less than 1% of the SPA's baseline winter population. The absence of any suitable breeding habitat (rocky islets, sea stacks, cliffs etc.) within areas potentially affected by the proposed route options, and with the traditional Deer Island breeding site more than 5.5km to the south across Galway Bay,

[28] With all route options (bar the Orange2 Route Option) having a new bridge crossing the River Corrib, there is a risk of birds commuting along the river corridor colliding with the bridge structure. The risk of birds colliding with a bridge is dependent on many factors such as bridge design, visibility (bridge strikes are more likely during poor weather conditions or at night), the structure of the surrounding habitat, the bird species present, their frequency of occurrence within the impact zone (and flight height relative to the bridge structure), and their relative susceptibility to colliding with structures. Collision risk would be expected to be higher for larger, less manoeuvrable species such as geese, swans, Cormorant etc. (particularly in relation to the risk of colliding with supporting cables) however, some studies have found that passerines make up the vast majority of dead birds recovered from studies to assess collision risk with man-made structures (Kahlert *et al.*, 2005)[28].

The bridge structures associated with the Yellow2, Blue2, Pink2 and Green2 Route Options are likely to require cable stays as part of their design, increasing the risk of bird collision over a design without. Surveys carried out in 2005/2006 as part of the Galway City Outer Bypass scheme (RPS, 2006) recorded the following SCI species flying through the proposed bridge site for that scheme over the survey period (52 surveys encompassing 104 hours of observations): Cormorant, Grey heron, Light-bellies brent goose, Red-breasted merganser, Lapwing, Dunlin, Curlew, Black-headed gull, Common gull and Common tern. The most frequently recorded of these were Black-headed gull, Common gull, Cormorant and Lapwing; other species were only recorded occasionally and in low numbers. Red-breasted merganser, Dunlin and Light-bellied brent goose were only observed on a single occasion during the 2006 surveys, with Curlew only observed on two occasions (individual birds for each observation).

Common tern were observed crossing the bridge site on only 43 occasions and generally low over the water (<5m). Although a full assessment of bird collision risk cannot be carried out until the details of the bridge structure are known, given the number of individuals recorded (particularly in the context of the SPA populations for those species) and the crossing frequencies observed a sensitively bridge would not be expected to pose a collision risk of a magnitude that it would significantly affect the numbers, distribution, or the existing population trend for these species in the SPA. Nor would the presence of a road outside of the River Corrib corridor be expected to pose any significant collision risk to winter birds moving between the coast, Lough Corrib or any of the other winter bird survey sites at which they were recorded, particularly given that to move between sites outside of the river corridor at present birds must fly over the existing road network and urban infrastructure in Galway City.

Therefore, given that all route options are remote from the SPA the discussions below are focused on the potential for disturbance/displacement of birds from affected habitats within the N6 GCTP scheme study area.

[29] Assessed as favourable = population is stable/increasing in the Inner Galway Bay Special Protection Area (Site Code 4031) Conservation Objectives Supporting Document, Version n 1 (National Parks and Wildlife Service, 2013).

the proposed route options would not have any effect on the breeding population. The potential displacement of such small numbers of Cormorant during construction or operation would not affect numbers, distribution, or the existing population trend for this species in the SPA (favourable) given the abundance of alternative suitable habitat in the greater Galway City area and hinterland (Cormorants were recorded using habitats ranging from lakes, to rivers, amenity grassland and upland heath).

Therefore, none of the route options are likely to affect the species' favourable conservation condition/site's conservation objectives for the species [30] and would not affect the integrity of the SPA, if indeed the birds recorded within affected winter bird sites in the scheme study area form part of the SPA population

Grey heron *Ardea cinerea* [A028] – Wintering

Grey heron were recorded from 15 out of the 60 winter bird sites surveyed in 2014/2015 with generally only single individual birds recorded. Notable exceptions were records of 18 and eight Grey heron at two of the coastal sites along the north shore of Oranmore Bay (WB70 and WB71 respectively) but neither of these locations would be affected by construction or operation disturbance/displacement associated with any of the route options.

Overall, the potential displacement of such small numbers of Grey heron during construction or operation (the baseline population for the SPA is 102) would not affect the species' favourable conservation condition/site's conservation objectives for the species (numbers, distribution, or the existing population trend for this species in the SPA - favourable) or affect the integrity of the SPA, given that many of the positive sites only recorded single individuals, are not directly affected and any potential disturbance effects and are buffered from the route options by urban development, the abundance of alternative suitable habitat locally (i.e. the species was recorded from wide range of habitat types including lakes, wetland habitats, upland habitats, and managed grasslands), and the transient usage by Grey heron of the majority of the surveyed sites used.

Light-bellied brent goose *Branta bernicla hrota* [A046] – Wintering

Light-bellied brent goose were recorded at three winter bird sites surveyed in 2014/15: Knocknacarra Golf Course (WB19), Claddagh/Nimmo's Pier (WB38) and along the north shore of Oranmore Bay (WB71). These sites are removed from the nearest route option by distances of (approximately) 500m, 1.5km, and 1.3km respectively and in all cases there is a belt of urban development present in the respective buffer zones. There is also a single record for the species along the River Corrib corridor (RPS, 2006) but given the rare occurrence of the species on the River Corrib any disturbance would not result in any significant effects in relation to this species here.

Therefore, there is no risk of construction or operational disturbance/displacement effects to this SCI species and none of the route options would affect the species' favourable conservation condition/site's conservation objectives for the species (numbers, distribution or the existing population trend for this species in the SPA - favourable) or affect the integrity of the SPA.

Wigeon *Anas penelope* [A050] – Wintering

Wigeon were recorded at five winter bird sites surveyed in 2014/15: WB02, WB22, WB31, WB70 and WB71.

The coastal survey sites at Lough Atalia (WB22), Renmore (WB31), and along the north shore of Oranmore Bay (WB70 and WB71) are buffered from any disturbance associated with construction or operation by a distance of at least 800m of urban development and the proposed route options would not affect the numbers, distribution, or the existing population trend for the species in the SPA (favourable).

Wigeon were also recorded on one occasion at Ballindooley Lough (WB02); 28 birds were recorded in February 2015 which would correspond with 2.4% of the SPA's baseline winter population[31].

[30] The conservation objectives for this species are as follows: breeding population abundance; productivity rate; distribution of breeding colonies; prey biomass availability; barriers to connectivity; level of disturbance at breeding sites; the species population trend; and, the species distribution.

[31] As per Table 2.1 of Inner Galway Bay Special Protection Area (Site Code 4031) Conservation Objectives Supporting Document, Version n 1 (National Parks and Wildlife Service, 2013).

The potential displacement of such low numbers of birds during construction or operation would not affect the species' favourable conservation condition/site's conservation objectives for the species (numbers, distribution, or the existing population trend for this species in the SPA - favourable) or affect the integrity of the SPA, considering the infrequent usage of Ballindooley Lough by Wigeon and that and disturbance/displacement would only affect small areas of the available suitable habitat resource within that winter bird survey sites, or in the locality.

Teal *Anas crecca* [A052] – Wintering

Teal were recorded at six winter bird sites surveyed in 2014/15: WB02, WB04, WB08, WB10, WB14 and WB71.

The numbers recorded at WB04, WB08, WB10, and WB71 were generally low (<6 birds, or <1% of the SPA's baseline winter population) and Teal were not present regularly throughout the winter period (recorded on 2, 4, 1 and 1 occasions respectively). WB71 is more than 1.3km away from the nearest route option, beyond the zone of influence of any disturbance/displacement during construction or operation. Considering the low numbers and infrequent use of sites WB04, WB08 and WB10, the potential for significant disturbance/displacement effects is further reduced by virtue of the fact that all route options that affect those locations only pass through small areas of habitat at the margins of each winter bird site leaving the majority of these sites, and many alternative areas of similar suitable habitat in the locality, unaffected.

In WB14, Teal were recorded during all survey visits in numbers ranging from 9 to 29 (corresponding with between 1.3% and 4.1% of the SPA's baseline winter population). Within WB14, Teal were recorded on the Terryland River or in flight over that part of WB14 to the north of the N6 between Castlegar and the N17. Yellow2 is the only route option which is off-line in this site and in close proximity to this section of the Terryland River where Teal were recorded.

Given the proximity of the existing N6 in this area, the level of disturbance/displacement effects to Teal during operation would not be significant. As disturbance effects are likely to be confined to that portion of the stream that would be underneath the proposed road and the immediate environs, particularly considering that the Yellow2 route option would be elevated through the Terryland River Valley, the majority of the stream would remain available for the species. The disturbance/displacement effects of construction works would be expected to have a greater zone of influence. However, the effects would be temporary in nature and, as above, would only affect the area least used by the species in the zone to the north of the N6 between Castlegar and the N17.

Teal were recorded on, or flying into, Ballindooley Lough (WB02) during all survey visits in numbers ranging from 3 on October 2014, to 146 in January 2015 (corresponding with between 0.4% and 20.9% of the SPA's baseline winter population). Although on occasion Teal were observed in the drainage ditches surrounding the lough, as would be expected for a dabbling duck species, the principle habitat used by the species in this site was the main body of the lake. The Blue2 and Pink2 Route Options pass 300m to the south of the lough; the Green2 Route Option approximately 70m to the north. At a distance of 300m, any disturbance or displacement effects associated with either construction or operation of the Blue2 or Pink2 Route Options would not affect usage of the lough by wintering Teal (in places, the existing N84 is half this distance from the lough). Given the closer proximity of the Green2 Route Option to the lake shore, some level of construction disturbance/displacement would be expected but would be limited to the northern most end of the lake. Similar to the Blue2 and Pink2 Route Options, given the close proximity of the existing N84 to much of the lake shore the long-term usage of the site by this species during operation is not likely to be affected.

Considering all of the factors discussed above, overall the route options proposed are not likely to affect Teal usage of Ballindooley Lough in the long-term and hence would not affect the species' favourable conservation condition/site's conservation objectives for the species (numbers, distribution, or the existing population trend for this species in the SPA - favourable) or affect the integrity of the SPA, if indeed the birds recorded within affected winter bird sites within the scheme study area form part of the SPA population.

Shoveler *Anas clypeata* [A056]

Shoveler were recorded on, or flying into, only one of the winter bird survey sites in 2011/15: Ballindooley Lough (WB02). They were recorded in five of the seven survey visits in numbers

ranging from 10 to 144. A flock of 144 birds is a significant number and is in excess of the SPA's baseline winter population of 88 (see Table 2.1 in National Parks and Wildlife Service, 2013).

As would be expected for a diving duck species, the principle habitat used by the species in this site was the main body of the lough. The Blue2 and Pink2 Route Options pass 300m to the south of the lake; the Green2 Route Option approximately 70m to the north. At a distance of 300m, any disturbance or displacement effects associated with either construction or operation of the Blue2 or Pink2 Route Options would not affect usage of the lake by wintering Shoveler (in places, the existing N84 is half this distance from the lake). Given the closer proximity of the Green2 Route Option to the lake shore, some level of construction disturbance/displacement would be expected but would be limited to the northern most end of the lake. Similar to the Blue2 and Pink2 Route Options, given the close proximity of the existing N84 to much of the lake shore the long-term usage of the site by this species during operation is not likely to be affected.

Considering all of the factors discussed above, overall the route options proposed are not likely to affect Shoveler usage of Ballindooley Lough in the long-term and hence would not affect the species' favourable conservation condition/site's conservation objectives for the species (numbers, distribution, or the existing population trend for the species in the SPA - favourable) or affect the integrity of the SPA, if indeed the birds recorded within affected winter bird sites within the scheme study area form part of the SPA population.

Red-breasted merganser *Mergus serrator* [A069] – Wintering

Red-breasted merganser were not recorded at any of the winter bird survey sites within the scheme study area. There is a single record for the species along the River Corrib corridor (RPS, 2006) but given the rare occurrence of the species on the River Corrib any disturbance would not result in any significant effects in relation to this species.

Therefore, there is no risk of construction or operational disturbance/displacement effects to this SCI species and none of the route options would affect the species' favourable conservation condition/site's conservation objectives for the species (numbers, distribution or the existing population trend for this species in the SPA - favourable) or affect the integrity of the SPA.

Ringed plover *Charadrius hiaticula* [A137] – Wintering

Ringed plover were not recorded at any of the winter bird survey sites within the scheme study area and therefore the proposed route options would not affect the species' favourable conservation condition/site's conservation objectives for the species (numbers, distribution, or the existing population trend for this species in the SPA - favourable) or affect the integrity of the SPA.

Golden plover *Pluvialis apricaria* [A140] – Wintering

Golden plover were recorded at two of the winter bird sites surveyed in 2014/15: to the east and west of Lough Inch (WB06 and WB08 respectively). The survey site east of Lough Inch is 500m from the nearest route option (Blue2), a distance at which disturbance or displacement effects associated with either construction or operation of the route options would not be expected to affect usage of the area by Golden plover. Golden plover were recorded frequently at WB08 (on four out of seven survey visits) but, on all but one occasion when a flock of 73 were recorded (in November 2014), in relatively low numbers (maximum of 9 birds, which corresponds with 0.4% of the SPA's baseline winter population[32]). The route options only clip the southernmost edges of this winter bird site, in an area with a relatively high density of residential dwellings for an upland area, far removed (more than 700m away) from the peatlands west of Lough Inch where the birds were observed. At this distance, disturbance or displacement effects associated with either construction or operation of the route options would not be expected to affect usage of the area by Golden plover.

Considering all of the factors discussed above, overall the route options proposed are not likely to affect Golden plover usage within the scheme study area in the long-term and therefore, would not affect the species' favourable conservation condition/site's conservation objectives for the species (numbers, distribution, or the existing population trend for the species in the SPA - favourable) or

[32]As per Table 2.1 of Inner Galway Bay Special Protection Area (Site Code 4031) Conservation Objectives Supporting Document, Version n 1 (National Parks and Wildlife Service, 2013)

affect the integrity of the SPA, if indeed the birds recorded within affected winter bird sites in the scheme study area form part of the SPA population.

Lapwing *Vanellus* [A142] – Wintering

Lapwing were recorded at four winter bird survey sites: Ballindooley Lough (WB02) where a flock of 16 and a single individual were recorded on January and March 2015 respectively; Na Foraí Maola/West of Lough Inch (WB08), where 17 were recorded in October 2014; Lough Atalia (WB22), where 26 were recorded in November 2014; and, along the north shore of Oranmore Bay (WB71), where flocks of 13 and 70 were recorded in September and December 2014 respectively. Lapwing were also recorded along the River Corrib corridor during surveys carried out in 2006 (RPS, 2006); however, there was only one large flock recorded on one occasion (123 birds). Of these locations, only the River Corrib, Ballindooley Lough and the area at Na Foraí Maola/West of Lough Inch have the potential to be affected by disturbance/displacement associated with some of the route options.

However, the numbers recorded at these sites were relatively low on the majority of occasions (a count of 17 represents 0.4% of the baseline population of the SPA) and therefore, any potential displacement of Lapwing during construction or operation would not affect the species' favourable conservation condition/site's conservation objectives for the species (numbers, distribution, or the existing population trend for the species in the SPA - favourable) or affect the integrity of the SPA, particularly considering the transient usage by Lapwing of these two sites and that the route options that affect these sites only pass through their outer margins, minimising the potential for disturbance and avoiding major habitat loss or habitat severance.

Dunlin *Calidris alpina* [A149] – Wintering

Dunlin were not recorded at any of the winter bird survey sites within the scheme study area. There was a single record for the species along the River Corrib corridor (RPS, 2006) but given the rare occurrence of the species on the River Corrib any disturbance would not result in any significant effects in relation to this species.

Therefore, there is no risk of construction or operational disturbance/displacement effects to this SCI species and none of the route options would affect the species' favourable conservation condition/site's conservation objectives for the species (numbers, distribution or the existing population trend for this species in the SPA - favourable) or affect the integrity of the SPA.

Bar-tailed Godwit *Limosa lapponica* [A157] – Wintering

Nine Bar-tailed godwit were recorded at one winter bird survey site, Ballindooley Lough, on a single occasion in February 2015. This corresponds with approximately 2% of the SPA's baseline population[33], if indeed the recorded birds form part of that population. Despite the percentage of the SPA's baseline population that could potentially be displaced from Ballindooley Lough during construction works associated with the Blue2, Pink2 and Green2 Route Options which pass to the south and north of the lake, it is considered that this impact would not affect the species' favourable conservation condition/site's conservation objectives for the species (numbers, distribution, or the existing population trend for the species in the SPA - favourable) or affect the integrity of the SPA , given that the majority of the wetland habitats surrounding the lake would not be affected, and those areas of habitat not affected would be no closer to the proposed route options than they are to the existing N84 and any potential disturbance from road traffic during operation, and the fact that based on the survey results this species only infrequently use the lakeshore habitats here.

Curlew *Numenius arquata* [A160] – Wintering

Curlew were recorded at 24 of the 60 winter bird sites surveyed in 2014/15; including the River Corrib, where they were recorded in 2006 (RPS, 2006).

Sixteen of the positive survey sites for Curlew are outside of the zone of influence of any disturbance/displacement effects associated with the route options due to distance from the site and/or the presence of a buffer zone of existing urban development (as is the case for the amenity

[33] Based on the baseline population numbers presented in Table 2.1 of the Inner Galway Bay Special Protection Area (Site Code 4031) Conservation Objectives Supporting Document, Version n 1 (National Parks and Wildlife Service, 2013).

grassland sites throughout the city and the coastal grassland sites). These are WB19, WB20, WB22, WB24, WB27, WB28, WB29, WB30, WB31, WB38, WB40, WB47, WB51, WB70 and WB71.

The majority (six) of the remaining eight sites only recorded Curlew on two or fewer occasions and in relatively low numbers. Survey sites WB7, WB8, and WB10 only had records of one or two birds present (<0.3% of the SPA's baseline winter population), WB03 had two records of five Curlew (0.7% of the SPA's baseline winter population), WB14 has records of eight and four birds (1.2% and 0.6% of the SPA's baseline winter population), and WB12, whilst there was a record of a larger number of Curlew from October 2014 (16, which corresponds with 2.3% of the SPA's baseline winter population), the species was only recorded here on one occasion. Ballindooley Lough was the only winter bird survey site regularly used by Curlew (recorded in five out of the seven survey visits); however, with the exception of a record of eight from September 2014 the numbers recorded were single, or on one occasion two, individuals.

In terms of the impacts of route options on wintering birds at those positive sites, there are no route options which impact on them all and most are only impacted marginally along the edge of the habitat block or are in close proximity to its edge (WB02, WB03, WB07, WB08, and WB10) and therefore disturbance/displacement effects would only affect bird usage of a small portion of those sites during construction (and most likely to a lesser extend during operation). Along the River Corrib corridor (WB12), only the Green2 Route Option impacts on the wet grassland area along the east river bank at Kentfield where Curlew were recorded on one occasion. In the case of the Terryland River Valley (WB14), only the Yellow2 Route Option is offline in the vicinity of the wet grassland fields to the north of the existing N6 between Castlegar and the N17, where Curlew were recorded. However, significant disturbance/displacement effects during construction/operation are not likely here given the extent of alternative suitable habitat within this site which would be outside of the zone of influence of such impacts. In Ballybrit (WB23), Curlew were recorded using the playing field amongst the industrial/commercial buildings in Ballybrit Business Park, in the south-west corner of the winter bird survey site. On one of the three survey visits on which the species was present, 37 Curlew were recorded (5.3% of the SPA's baseline winter population). Both the Blue2 and Pink2 Route Options pass close to this location (40m away) and some level of construction and operational disturbance/displacement would be expected. However, given the infrequent use of this location by larger numbers of Curlew, the temporary nature of any construction works in this area and the large area of alternative habitat present elsewhere in the Racecourse complex, this impact is not likely to be significant.

Overall, given the number of positive sites unaffected by the route options that remain available to Curlew and that impacted sites supported Curlew in relatively low numbers and/or infrequently over the survey period, the proposed route options would not affect the species' favourable conservation condition/site's conservation objectives for the species (numbers, distribution, or the existing population trend for the species in the SPA - favourable) or affect the integrity of the SPA.

Redshank *Tringa totanus* [A162] – Wintering

Redshank were recorded at six winter bird sites surveyed in 2014/15: WB08, WB12, WB30, WB52, WB70 and WB71. The numbers present were generally low (<9) with the exception of a flock of 47 Redshank recorded in WB71 in January 2015.

Due to either direct impacts or the close proximity of route options to winter bird survey sites, only birds in WB08 and WB12 could potentially be affected by disturbance/displacement associated with the route options. The southern margin of WB08 is affected by the Green2 and Yellow2 Route Options; all route options cross WB12. However at these sites the maximum number of birds recorded was 2 and 1 respectively; corresponding to 0.4% of the SPA's baseline winter population[34].

The potential displacement of such low numbers of birds during construction or operation would not affect the species' favourable conservation condition/site's conservation objectives for the species (numbers, distribution, or the existing population trend for the species in the SPA-favourable) or affect the integrity of the SPA, considering the transient usage of these areas by Redshank and that and disturbance/displacement would only affect small areas of the available suitable habitat resource that is available within those winter bird survey sites or in the locality.

[34] Based on the baseline population numbers presented in Table 2.1 of the Inner Galway Bay Special Protection Area (Site Code 4031) Conservation Objectives Supporting Document, Version n 1 (National Parks and Wildlife Service, 2013).

Turnstone *Arenaria interpres* [A169] – Wintering

Turnstone were recorded at one winter bird survey site; an area of coastal grasslands at Ballyloughaun (WB30) where five birds were recorded in October 2014. This site is buffered from any disturbance associated with construction or operation by more than 1.5km of urban development and the proposed route options would not affect the species' favourable conservation condition/site's conservation objectives for the species (numbers, distribution, or the existing population trend for the species in the SPA - favourable) or affect the integrity of the SPA.

Black-headed Gull *Chroicocephalus ridibundus* [A179] – Wintering

Black-headed gull were recorded widely across the scheme study area (from 39 out of the 60 winter bird sites surveyed in 2014/2015) and in numbers ranging from single individuals to a flock of 130 birds; the average count per surveyed site per month was 20. Black-headed gull were also frequently recorded (in low numbers) along the River Corrib corridor during surveys undertaken in 2006 (RPS, 2006). Those sites which recorded the larger flocks of over 40 individuals were the River Corrib corridor (WB12), several urban parks within Galway City (WB28, 31, 38, and 44), fields along the northern shore of Oranmore Bay (WB71, where 130 were recorded in October 2014; the highest single record during the surveys), and the NUI Galway Recreational Facilities (WB45). Of these, and accounting for the fact that along the River Corrib corridor the majority of birds were recorded in the area immediately upstream of the Salmon Weir, only the NUI Galway Recreational Facilities are likely to be subject to significant disturbance/displacement effects during construction by a route option (in this location, the Blue2, Pink2 and Yellow2 Route Options). Operational displacement is not considered to be a significant risk at this site given that birds recorded in parks throughout Galway City have habituated to the proximity of existing roads and that the carriageway for all route options through NUIG would be elevated above ground level, visually screening habitats used by the gulls from traffic. It was also noted during the surveys that birds were regularly disturbed and temporarily displaced from playing fields by users of the sports facilities. Black-headed gull were recorded in four of the seven survey visits to NUI Galway with 47 the maximum number recorded on any one visit (February 2015), which represents approximately 23.9% of the SPA's baseline population (if indeed the recorded birds form part of that population only), and an average of 30 over the survey period which accounts for approximately 15.2%.

Despite the percentage of the baseline population that could potentially be displaced during construction at NUI Galway, it is considered that this impact would not affect the species' favourable conservation condition/site's conservation objectives for the species (numbers, distribution, or the existing population trend for the species in the SPA - favourable) or affect the integrity of the SPA, given the abundance of alternative suitable habitat both within the NUI Galway grounds and in the wider area (as evidenced by the 39 sites at which the species was recorded throughout the scheme study area), and the transient usage by Black-headed gulls of the majority of the surveyed sites used[35].

Common gull *Larus canus* [A182] – Wintering

Common gull were recorded widely across the scheme study area (from 27 out of the 60 winter bird sites surveyed in 2014/2015) and in numbers ranging in size from single individuals to a flock of 120 birds. Common gull were also frequently recorded (in low numbers) along the River Corrib corridor during surveys undertaken in 2006 (RPS, 2006). However, the species was generally recorded infrequently at individual sites and in relatively low numbers; at 23 of the 27 surveyed sites this species was only recorded on one or two of the seven survey visits and at 21 surveyed sites fewer than ten birds were recorded during all survey visits. The largest flocks were recorded along the north shore of Oranmore Bay (WB71), where 120 were recorded in October 2014, and along the River Corrib corridor (WB12) where flocks of 48 and 78 were recorded in the area immediately upstream of the Salmon Weir in September and November 2014, respectively. Neither of these locations would be affected by construction or operation disturbance/displacement associated with any of the route options.

Overall, the potential displacement of relatively significant numbers of Common gull during construction or operation (a record of 21 corresponds with what could be <43.8% of the SPA's

[35] 77% of positive survey sites (i.e. where Black-headed gull were recorded at least once) only had the species present on three or fewer of the seven survey visits; only one surveyed site, the River Corrib corridor, had records of the species from all survey visits

baseline winter population of 48) will not affect numbers, distribution, or the existing population trend for the species in the SPA[36] given the transient usage by Common gulls of the majority of the surveyed sites at which they were present, given that the majority of positive sites are not directly affected and any potential disturbance effects at many of those are buffered from the route options by urban development, and the abundance of suitable alternative habitat available (i.e. the majority of the 27 sites used by the species locally comprised managed amenity grassland or managed agricultural fields along the coastline).

Sandwich tern *Sterna sandvicensis* [A191] – Breeding

Galway Bay supports important breeding colonies of Sandwich tern on many of its islands (Galway Harbour Company, 2014; and, NPWS, 2005). The only impact pathway with the potential to significantly affect breeding tern, is a reduction in water quality in the receiving watercourses which could affect water quality in Galway Bay. A significant impact on water quality in Galway Bay could affect fish populations – a food source for Sandwich terns.

Reduction in Water Quality

During construction, contaminated surface water runoff and/or an accidental spillage or pollution event into any surface water feature has the potential to have a significant negative impact on water quality in receiving watercourses and consequently in Galway Bay. The effects of frequent and/or prolonged pollution events in a river system have the potential to be extensive and far-reaching and could potentially have significant long-term effects. In an extreme scenario, with a pollution event of sufficient magnitude, the marine environment could be affected.

However, it is considered extremely unlikely that a pollution event of such a magnitude would occur during construction. Any pollution events that may occur would be expected to be relatively minor in comparison to the dilution factor and assimilative capacity of a coastal water body the size of Galway Bay, or to be any more than temporary in nature, and therefore is unlikely to have any perceptible or far-reaching effects within the bay. Nevertheless, a precautionary approach is being taken in assuming a level of risk of water quality impacts and detailed mitigation measures would need to be proposed to further minimise the risk of a route option having any perceptible effect on water quality during construction.

There will be outfall points to surface water features from the road drainage network during operation. However, given the drainage design as described in **Section 2.3** (which includes attenuation and pollution control measures) it is extremely unlikely that the normal operating water quality of the drainage outfalls, even in the unlikely event of a pollution incident, would have any perceptible impact on water quality in receiving watercourses.

With a mitigation strategy in place to deal with the risk of construction impacts to water quality in receiving watercourses, it is unlikely that the proposed route options would result in any significant effects to water quality in Galway Bay during construction or operation and therefore effect breeding sites or the food source of this SCI bird species.

Therefore, there is no risk of construction or operational disturbance/displacement effects to this SCI species and none of the route options would affect the species' favourable conservation condition/site's conservation objectives for the species [37] or affect the integrity of the SPA.

Common Tern *Sterna hirundo* [A193] – Breeding

Galway Bay supports important breeding colonies of Common tern on many of its islands (Galway Harbour Company, 2014; and, NPWS, 2005). A reduction in water quality in the receiving watercourses which could affect water quality in Galway Bay could in turn affect fish populations – a food source for Sandwich terns.

As discussed above under the Sandwich tern assessment, with a mitigation strategy in place to deal with the risk of construction impacts to water quality in receiving watercourses, it is unlikely that the proposed route options would result in any significant effects to water quality in Galway Bay

[36] Current data on the species' population trend in the SPA is not currently published on the NPWS website

[37] The conservation objectives for this species are as follows: breeding population abundance; productivity rate; distribution of breeding colonies; prey biomass availability; barriers to connectivity; and the level of disturbance at breeding sites.

during construction or operation and therefore effect breeding sites or the food source of this SCI bird species.

There were also records for the species along the River Corrib corridor (RPS, 2006) but given the low numbers recorded over the survey period on the River Corrib (43 individuals recorded over 104 hours of observation) any disturbance would not result in any significant effect on the breeding population.

Therefore, there is no risk of construction or operational disturbance/displacement effects to this SCI species and none of the route options would affect the numbers, distribution or the existing population trend for this species in the SPA (favourable).

Therefore, there is no risk of construction or operational disturbance/displacement effects to this SCI species and none of the route options would affect the species' favourable conservation condition/site's conservation objectives for the species [38] or affect the integrity of the SPA.

Wetlands habitats

As no wetland habitats in the SPA are directly impacted by any of the route options, the only impact pathway with the potential to significantly affect the SPA wetlands, is a reduction in water quality in the receiving watercourses which could affect water quality in Galway Bay.

As discussed above under the Sandwich tern assessment, with a mitigation strategy in place to deal with the risk of construction impacts to water quality in receiving watercourses, it is unlikely that the proposed route options would result in any significant effects to water quality in Galway Bay during construction or operation and therefore effect wetland habitats that support the SCI bird species. None of the route options would affect the site's conservation objectives for wetland habitats (maintain stable area of wetland habitat) or affect the integrity of the SPA in this regard.

[38] The conservation objectives for this species are as follows: breeding population abundance; productivity rate; distribution of breeding colonies; prey biomass availability; barriers to connectivity; and the level of disturbance at breeding sites.

Table B.5: Sample Conservation Objectives for 3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. **To restore/maintain the favourable conservation condition of Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. in Lough Corrib cSAC[39], which is likely to be defined by a list of attributes and targets comparable to that outlined below:**			
Attribute	**Measure**	**Target**	**Is the proposed development likely to affect the conservation target?**
Habitat area	Hectares	Area stable or increasing, subject to natural processes	No.
Habitat distribution	Occurrence	No decline, subject to natural processes.	No.
Typical species	Occurrence	Typical species present, in good condition, and demonstrating typical abundances and distribution	No.
Vegetation composition: characteristic zonation	Occurrence	All characteristic zones should be present, correctly distributed and in good condition	No.
Vegetation distribution: maximum depth	Metres	No change to maximum depth of vegetation, subject to natural processes	No.
Hydrological regime: water level fluctuations	Metres	Maintain appropriate natural hydrological regime necessary to support the habitat	No.
Lake substratum quality	Various	Maintain appropriate substratum type, extent and chemistry to support the vegetation	No.

[39] In the absence of site specific conservation objectives for Lough Corrib cSAC these attributes and targets are taken from Slyne Head Peninsula cSAC (Version 1.0, Feb 2014 – accessed June 2015).

Table B.5: Sample Conservation Objectives for 3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. **To restore/maintain the favourable conservation condition of Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. in Lough Corrib cSAC[39], which is likely to be defined by a list of attributes and targets comparable to that outlined below:**			
Attribute	**Measure**	**Target**	**Is the proposed development likely to affect the conservation target?**
Water quality: transparency	Metres	Maintain appropriate Secchi transparency. There should be no decline in Secchi depth/transparency	No.
Water quality: nutrients	µg/l P; mg/l N	Maintain the concentration of nutrients in the water column at sufficiently low levels to support the habitat and its typical species	No.
Water quality: phytoplankton biomass	µg l-1 Chlorophyll *a*	Maintain appropriate water quality to support the habitat, including high chlorophyll a status	No.
Water quality: phytoplankton composition	EPA phytoplankton composition metric	Maintain appropriate water quality to support the habitat, including high phytoplankton composition status	No.
Water quality: attached algal biomass	Algal cover and EPA phytobenthos metric	Maintain trace/ absent attached algal biomass (	No.
Water quality: macrophyte status	EPA macrophyte metric (The Free Index)	Maintain high macrophyte status	No.
Acidification status	pH units; mg/l	Maintain appropriate water and sediment pH, alkalinity and cation concentrations to support the habitat, subject to natural processes	No.

Table B.5: Sample Conservation Objectives for 3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. **To restore/maintain the favourable conservation condition of Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. in Lough Corrib cSAC[39], which is likely to be defined by a list of attributes and targets comparable to that outlined below:**			
Attribute	**Measure**	**Target**	**Is the proposed development likely to affect the conservation target?**
Water colour	mg/l PtCo	Maintain appropriate water colour to support the habitat	No.
Dissolved organic carbon (DOC)	mg/l	Maintain appropriate organic carbon levels to support the habitat	No.
Turbidity	nephelometric turbidity units/ mg/l SS/ other appropriate unit	Maintain appropriate turbidity to support the habitat	No.
Fringing habitat: area	Hectares	Maintain the area and condition of fringing habitats necessary to support the natural structure and functioning of habitat 3140	No.

Table B.6: Sample Conservation Objectives for 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*)(*important orchid sites) **To restore/maintain the favourable conservation condition of Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*)(*important orchid sites) in Lough Corrib cSAC[40], which is likely to be defined by a list of attributes and targets comparable to that outlined below:**			
Attribute	**Measure**	**Target**	**Is the proposed development likely to affect the conservation target?**
Habitat area	Hectares	Area stable or increasing, subject to natural processes	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target.
Habitat distribution	Occurrence	No decline, subject to natural processes	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target.
Vegetation composition: typical species	Number at a representative number of monitoring stops	At least seven positive indicator species present, including two "high quality" species	Effects of the viaduct structure associated with the Yellow2 Route Option could potentially affect this attribute and target.
Vegetation composition: negative indicator species	Percentage at a representative number of monitoring stops	Negative indicator species collectively not more than 20% cover, with cover by an individual species not more than 10%	Effects of the viaduct structure associated with the Yellow2 Route Option could potentially affect this attribute and target.
Vegetation composition: non-native species	Percentage at a representative number of monitoring stops	Cover of non-native species not more than 1%	Effects of the viaduct structure associated with the Yellow2 Route Option could potentially affect this attribute and target.
Vegetation composition: woody species and bracken	Percentage at a representative number of monitoring stops	Cover of woody species (except certain listed species) and bracken	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target.

[40] In the absence of site specific conservation objectives for Lough Corrib cSAC these attributes and targets are taken from Slyne Head Peninsula cSAC (Version 1.0, Feb 2014 – accessed June 2015) and Black Head-Poulsallagh Complex cSAC (Version 1.0, May 2014 – accessed June 2015).

Table B.6: Sample Conservation Objectives for 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*)(*important orchid sites) **To restore/maintain the favourable conservation condition of Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco Brometalia*)(*important orchid sites) in Lough Corrib cSAC[40], which is likely to be defined by a list of attributes and targets comparable to that outlined below:**			
		(Pteridium aquilinum) not more than 5%	
Vegetation structure: broadleaf herb: grass ratio	Percentage at a representative number of monitoring stops	Broadleaf herb component of vegetation between 40 and 90%	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target.
Vegetation structure: sward height	Percentage at a representative number of monitoring stops	At least 30% of sward between 5cm and 40cm tall	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target.
Vegetation structure: litter	Percentage at a representative number of monitoring stops	Litter cover not more than 25%	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target.
Physical structure: bare soil	Percentage at a representative number of monitoring stops	Not more than 10% bare soil	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target.
Physical structure: disturbance	Square metres	Area showing signs of serious grazing or other disturbance less than 20m²	No.

Table B.7: Sample Conservation Objectives for *7230 Alkaline fens **To restore/maintain the favourable conservation condition of Alkaline fens in Lough Corrib cSAC[41], which is likely to be defined by a list of attributes and targets comparable to that outlined below:**			
Attribute	**Measure**	**Target**	**Is the proposed development likely to affect the conservation target?**
Habitat area	Hectares	Area stable or increasing, subject to natural processes	Effects of the viaduct structure associated with the Green2 Route Option are likely to affect this attribute and target.
Habitat distribution	Occurrence	No decline, subject to natural processes	Effects of the viaduct structure associated with the Green2 Route Option are likely to affect this attribute and target.
Hydrological regime	Metres	Appropriate natural hydrological regimes necessary to support the natural structure and functioning of the habitat	Effects of the viaduct structure associated with the Green2 Route Option could potentially affect this attribute and target.
Peat formation	Flood duration	Active peat formation, where appropriate	No.
Water quality: nutrients	Water chemistry measures	Appropriate water quality to support the natural structure and functioning of the habitat	No.
Vegetation composition: typical species	Percentage	Maintain vegetation cover of typical species including brown mosses and vascular plants	Effects of the viaduct structure associated with the Green2 Route Option are likely to affect this attribute and target.

[41] In the absence of site specific conservation objectives for Lough Corrib cSAC these attributes and targets are taken from Slyne Head Peninsula cSAC (Version 1.0, Feb 2014 – accessed June 2015).

Table B.7: Sample Conservation Objectives for *7230 Alkaline fens **To restore/maintain the favourable conservation condition of Alkaline fens in Lough Corrib cSAC[41], which is likely to be defined by a list of attributes and targets comparable to that outlined below:**			
Attribute	**Measure**	**Target**	**Is the proposed development likely to affect the conservation target?**
Vegetation composition: trees and shrubs	Percentage cover in local vicinity	Cover of scattered native trees and shrubs less than 10%	Effects of the viaduct structure associated with the Green2 Route Option could potentially affect this attribute and target.
Physical structure: disturbed bare ground	Percentage cover at a representative number of monitoring stops and in local vicinity	Cover of disturbed bare ground less than 10%. Where tufa is present, disturbed bare ground less than 1%	Effects of the viaduct structure associated with the Green2 Route Option are likely to affect this attribute and target.
Physical structure: drainage	Percentage cover in local vicinity	Area showing signs of drainage as a result of drainage ditches or heavy trampling less than 10%	Effects of the viaduct structure associated with the Green2 Route Option could potentially affect this attribute and target.

Table B.8: Sample Conservation Objectives for *7210 Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*			
To restore/maintain the favourable conservation condition of Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* in Lough Corrib cSAC[42], which is likely to be defined by a list of attributes and targets comparable to that outlined below:			
Attribute	**Measure**	**Target**	**Is the proposed development likely to affect the conservation target?**
Habitat area	Hectares	Area stable or increasing, subject to natural processes	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target. If the tunnel associated with the Blue2/Pink2 Route Options will not affect the groundwater supply to the Coolagh Lakes then those route options are not likely to affect this conservation target.
Habitat distribution	Occurrence	No decline, subject to natural processes	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target. If the tunnel associated with the Blue2/Pink2 Route Options will not affect the groundwater supply to the Coolagh Lakes then those route options are not likely to affect this conservation target.
Hydrological regime	Flow rates, metres	Appropriate natural hydrological regime necessary to support the natural structure and functioning of the habitat	If the tunnel associated with the Blue2/Pink2 Route Options will not affect the groundwater supply to the Coolagh Lakes then route options are not likely to affect this conservation target.
Peat formation	Flood duration	Active peat formation, where appropriate	If the tunnel associated with the Blue2/Pink2 Route Options will not affect the groundwater supply to the

[42] In the absence of site specific conservation objectives for Lough Corrib cSAC these attributes and targets are taken from Galway Bay Complex cSAC (Version 1.0, Apr 2013 – accessed June 2015).

Table B.8: Sample Conservation Objectives for *7210 Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*			
To restore/maintain the favourable conservation condition of Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* in Lough Corrib cSAC[42], which is likely to be defined by a list of attributes and targets comparable to that outlined below:			
Attribute	**Measure**	**Target**	**Is the proposed development likely to affect the conservation target?**
			Coolagh Lakes then route options are not likely to affect this conservation target.
Water quality: nutrients	Water chemistry measures	Appropriate water quality to support the natural structure and functioning of the habitat	If the tunnel associated with the Blue2/Pink2 Route Options will not affect the groundwater supply to the Coolagh Lakes then route options are not likely to affect this conservation target.
Vegetation composition: typical species	Presence	Maintain vegetation cover of typical species including brown mosses and vascular plants	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target. If the tunnel associated with the Blue2/Pink2 Route Options will not affect the groundwater supply to the Coolagh Lakes then these route options are not likely to affect this conservation target.
Vegetation composition: trees and shrubs	Percentage	Cover of scattered native trees and shrubs not more than 10%	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target. If the tunnel associated with the Blue2/Pink2 Route Options will not affect the groundwater supply to the Coolagh Lakes then these route options are not likely to affect this conservation target.
Physical structure: disturbed bare ground	Percentage	Cover of disturbed bare ground not more than 10%. Where tufa is present, disturbed bare ground not more than 1%	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target.

Table B.8: Sample Conservation Objectives for *7210 Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*			
To restore/maintain the favourable conservation condition of Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* in Lough Corrib cSAC[42], which is likely to be defined by a list of attributes and targets comparable to that outlined below:			
Attribute	**Measure**	**Target**	**Is the proposed development likely to affect the conservation target?**
			If the tunnel associated with the Blue2/Pink2 Route Options will not affect the groundwater supply to the Coolagh Lakes then these route options are not likely to affect this conservation target.
Physical structure: drainage	Percentage	Areas showing signs of drainage as a result of drainage ditches or heavy trampling not more than 10%	Effects of the viaduct structure associated with the Yellow2 Route Option could potentially affect this attribute and target. If the tunnel associated with the Blue2/Pink2 Route Options will not affect the groundwater supply to the Coolagh Lakes then these route options are not likely to affect this conservation target.

Table B.9: Sample Conservation Objectives for *8240 Limestone pavements **To restore/maintain the favourable conservation condition of Limestone pavements in Lough Corrib cSAC[43], which is likely to be defined by a list of attributes and targets comparable to that outlined below:**			
Attribute	**Measure**	**Target**	**Is the proposed development likely to affect the conservation target?**
Habitat area	Hectares	Area stable or increasing, subject to natural processes	No.
Habitat distribution	Occurrence	No decline.	No.
Vegetation composition: typical species	Number at a representative number of monitoring stops	At least seven positive indicator species present	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target.
Vegetation composition: negative indicator species	Percentage at a representative number of monitoring stops	Collective cover of negative indicator species on exposed pavement not more than 1%	Effects of the viaduct structure associated with the Yellow2 Route Option could potentially affect this attribute and target.
Vegetation composition: non-native species	Percentage at a representative number of monitoring stops	Cover of non-native species not more than 1% on exposed pavement	Effects of the viaduct structure associated with the Yellow2 Route Option could potentially affect this attribute and target.
Vegetation composition: scrub	Percentage at a representative number of monitoring stops	Scrub cover no more than 25% of exposed pavement	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target.
Vegetation composition: bracken cover	Percentage at a representative number of monitoring stops	Bracken (Pteridium aquilinum) cover no more than 10% on exposed pavement	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target.

[43] In the absence of site specific conservation objectives for Lough Corrib cSAC these attributes and targets are taken from Inishmore Island cSAC (Version 1.0, Jan 2015 – accessed June 2015).

Table B.9: Sample Conservation Objectives for *8240 Limestone pavements **To restore/maintain the favourable conservation condition of Limestone pavements in Lough Corrib cSAC[43], which is likely to be defined by a list of attributes and targets comparable to that outlined below:**			
Attribute	**Measure**	**Target**	**Is the proposed development likely to affect the conservation target?**
Vegetation structure: woodland canopy	Percentage at a representative number of monitoring stops	Canopy cover on wooded pavement at least 30%	Effects of the viaduct structure associated with the Yellow2 Route Option could potentially affect this attribute and target.
Vegetation structure: dead wood	Occurrence in a representative number of monitoring stops	Sufficient quantity of dead wood on wooded pavement to provide habitat for saproxylic organisms	No.
Indicators of local distinctiveness	Occurrence	Indicators of local distinctiveness are maintained	Effects of the viaduct structure associated with the Yellow2 Route Option are likely to affect this attribute and target.

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Appendix C

Shading Analysis Figures

C1 Shading Analysis Methodology

A series of computer simulations have been carried out in order to calculate the effect of the proposed construction on solar exposure for the adjacent land.

The computer simulations are based on a 3D computer model for the proposed construction and associated design options. The sunlight exposure is calculated by ray racing and the software use is Radiance. Points on the ground can either receive or not direct sunlight. The cumulative number of hours that a point can see direct sunlight is used as the measure of solar exposure.

Solar exposure has been calculated for equinoxes and solstices. The latitude and longitude used to determine the solar geometry are: 53.3°N and 9°W. The information is presented on a sample series of falsecolor diagrams in Appendix C1 that show the distribution of solar exposure on the ground for a section of the Green2 Route Option (within Lough Corrib cSAC in the vicinity of the proposed River Corrib crossing) and a section of the Blue2 Route Option viaduct at Coolagh (adjacent to the Lough Corrib cSAC boundary). The colour scale indicates the number of hours that sunlight is received at a given point, throughout the day considered.

It is also possible to trace the effect of shadowing throughout the year from this sequence of sketches.