Contents

8 Biodiversity

8.0 Executive Summary

This chapter presents an assessment of the likely significant effects of the proposed road development on the receiving biodiversity environment. Given the considerable level of detail contained in this assessment, a summary is first presented to give an overview and assist in an understanding of this chapter. Alongside the term “biodiversity”, the terms “ecology” and “ecological” are also used throughout this chapter as a broader term to refer to the relationships of biodiversity receptors to one another and to their environment.

The collation of the biodiversity baseline data and the preparation of this chapter has had regard to current legislation relating to biodiversity protection and current best practice guidance documents on valuing biodiversity receptors and impact assessment - both for the purposes of EIA and AA.

A desktop study was carried out to inform the initial scope of the ecological surveys required for the environmental impact assessment. The desktop study involved collection and review of relevant published and unpublished sources of data, collation of existing information on the ecological environment and consultation with relevant statutory bodies (e.g. National Parks & Wildlife Service (NPWS) and Inland Fisheries Ireland (IFI)).

A comprehensive range of field surveys were carried out between 2013 and 2018 to inform the impact assessment. These included habitat surveys, surveys for protected plant species, mammal surveys (including dedicated surveys for Otter, Badger and bats), White-clawed crayfish surveys, molluscan surveys (including Freshwater pearl mussel and *Vertigo* snail species surveys), Marsh fritillary butterfly surveys, breeding and wintering bird surveys (including dedicated Barn owl, Peregrine falcon, Red grouse and Woodcock surveys), amphibian surveys, Common lizard surveys and fish surveys (including assessment of biological water quality status).

Each of the sections below provides a summary for each of the key ecological receptors (KERs[1]) in the receiving environment. These summaries include an overview of the baseline, the likely impacts of the proposed road development and the mitigation measures proposed to avoid or minimise the predicted impacts, including a monitoring[2] programme where relevant, the residual impacts remaining, and (where relevant) any compensation measures proposed to further address those residual impacts. Where used below, the term Zone of Influence (ZoI) refers to the area within which the proposed road development could affect the receiving biodiversity environment as a consequence of a particular potential impact.

---

[1]KERs are those biodiversity receptors within the ZoI of the proposed road development which are “both of sufficient value to be material in decision making and likely to be affected significantly” i.e. with an ecological value of local importance (higher value) or greater.

[2] In accordance with the requirement for monitoring set out in the EIA Directive 2014/52/EU to monitor significant effects on the environment

The KER summaries are divided into the following headings for ease of reading:

- Designed areas for nature conservation:
    - European sites (cSAC & SPA)
    - Natural Heritage Areas (NHA)
    - Proposed Natural Heritage Areas (pNHA)
- Habitats
- Rare and protected species
- Otter
- Bats
- Badger
- Other Mammal Species
- Mollusc species
- Marsh fritillary butterfly
- Breeding birds
- Wintering birds
- Amphibians
- Reptiles
- Fish

Local biodiversity areas, as defined in the *Galway City Development Plan 2017–2023* and the most recent draft of the *Galway City Biodiversity Action Plan 2014–2024* are also considered. Local biodiversity areas provide habitat for a range of species with the River Corrib corridor providing an important link between Galway Bay and the mosaic of habitats surrounding the city, which includes the wetland complex associated with Lough Corrib. The local biodivsersity areas that lie within the zone of influence of the proposed road development are:

- Rusheen Bay – Barna Woods – Illaunafamona
- Cappagh – Ballymoneen
- Ballagh – Barnacranny Hill
- River Corrib and adjoining wetlands
- Menlough to Coolough Hill
- Ballindooley – Castlegar (which is linked to the River Corrib by the Terryland River)
- Galway Racecourse, Ballybrit
- Doughiska
- Mutton Island and nearby shoreline

8.0.1 Designed areas for nature conservation

8.0.1.1 European sites – (candidate) Special Areas of Conservation ((c)SACs) and Special Protection Areas (SPAs)

There are four European sites within the ZoI of the proposed road development: Lough Corrib cSAC is traversed by the proposed road development, with Lough Corrib SPA located upstream and Galway Bay Complex cSAC and Inner Galway Bay SPA downstream of the proposed road development. There are no other European sites at risk of impacts from the proposed road development.

The potential impacts associated with the proposed road development, how these might affect the European sites' conservation objectives, and the mitigation measures that will be implemented to ensure that adverse effects on site integrity do not arise, are considered and assessed in full detail in the Natura Impact Statement (NIS). The conclusion of the NIS assessment was that the proposed road development will not adversely affect the integrity of any European site, either alone or in combination with other plans or projects.

The proposed road development will, however, have a residual biodiversity effect on Lough Corrib cSAC locally, as there will be permanent habitat losses and long-term effects on local bat populations[3] that use habitats within the European site. None of these impacts will affect the site's conservation objectives or adversely affect the integrity of Lough Corrib cSAC and therefore, the proposed road development will not result in a likely significant residual effect on any European sites.

The European sites are discussed in detail below with the receiving environment in **Section 8.3.3**; evaluation of impacts in **Section 8.5.3**; proposed mitigation measures in **Section 8.6.1** and residual impacts in **Section 8.7.1**.

8.0.1.2 Natural Heritage Areas (NHAs) and proposed Natural Heritage Areas (pNHAs)

Moycullen Bogs NHA lies immediately adjacent to the proposed road development at Tonabrocky and is the only NHA site within the ZoI of the proposed road development.

The potential impacts associated with the proposed road development on Moycullen Bogs NHA include the deposition of dust during construction, the introduction of non-native invasive plant species and surface water impacts during construction. Moycullen Bogs NHA is beyond the ZoI of any hydrogeological effects from the proposed road development. Mitigation measures will be implemented to ensure that the proposed road development does not affect habitats

[3] The Menlough Lesser horseshoe bat population is not connected to the Eborhall Lesser horseshoe bat population, which is the qualifying interest (QI) population for Lough Corrib cSAC. Any predicted impacts on Lesser horseshoe bats associated with the proposed road development will not affect the conservation objectives of the Lough Corrib cSACs QI Lesser horseshoe bat population.

and species in Moycullen Bogs NHA via these impacts. Therefore, the proposed road development will not result in likely significant residual effects on the NHA.

There are only two pNHA sites within the ZoI of the proposed road development: Lough Corrib pNHA and Galway bay Complex pNHA.

Lough Corrib pNHA is traversed by the proposed road development at the River Corrib Bridge crossing. The potential impacts associated with the proposed road development on this pNHA site are generally as per those discussed in the NIS in relation to Lough Corrib cSAC and Lough Corrib SPA – habitat loss, surface water impacts during construction, deposition of dust during construction, the introduction of non-native invasive plant species, hydrogeological impacts and mortality risk to aquatic species. However, the zone within which the proposed road development directly interacts with Lough Corrib pNHA is much smaller than that directly affected within Lough Corrib cSAC, and is limited to the River Corrib channel and banks at the proposed River Corrib Bridge. Mitigation measures will be implemented to avoid and minimise effects on biodiversity receptors in the receiving environment. As with Lough Corrib cSAC, although there will be some level of residual impact in the vicinity of the River Corrib this is not likely to affect the integrity of Lough Corrib pNHA.

Galway Bay Complex pNHA lies downstream of the proposed road development where it crosses the Bearna Stream catchment, the Knocknacarra Stream catchment and the River Corrib. The potential impacts associated with the proposed road development on this pNHA site are generally as per those discussed in the NIS in relation to Galway Bay Complex cSAC and Inner Galway Bay SPA - surface water impacts during construction, the introduction of non-native invasive plant species, barrier effect and mortality risk to aquatic species, affecting groundwater and disturbing wintering birds at important wetland sites (e.g. Ballindooley Lough). Mitigation measures will be implemented to ensure that the proposed road development will not result in likely significant residual effects on the pNHA via these impacts.

Therefore, the proposed road development will not result in likely significant residual effects on pNHAs.

The NHA and pNHA sites are discussed in detail below with the receiving environment in **Section 8.3.3**; evaluation of impacts in **Section 8.5.3**; proposed mitigation measures in **Section 8.6.1** and residual impacts in **Section 8.7.1**.

8.0.2 Habitats

West of the River Corrib, outside of the built environment, habitats recorded during the surveys generally consisted of a mosaic of agricultural fields, peatland/heath habitats, and scrub; separated into distinct habitat blocks of varying sizes by the local road network and the associated linear residential development. The peatland habitat blocks consisted of predominantly wet heath, dry heath and bog habitat mosaics.

The area from the River Corrib to the N84 Headford Road comprised of a patchwork of semi-natural woodland, limestone pavement, scrub and calcareous grassland fields. East of the N84 Headford Road, habitats comprised of predominantly improved agricultural grasslands surrounded by residential and industrial development in Parkmore, Ballybrit, Briarhill and Doughiska, although there were some isolated patches of semi-natural habitats – calcareous grassland and limestone pavement – in the Coolagh/Doughiska area. There were also two wetland complexes of note: at the Coolagh Lakes and at Ballindooley Lough.

Non-native invasive plant species (Japanese knotweed, Himalayan knotweed and Rhododendron) were recorded in dispersed locations across the study area.

The following Annex I habitats were recorded within, or adjacent to, the proposed development boundary: Hard water lakes [3140], Turloughs [*3180], Petrifying springs [*7220], Residual alluvial forests [*91E0], Limestone pavement [*8240], Wet heath [4010], Dry heath [4030], Calcareous grassland [*6210/6210], *Molinia* meadow [6410], Blanket bog (active) [*7130], *Cladium* fen [*7210], and Alkaline fen [7230].

The potential impacts of the proposed road development are loss of habitat, habitat fragmentation, and habitat degradation through effects on surface water quality, groundwater, deposition of dust during construction, the introduction of non-native invasive plant species and the structural stability of rock around tunnels and deep excavations/cuttings.

Mitigation measures will be implemented to protect surface water quality and groundwater in the receiving environment, control dust emissions from the construction site, control and prevent the spread of non-native invasive plant species, ensure that tunnelling and deep excavations do not affect the structural integrity of the surrounding rock mass, and to minimise habitat losses within the proposed development boundary.

However, the permanent losses of the following habitats will result in a likely significant negative residual effect at geographic scales ranging from local to international: a Petrifying spring feature at Lackagh Quarry, c.0.1ha of Residual alluvial forest habitat, c.0.54ha of Limestone pavement habitat, c.2.06ha of Wet heath habitat, c.1.85ha of Dry heath habitat, c.0.87ha of Wet heath/Dry heath/*Molinia* habitat mosaic, c.0.7ha of Calcareous grassland habitat (non-priority), c.0.28ha of *Molinia* meadow habitat, fifteen calcareous spring features (FP1), c.7.81ha of dry-humid acid grassland habitat, c.0.13ha of poor fen and flush (PF2) habitat, c.2.62ha of (mixed) broadleaved woodland (WD1), c.7.8km of hedgerows (WL1) and c.4km of treelines.

Compensatory habitat will be provided to replace the areas of Residual alluvial forest (c.0.18ha), Dry heath (c.7.06ha), Calcareous grassland (c.7.14ha), *Molinia* meadow (0.49ha), (mixed) broadleaved woodland (> 2.62ha), hedgerows (> 7.8km) and treelines (> 4km) by providing a greater area to that being permanently lost to the proposed road development.

However, some of the Annex I habitat types that are being lost, outside of any European sites, cannot be directly compensated. Therefore, there will be a likely significant residual negative effect at the international geographic scale for the permanent loss of c.0.54ha of Limestone pavement, at the national geographic scale for the permanent loss of c.2.93ha of Wet heath and wet heath mosaic habitat, at the county geographic scale for the loss of a Petrifying spring feature at Lackagh

Quarry, and at the local geographic scale for the permanent loss of 15 calcareous springs at Lackagh Quarry, c.7.81ha of dry-humid acid grassland and c.0.13ha of poor fen and flush habitat. The Annex I habitat impacts are summarised in **Table 8.0** below.

Table 8.0: Summary of Annex I Habitat Impacts

Annex I habitat type	Area Potentially Impacted	Area to be Retained	Permanent area of habitat loss	Area of Compensatory Habitat	Residual Habitat Loss
Turlough [*3180]	c.0.04ha within proposed development boundary[4]	All	None	n/a	None
Petrifying springs [*7220]	Two Petrifying spring features at Lackagh Quarry	One feature to be retained	One Petrifying spring feature	n/a	One Petrifying spring feature
Residual alluvial forest [*91E0]	c.0.1ha	None	c.0.1ha	c.0.18ha	None
Limestone pavement [*8240]	c.2.18ha	c.1.64ha	c.0.54ha	n/a	c.0.54ha
Limestone pavement/Calcareous grassland [*8240/6210] Above Lackagh Tunnel	c.0.12ha	All	None	n/a	None
Wet heath [4010]	c.2.06ha	None	c.2.06ha	n/a	c.2.06ha
Dry heath [4030]	c.1.96ha	c.0.11ha	c.1.85ha	c.7.06ha	None
Wet heath/Dry heath/*Molinia* mosaic [4010/4030/6410]	c.1.13ha	c.0.26ha	c.0.87ha	n/a	c.0.87ha
Calcareous grassland [6210]	c.1.14ha	c.0.44ha	c.0.7ha	c.7.14ha	None
Molinia meadow [6410]	c.1.02ha	c.0.74ha	c.0.28ha	c.0.49ha	None

Habitats are discussed in detail below with the receiving environment in **Section 8.3.4** and **8.3.6** (for non-native invasive plants); evaluation of impacts in **Section 8.5.4**; proposed mitigation measures in **Section 8.6.2** to **8.6.6**; residual impacts in **Section 8.7.2** and proposed compensatory measures in **Section 8.9.1**.

[4] Total area of Turlough is c.0.1ha

8.0.3 Rare and protected plant species

There are no rare or legally protected plant species present within the proposed development boundary or known from areas within the ZoI of the proposed road development. Therefore, the proposed road development will not result in likely significant residual effects on rare or legally protected plant species.

Rare and protected plant species are discussed in detail below with the receiving environment in **Section 8.3.5**; evaluation of impacts in **Section 8.5.5** and residual impacts in **Section 8.7.3**.

8.0.4 Otter

Otter, and their breeding and resting places, are protected under the Wildlife Acts. Otter are also listed on Annex II and Annex IV of the EU Habitats Directive. Evidence of Otter activity was abundant and widespread along the River Corrib corridor and the south-eastern shore of Lough Corrib. Otter were also recorded in the catchment of the Bearna Stream and the Tonabrocky Stream. There were no Otter holt or couch sites within the ZoI of the proposed road development.

The proposed road development will result in the loss of a small area of Otter habitat, it may pose a temporary habitat severance/barrier effect, and will result in some level of disturbance to Otter during construction and operation. However, this will not result in any long-term effects on the local Otter population. During operation, the combination of the network of wildlife passage facilities, culverts, bridges and viaduct structures (e.g. the proposed River Corrib Bridge and the Menlough Viaduct), and the mammal fencing, will reduce any long-term severance or barrier effects and the mortality risk associated with the proposed road development, such that the local Otter population will not be negatively affected. The effectiveness of the mitigation measures will be monitored post-construction.

Therefore, the proposed road development will not result in likely significant residual effects on the local Otter population.

Otter are discussed in detail below with the receiving environment in **Section 8.3.7.1**; evaluation of impacts in **Section 8.5.6.1**; proposed mitigation measures in **Section 8.6.7.1** and residual impacts in **Section 8.7.4.1**.

8.0.5 Bats

Bats, and their breeding and resting places, are protected under the Wildlife Acts. All bat species are also listed on Annex IV of the Habitats Directive; with the Lesser horseshoe bat also listed on Annex II. The following bat species were recorded locally during the field surveys: the Lesser horseshoe bat, Leisler’s bat, the Common pipistrelle bat, the Soprano pipistrelle bat, Nathusius’ pipistrelle bat, the Brown long-eared bat, Daubenton’s bat, Natterer’s bat and the Whiskered bat. A total of 88 roost sites were recorded within the local area during the field surveys.

The local Lesser horseshoe population is of particular importance given its Annex II status and the importance of the local area as a stepping-stone for the species between Lesser horseshoe bat populations in north Galway/south Mayo and south

Galway/Clare[5]. The maternity/hibernation roost at Menlo Castle and the mating/hibernation roost at Cooper's Cave in Castlegar are key roost sites for the Menlough Lesser horseshoe bat population, which are also supported by a network of smaller day/night roost sites across the local area. The foraging habitat surrounding the maternity roost is vital in supporting the local Lesser horseshoe bat population, as is the extent of foraging habitat and the commuting routes that connect the landscape between those key roost sites at Menlo Castle and Cooper's Cave. Although the proposed road development does not directly affect either the Menlo Castle or Cooper's Cave roosts, it will affect three Lesser horseshoe bat roost sites used by the Menlough population, will result in habitat loss within their foraging area (including in the vicinity of the maternity roost), and will present a barrier to movement between the maternity, mating and hibernation roost sites.

Fifteen buildings which support 20 bat roosts are within the proposed development boundary:

- six Soprano pipistrelle roosts
- one Common pipistrelle roost
- one unidentified Pipistrelle species bat roost
- seven Brown long-eared bats roost
- three Lesser horseshoe bat roosts
- two roosts of unidentified bat species

Fourteen of these buildings will be demolished with one (a Soprano pipistrelle roost) being retained.

Two of the trees along the proposed road development with a high potential to support roosting bats were confirmed as roosting sites, and will be removed:

- one Leisler's bat roost
- one Soprano pipistrelle roost

During construction, the proposed road development will also result in the loss of foraging habitat, habitat severance will affect bat commuting routes, habitat loss will present a barrier to bat flight paths, construction works will cause disturbance to roost sites, and lighting will disturb foraging and commuting bats.

During operation, the proposed road development will present a permanent mortality risk to the local bat populations, will permanently sever bat habitat and commuting routes and present a barrier to bat movements at a landscape scale. Operational lighting will also disturb and displace bats.

Mitigation measures will be implemented during construction to protect bats during building demolitions and tree removal and to preserve flight paths across the construction site. During operation, a series of underpasses and the Castlegar

[5] The Menlough Lesser horseshoe bat population is not connected to the Eborhall Lesser horseshoe bat population, which is the qualifying interest (QI) population for Lough Corrib cSAC. Any predicted impacts on Lesser horseshoe bats associated with the proposed road development will not affect the conservation objectives of the Lough Corrib cSACs QI Lesser horseshoe bat population.

Wildlife Overpass will be installed to allow bats to cross the proposed road development away from traffic, reducing the mortality risk and any permanent barrier effects. The lighting design has minimised the disturbance and displacement effects on bats during operation. The mitigation strategy includes pre-construction monitoring and monitoring of the effectiveness of the mitigation measures during and post-construction.

Despite the implementation of these mitigation measures there will be a significant residual effect on the local Lesser horseshoe bat population at the national geographic scale (given the importance of the local population), and on all other bat species at the local geographic scale.

To further reduce the effects of the residual impacts on the local bat populations, compensation measures are also proposed. These measures are:

- the provision of new roosting sites (new buildings, buildings retrofitted to create roost sites and bat boxes)
- measures to protect these roosts during construction
- and habitat enhancement measures (e.g. planting)

The effectiveness of the mitigation measures will be monitored as part of the monitoring programme.

With the compensation measures implemented the residual impacts of the proposed road development on bats will be reduced from a likely significant residual negative effect on the local bat populations at the national geographic scale to a local geographic scale.

Bats are discussed in detail below with the receiving environment in **Section 8.3.7.2**; evaluation of impacts in **Section 8.5.6.2**; proposed mitigation measures in **Section 8.6.7.2**; residual impacts in **Section 8.7.4.2** and proposed compensatory measures in **Section 8.9.2**.

8.0.6 Badger

Badger are protected under the Wildlife Acts and were recorded across the study area from Na Foraí Maola to the N83 Tuam Road. The highest concentrations of badger activity were recorded in the Menlough area and the area between Lackagh Quarry and the N84 Headford Road. A total of 17 badger setts were identified both within and in the vicinity of the study area.

Although the proposed road development will result in the loss of foraging habitat and disturbance due to light spill during operation, these impacts will not result in any long-term effects on the local population. The proposed road development will result in the loss of three badger setts, which includes the main and a subsidiary sett of one badger group at Lackagh. An artificial badger sett will be provided to reduce the effects of sett loss on this badger group.

Mitigation measures will also be implemented during construction to minimise the effects of disturbance on the local badger population and to avoid badgers being killed during sett removal. During operation, the combination of the network of wildlife passage facilities, culverts, bridges and viaduct structures (e.g. the proposed River Corrib Bridge and the Menlough Viaduct), and mammal fencing will reduce any long-term severance or barrier effects and the mortality risk associated with the proposed road development, such that the local Badger population will not be negatively affected. The effectiveness of the mitigation measures will be monitored post-construction.

Therefore, the proposed road development will not result in likely significant residual effects on the local Badger population.

Badgers are discussed in detail below with the receiving environment in **Section 8.3.7.3**; evaluation of impacts in **Section 8.5.6.3**; proposed mitigation measures in **Section 8.6.7.3** and residual impacts in **Section 8.7.4.3**.

8.0.7 Other Mammal Species

The following terrestrial mammal species protected under the Wildlife Acts were recorded, or are known, from the area surrounding the proposed road development:

- Pine marten
- Wood mouse
- Red squirrel
- Irish stoat
- Irish hare
- Hedgehog
- Pygmy shrew

Fox, Rabbit, Mink and Bank vole were also recorded during the field surveys.

Although the proposed road development will result in the loss of foraging habitat for these mammals, will present a low level of mortality risk and will result in disturbance/displacement effects, these impacts will not result in any long-term effects on local populations.

During operation, the combination of the network of wildlife passage facilities, culverts, bridges and viaduct structures (e.g. the proposed River Corrib Bridge and the Menlough Viaduct) will reduce any long-term severance or barrier effects associated with the proposed road development such that the local populations of these mammal species will not be negatively affected.

Harbour seal, Grey seal, Common dolphin and Harbour porpoise are known from Galway Bay and these species are all protected under the Wildlife Acts – both seal species are also listed on Annex II of the habitats directive and all cetacean species are listed on Annex IV of the Habitats Directive.

Mitigation measures will be implemented to ensure that the proposed road development will not affect water quality in the receiving aquatic or marine environments and therefore, will not affect the marine mammal populations in Galway Bay.

Therefore, the proposed road development will not result in likely significant residual effects on these terrestrial or marine mammal species.

These species are discussed in detail below with the receiving environment in **Section 8.3.7.4**; evaluation of impacts in **Section 8.5.6.4**; proposed mitigation measures in **Section 8.6.7.4** and residual impacts in **Section 8.7.4.4**.

8.0.8 Mollusc species

Neither the White-clawed crayfish, the Freshwater pearl mussel, nor any other legally protected mollusc species, were recorded within the ZoI of the proposed road development.

There is a Freshwater pearl mussel population in the Owenriff River (c.23km to the north, at Oughterard, Co. Galway) which the proposed road development could affect indirectly through impacting on salmonid fish populations in the River Corrib. This was considered and assessed in the NIS, as the Owenriff population are the qualifying interest population for Lough Corrib cSAC. The conclusion of this assessment was that, considering the mitigation measures to protect the aquatic environment, the proposed road development would not affect salmonid fish species in the receiving environment and therefore not affect that Freshwater pearl mussel population.

The Marsh whorl snail is listed as vulnerable in the Irish Red Data List of molluscs (Byrne *et al*., 2009) and was recorded in wetland habitat along the River Corrib, in fringing wetland habitat at the Coolagh Lakes, at Ballindooley Lough and at the marsh in Castlegar. Although the proposed road development will result in some level of habitat loss locally, and may also result in a level of mortality at affected sites during construction, this will not result in any long-term effects on the local population. Mitigation measures will be implemented to ensure that the proposed road development will not affect water quality in the receiving environment during construction or affect the local groundwater regime.

Therefore, the proposed road development will not result in likely significant residual effects on mollusc species.

White-clawed crayfish and Freshwater pearl mussel are discussed in detail below with the receiving environment in **Section 8.3.8.1** and **8.3.8.2**; evaluation of impacts in **Section 8.5.7.1** and **8.5.7.2** and residual impacts in **Section 8.7.5.1** and **8.7.5.2**.

8.0.9 Marsh fritillary butterfly

The Marsh fritillary butterfly is listed on Annex II of the Habitats Directive. A local breeding population is present and is supported by suitable habitat patches across the western part of the study area, some of which are directly affected by the proposed road development.

Although the proposed road development will result in the loss of Marsh fritillary habitat, and will sever some habitat areas within their local range, and will likely cause a low level of mortality during operation, this will not result in any long-tern effects on the local population. However, the mortality risk during site clearance has the potential to have a significant effect on the local Marsh fritillary butterfly population. A mitigation strategy will be implemented to minimise this risk and avoid any population level effects.

Therefore, the proposed road development will not result in likely significant residual effects on the Marsh fritillary butterfly.

Marsh fritillary butterfly are discussed in detail below with the receiving environment in **Section 8.3.8.4**; evaluation of impacts in **Section 8.5.7.4**; proposed mitigation measures in **Section 8.6.8.2** and residual impacts in **Section 8.7.5.4**.

8.0.10 Breeding birds

A wide range of breeding bird species (62 in total) were recorded across the study area. These included species of conservation concern listed on the Amber and Red Birds of Conservation Concern in Ireland (BoCCI) lists, Annex I bird species, and species listed as SCIs for nearby SPA sites. All wild bird species are protected under the Wildlife Acts.

The proposed road development will result in the loss of breeding bird nesting and foraging habitat, it will pose a mortality risk to birds and it will disturb and potentially displace birds from breeding and foraging habitat. However, it will not result in any long-term effects on the majority of local breeding bird populations.

Barn owl are a breeding bird species of high conservation concern in Ireland and are particularly at risk of mortality from collisions with traffic. The nest site at Menlo Castle is in close proximity to the main construction works. Mitigation measures will be implemented to minimise the risk of impacts on Barn owl and to avoid any significant long-term residual impact on the local Barn owl population. These measures include the provision of additional nesting opportunities (nest boxes) and planting in high-risk areas to discourage Barn owl from foraging along the road edge and to encourage Barn owl to fly over the road carriageway above traffic height. The effectiveness of the mitigation measures will be monitored post-construction as part of the monitoring programme.

Although the Peregrine falcon nest site at Lackagh Quarry will be retained, it will be subject to high levels of disturbance during construction and operation. Mitigation measures will be implemented to minimise any disturbance effects (seasonal constraint during construction). However, there remains a risk that the Peregrine falcon will abandon Lackagh Quarry as a nesting site as a result of the proximity of the road carriageway to the existing nest site and due to the lack of suitable alternatives ledges in the quarry post-construction. This is likely to have long-term effects on the Peregrine falcon population at a local and county geographic scale.

Although the proposed road development is not likely to result in any significant residual effects on the majority of breeding bird species, there is likely to be a significant negative residual effect on Peregrine falcon at the county geographic scale.

Breeding birds are discussed in detail below with the receiving environment in **Section 8.3.9.1**; evaluation of impacts in **Section 8.4.8.1**; proposed mitigation measures in **Section 8.5.9.1**; residual impacts in **Section 8.6.6.1** and proposed compensation measures in **Section 8.8.3**.

8.0.11 Wintering birds

A wide range of wintering bird species were recorded across the study area. These included species of conservation concern listed on the Amber and Red BoCCI lists, Annex I bird species, and species listed as SCIs for nearby SPA sites. All wild bird species are protected under the Wildlife Acts.

The proposed road development will result in habitat loss across sites where wintering birds were recorded. It will result in some level of disturbance during operation and the proposed River Corrib Bridge poses a low level of collision risk to birds. However, it is not likely to result in any long-term effects on most local wintering bird populations. Ballindooley Lough, however, is an important local site for wintering birds – fourteen wintering bird species were recorded during the field surveys, including species listed as SCIs for Lough Corrib SPA and Inner Galway Bay SPA. Blasting in the vicinity of Ballindooley Lough during construction has the potential to displace wintering birds from this wetland habitat complex over multiple seasons. A seasonal restriction on blasting in this area will minimise the impact and avoid any long-term effects on wintering birds at Ballindooley Lough. Mitigation measures will also be implemented to ensure that the proposed road development will not affect water quality in the receiving environment during construction, or affect the local groundwater regime that supports wetland used by wintering birds.

Therefore, the proposed road development will not result in likely significant residual effects on wintering birds.

Wintering birds are discussed in detail below with the receiving environment in **Section 8.3.9.2**; evaluation of impacts in **Section 8.4.8.2**; proposed mitigation measures in **Section 8.5.9.2** and residual impacts in **Section 8.6.6.2**.

8.0.12 Amphibians

The Common frog and the Smooth newt are protected under the Wildlife Acts and were recorded in wetland habitats across the local area, including habitat impacted by the proposed road development.

Although the proposed road development will result in a temporary severance/barrier effect during construction, and present a mortality risk during operation, these impacts will not result in any long-term effects on the local population.

Mitigation measures will be implemented during construction to minimise the effects of habitat loss and disturbance to amphibians, to ensure that Common frog or Smooth newt are not killed during site clearance works, and to protect water quality in wetland habitat used by these species. During operation, the combination of the network of wildlife passage facilities, culverts, bridges and viaduct structures (e.g. the proposed River Corrib Bridge and the Menlough Viaduct) will reduce any long-term severance or barrier effects associated with the proposed road development such that the local amphibian populations will not be negatively affected.

Therefore, the proposed road development will not result in likely significant residual effects on amphibian species.

Amphibians are discussed in detail below with the receiving environment in **Section 8.3.10**; evaluation of impacts in **Section 8.4.9**; proposed mitigation measures in **Section 8.5.10** and residual impacts in **Section 8.6.7**.

8.0.13 Reptiles

Common lizard are protected under the Wildlife Acts and were recorded at Troscaigh Thiar, north of Bearna Woods and Knocknafroska/Knocknabrona during the field surveys.

Although the proposed road development will result in a temporary severance/barrier effect during construction, and present a mortality risk during operation, these impacts will not result in any long-term effects on the local population.

Mitigation measures will be implemented during construction to minimise the effects of habitat loss and disturbance on the local Common lizard population and to ensure that lizards are not killed during site clearance works. During operation, the combination of the network of wildlife passage facilities, culverts, bridges and viaduct structures (e.g. the proposed River Corrib Bridge and the Menlough Viaduct) will reduce any long-term severance or barrier effects associated with the proposed road development such that the local lizard populations will not be negatively affected.

Therefore, the proposed road development will not result in likely significant residual effects on the Common lizard.

Reptiles are discussed in detail below with the receiving environment in **Section 8.3.11**; evaluation of impacts in **Section 8.4.10**; proposed mitigation measures in **Section 8.5.11** and residual impacts in **Section 8.6.8**.

8.0.14 Fish

Fish species are protected under the Fisheries Acts, with Atlantic salmon, Brook lamprey and Sea lamprey also listed on Annex II of the Habitats Directive.

The proposed road development will result the loss of aquatic habitat, construction works may disturb fish species, and construction works may pose a temporary barrier to fish movement on minor watercourses. However, it will not result in any long-term effects on local fish populations. The drainage design will protect water quality in the receiving aquatic environment during operation. Mitigation measures will be implemented to ensure that the proposed road development will not affect water quality in the receiving environment during construction, affect the local groundwater regime, and minimise the risk of fish mortality during construction.

Therefore, the proposed road development will not result in likely significant residual effects on fish species.

8.0.15 Significant Residual Impacts

The significant residual impacts remaining after mitigation are those associated with habitat loss (see **Section 8.1.2**), impacts on bats (see **Section 8.1.5**) and impacts on Peregrine falcon (see **Section 8.1.10**). In relation to habitat loss, this includes three priority Annex I habitats (Petrifying springs, Residual alluvial forests and Limestone pavement), four Annex I habitat types (Wet heath, Dry heath, *Molinia* meadow and Calcareous grassland), in addition to five other non-Annex habitat types of a local biodiversity value.

Where possible, compensatory measures will be implemented to reduce or avoid these significant residual impacts. The loss of areas of the Annex I habitats Residual alluvial forests, Dry heath, *Molinia* meadows and Calcareous grassland will be compensated for, as will the loss of broadleaved woodland, hedgerows and treelines, and there will not be any significant residual impacts. The compensatory measures will reduce the residual impact significance on all bat species to a local level.

Despite the implementation of the mitigation and compensation measures proposed, the proposed road development will have the following likely significant residual effects on biodiversity:

- A likely significant residual effect, at the international geographic scale, for the permanent loss of c.0.54ha of the priority Annex I habitat Limestone pavement [*8240]
- A likely significant residual effect, at the national geographic scale, for the permanent loss of c.2.93ha of the Annex I habitat Wet heath [4010]
- A likely significant residual effect, at the county geographic scale, for the permanent loss of a Petrifying spring [*7220] feature at Lackagh Quarry
- A likely significant residual effect, at the county geographic scale, for the potential permanent loss of a Peregrine falcon nest site at Lackagh Quarry
- A likely significant residual effect, at the local geographic scale, on all bat species due to the presence of the proposed road development within their foraging areas
- A likely significant residual effect, at the local geographic scale, for the permanent loss of 15 calcareous springs (FP1) at Lackagh Quarry, c.7.81ha of Dry-humid acid grassland (GS3) and c.0.13ha of Poor fen and flush habitat (PF2).

These significant residual effects will also affect the following local biodiversity areas: Coast Road (R336) to the N59 Moycullen Road, the River Corrib and the Coolagh Lakes, Menlough to Coolough Hill, Ballindooley – Castlegar and the Doughiska area.

Although the significant residual effects associated with the losses of Limestone pavement and Wet heath habitat cannot be directly compensated for, areas of related habitats will be created to provide a biodiversity gain for both peatland and limestone associated habitats locally. The area of Dry heath habitat being provided is c.7.06ha which is greater than the combined losses of all peatland habitats (c.4.78ha). The area of Calcareous grassland habitat being provided is c.7.14ha which is greater than the combined losses of Limestone pavement and Calcareous grassland habitat (c.1.24ha).

8.1 Introduction

This chapter of the EIAR consists of an impact appraisal of the proposed N6 Galway City Ring Road, hereafter referred to as the proposed road development, under the heading of Biodiversity.

In accordance with the requirements of *Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment* (i.e. the EIA Directive), this chapter of the EIAR identifies, describes and assesses the likely direct and indirect significant effects of the proposed road development on biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC (i.e. the Habitats and Birds Directives). In addition, this chapter of the EIAR also identifies, describes and assesses the likely direct and indirect significant effects of the proposed road development on species protected pursuant to the Wildlife Acts 1976 to 2017.

The EIA Directive does not provide a definition of biodiversity. The Convention on Biological Diversity, however, gives a formal definition of biodiversity in its article 2: "biological diversity means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems". Alongside the term “biodiversity” the terms “ecology” and “ecological” are also used throughout this chapter as a broader term to consider the relationships of biodiversity receptors to one another and to their environment.

The chapter is set out as follows:

- **Section 8.2** presents the methodology
- **Section 8.3** describes the existing environment
- **Section 8.4** summarises the main characteristics of the proposed road development which are of relevance for biodiversity
- **Section 8.5** evaluates the impacts of the proposed road development on biodiversity
- **Section 8.6** describes the measures proposed to mitigate these impacts
- **Section 8.7** describes the residual impacts
- **Section 8.8** describes the cumulative impacts

- **Section 8.9** describes the compensatory measures proposed to address the residual impacts
- **Section 8.10** presents a summary of the biodiversity chapter
- **Section 8.11** are the references quoted throughout the chapter

Table 8.1 below presents an outline of where the various groupings of ecological receptors are discussed in this chapter, for ease of reference.

Table 8.1: Ecological Receptors Presented within this Chapter

Ecological Receptor	Information Presented	Section Reference
Designated Areas for Nature Conservation	Receiving Environment	8.3.3
	Evaluation of Impacts	8.5.3
	Mitigation Measures	8.6.1
	Residual Impacts	8.7.1
	Compensation	n/a
Habitats	Receiving Environment	8.3.4
	Evaluation of Impacts	8.5.4
	Mitigation Measures	8.6.2-8.6.6
	Residual Impacts	8.7.2
	Compensation	8.9.1
Rare and protected plant species	Receiving Environment	8.3.5
	Evaluation of Impacts	8.5.5
	Mitigation Measures	n/a
	Residual Impacts	8.7.3
	Compensation	n/a
Non-native invasive plant species	Receiving Environment	8.3.6
	Evaluation of Impacts	n/a
	Mitigation Measures	n/a
	Residual Impacts	n/a
	Compensation	n/a
Otter	Receiving Environment	8.3.7.1
	Evaluation of Impacts	8.5.6.1
	Mitigation Measures	8.6.7.1
	Residual Impacts	8.7.4.1
	Compensation	n/a
Bats	Receiving Environment	8.3.7.2
	Evaluation of Impacts	8.5.6.2
	Mitigation Measures	8.6.7.2
	Residual Impacts	8.7.4.2

Ecological Receptor	Information Presented	Section Reference
	Compensation	8.9.2
Badgers	Receiving Environment	8.3.7.3
	Evaluation of Impacts	8.5.6.3
	Mitigation Measures	8.6.7.3
	Residual Impacts	8.7.4.3
	Compensation	n/a
Other Mammal Species	Receiving Environment	8.3.7.4
	Evaluation of Impacts	8.5.6.4
	Mitigation Measures	8.6.7.4
	Residual Impacts	8.7.4.4
	Compensation	n/a
White-clawed crayfish	Receiving Environment	8.3.8.1
	Evaluation of Impacts	8.5.7.1
	Mitigation Measures	n/a
	Residual Impacts	8.7.5.1
	Compensation	n/a
Freshwater pearl mussel	Receiving Environment	8.3.8.2
	Evaluation of Impacts	8.5.7.2
	Mitigation Measures	n/a
	Residual Impacts	8.7.5.2
	Compensation	n/a
Marsh whorl snail	Receiving Environment	8.3.8.3
	Evaluation of Impacts	8.5.7.3
	Mitigation Measures	8.6.8.1
	Residual Impacts	8.7.5.3
	Compensation	n/a
Marsh fritillary butterfly	Receiving Environment	8.3.8.4
	Evaluation of Impacts	8.5.7.4
	Mitigation Measures	8.6.8.2
	Residual Impacts	8.7.5.4
	Compensation	n/a
Breeding Birds	Receiving Environment	8.3.9.1
	Evaluation of Impacts	8.5.8.1
	Mitigation Measures	8.6.9.1
	Residual Impacts	8.7.6.1
	Compensation	8.9.3
Wintering Birds	Receiving Environment	8.3.9.2

Ecological Receptor	Information Presented	Section Reference
	Evaluation of Impacts	8.5.8.2
	Mitigation Measures	8.6.9.2
	Residual Impacts	8.7.6.2
	Compensation	n/a
Amphibians	Receiving Environment	8.3.10
	Evaluation of Impacts	8.5.9
	Mitigation Measures	8.6.10
	Residual Impacts	8.7.7
	Compensation	n/a
Reptiles	Receiving Environment	8.3.11
	Evaluation of Impacts	8.5.10
	Mitigation Measures	8.6.11
	Residual Impacts	8.7.8
	Compensation	n/a
Fish	Receiving Environment	8.3.12
	Evaluation of Impacts	8.5.11
	Mitigation Measures	8.6.12
	Residual Impacts	8.7.9
	Compensation	n/a

Along with surveys carried out specifically during the EIA phase of this project, this chapter has also utilised the information gathered during the constraints and route selection studies for the proposed road development to inform the biodiversity impact assessment. **Sections 4.3**, **6.5.1** and **7.6.1** of the **Route Selection Report** examined the biodiversity constraints within the scheme study area and compared the potential biodiversity impacts of the respective route corridors. These sections of the Route Selection Report contributed to the design of the proposed road development which this chapter assesses. **Chapter 5, Description of the Proposed Road Development** provides a detailed description of the proposed road development and **Chapter 7, Consturction Activies** outlines how it is proposed to construct the proposed road development.

8.2 Methodology

8.2.1 Introduction

The methodologies used to collate information on the baseline biodiversity environment and assess the potential impacts of the proposed road development are detailed in the following sections.

8.2.2 Legislation and Guidelines

The collation of ecological baseline data and the preparation of this chapter has had regard to the following legislation and guidance documents. This is not an exhaustive list of all legislation and guidelines but the most relevant legislative and guidelines basis for the purposes of preparing this EIAR.

Legislation:

- *Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora*, hereafter referred to as the Habitats Directive
- *Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds*, hereafter referred to as the Birds Directive
- *European Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. No. 477 of 2011)*, as amended, hereafter referred to as the Birds and Habitats Regulations
- *Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment, as amended by Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014*, hereafter referred to as the EIA Directive
- *Planning and Development Acts 2000 to 2017*, hereafter referred to as the Planning Acts[6]
- *Wildlife Acts 1976 to 2017*, hereafter referred to as the Wildlife Acts
- *Flora (Protection) Order, 2015 (S.I. No. 356 of 2015)*
- *Inland Fisheries Acts 1959 to 2017*, hereafter referred to as the Fisheries Acts.[7]

Guidance Documents:

- *Environmental Impact Assessment of Projects, Guidance on the preparation of the Environmental Impact Assessment Report* (European Commission, 2017)

[6] Updated to 2017 by virtue of Planning and Development (Amendment) Act 2017, s. 2(2).
[7] Updated to 2017 by virtue of Inland Fisheries (Amendment) Act 2017, s. 5(3).

- *Advice notes for Preparing Environmental Impact Statements* (Environmental Protection Agency, Draft September 2015)
- *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (Environmental Protection Agency, Draft August 2017)
- *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)
- *Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment* (European Union, 2013)
- *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition* (CIEEM, 2016)
- Environmental Guidelines Series for Planning and Construction of National Roads *(*National Roads Authority, 2005-2009)
- *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (National Roads Authority, 2009)
- *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes* (National Roads Authority, 2008a) *Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn)* (Collins, (ed.) 2016)
- *Environmental Impact Assessment of National Road Schemes – A Practical Guide* (National Roads Authority, 2008b)
- *The Bat Workers' Manual, 2nd Edition* (Mitchell-Jones & McLeish, 1999)
- *Bat Mitigation Guidelines for Ireland. Irish Wildlife Manuals, No. 25.* (Kelleher & Marnell, 2006)
- Design Manual for Roads and Bridges (Highways Agency 2001a, 2001b and 2005)
- *Circular NPW 1/10 & PSSP 2/10 Appropriate Assessment under Article 6 of the Habitats Directive: Guidance for Planning Authorities* (National Parks & Wildlife Service, 2010)
- *Circular Letter NPWS 2/07 Guidance on compliance with Regulation 23 of the Habitats Regulations 1997 – strict protection of certain species/applications for derogation licences* (National Parks & Wildlife Service, 2007a)
- *Circular Letter PD 2/07 and NPWS 1/07 Compliance Conditions in respect of Developments requiring (1) Environmental Impact Assessment (EIA); or (2) having potential impacts on Natura 2000 sites* (National Parks & Wildlife Service, 2007b)
- *Turloughs over 10 ha: vegetation survey and evaluation* (Goodwillie, R., 1992)
- *Turlough Hydrology, Ecology and Conservation* (Waldren, S. 2015, Ed.)
- *Summary of findings from the Survey of Potential Turloughs 2015* (O'Neill & Martin, 2015)

- *The Irish semi-natural grasslands survey 2007-2012. Irish Wildlife Manuals, No. 78* (O'Neill et al., 2013)
- *Results of monitoring survey of old sessile oak woods and alluvial forests. Irish Wildlife Manuals, No. 71* (O'Neill & Barron, 2013)
- *National survey of limestone pavement and associated habitats in Ireland. Irish Wildlife Manuals, No. 73* (Wilson & Fernández, 2013)
- *Coolagh Lakes, Lough Corrib SAC, Co. Galway: Wetland Survey and Conservation Assessment* (Crushell & Foss, 2014a: unpublished report)
- *Coolanillaun Bog, Lough Corrib SAC, Co. Galway: Wetland Survey and Conservation Assessment* (Crushell & Foss, 2014b: unpublished report)
- *Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79* (Perrin et al., 2014)
- *Monitoring guidelines for the assessment of petrifying springs in Ireland. Irish Wildlife Manuals, No. 94* (Lyons & Kelly, 2016)

8.2.3 Data Sources and Consultations

A desktop study was carried out to inform the initial scope of the ecological surveys required to inform the environmental impact assessment. The desktop study involved collection and review of relevant published and unpublished sources of data, collation of existing information on the ecological environment and consultation with relevant statutory bodies.

8.2.3.1 Desk Study

The following sources were consulted during the desktop study to inform the scope of the ecological surveys:

- Online data available on Natura 2000 network of sites (hereafter referred to as European sites)[8] and on Natural Heritage Areas (NHAs) or proposed Natural Heritage Areas (pNHAs) as held by the National Parks and Wildlife Service (NPWS). Available online at <www.npws.ie/protectedsites/> and < http://webgis.npws.ie/npwsviewer/>. Accessed 06/09/2016 and 14/06/2017

[8] Article 3 of the Habitats Directive provides for the establishment of a coherent European ecological network of special areas of conservation, under the title Natura 2000. All Special Protection Areas for birds, as designated by legislation implementing the Birds Directive, are part of this Natura 2000 network. The aim of the network is to aid the long-term survival of Europe's most vulnerable and threatened species and habitats. In Ireland these sites are designated as "European sites" – defined under the Planning Acts and/or Birds and Habitats Regulations as (a) a candidate site of Community importance, (b) a site of Community importance, (c) a candidate special area of conservation, (d) a special area of conservation, (e) a candidate special protection area, or (f) a special protection area. They are commonly referred to in Ireland as Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

- National Biodiversity Data Centre (NBDC) Online Database. Available online at <http://maps.biodiversityireland.ie/#/Map>. Accessed 19/02/2016 and 14/06/2017
- Ordnance Survey Ireland (OSI) orthophotography (from 1995 to 2012) for the scheme study area
- Records of rare and protected species for the 10km grid squares M22 and M32, held by the NPWS
- Habitat and species GIS datasets provided by the NPWS
- Bat records from Bat Conservation Ireland's (BCI) database
- N6 Galway City Outer Bypass. Environmental Impact Statement (RPS, 2006)
- N59 Maigh Cuilinn (Moycullen) Bypass Road Project Environmental Impact Statement (Galway County Council/Roscommon National Roads Design Office, 2011)
- Series of ecological reports carried out by RPS relating to the proposed R336 to N59 Road Scheme, Co. Galway (RPS, 2012a; RPS, 2012b; RPS, 2013a; RPS, 2013b; and, RPS, 2013c)
- Galway City Habitat Inventory. Galway City Council (Natura Environmental Consultants, 2005) – including digital mapping dataset
- Galway City Council Ardaun Local Area Plan Habitat Assessment (Natura Environmental Consultants, 2012)
- Coastal Habitat Study for Bearna (Galway County Council, 2007)
- *Pseudorchis albida* at Doughiska, Galway City – Report of a search in May-June 2005 (Roden, 2005)
- Galway Harbour Extension Environmental Impact Statement (Galway Harbour Company, 2014)
- The Barna Woods Project, Biodiversity Report (Browne et al., 2009)
- Results of the NBDC's 'Bioblitz' event (2014 & 2015) at the NUI Galway Campus
- The phytosociology and ecology of the aquatic and the wetland plant communities of the Lower Corrib Basin, Co. Galway. Proceedings of the Royal Irish Academy 90B (5) (Mooney & O'Connell, 1990)
- Various environmental planning reports relating to developments associated with NUI Galway (McCarthy, Keville & O'Sullivan, 2014a; McCarthy, Keville & O'Sullivan, 2014b; McCarthy, Keville & O'Sullivan, 2009a; McCarthy, Keville & O'Sullivan, 2009b; McCarthy, Keville & O'Sullivan, 2011; A.P. McCarthy Planning Consultants, 2007a and 2007b; and, Moore Group Environmental Services, 2011)
- The results of ecological surveys undertaken as part of the constraints and route selection studies (*N6 Galway City Transport Project: Route Selection Report* (Arup, 2016)4)

- The results of bird surveys carried out for the 2006 N6 Galway City Outer Bypass EIS (RPS, 2006)
- Environmental information/data for the area available from www.epa.ie (Envision Online Environmental Map Viewer - http://gis.epa.ie)
- Information on the status of EU protected habitats and species in Ireland (National Parks & Wildlife Service, 2013a, 2013b and 2013c)
- Water Framework Directive Fish Stock Survey of Lough Corrib, June 2014 (Kelly *et al.* 2014), and
- Corrib Estuary: Sampling Fish for the Water Framework Directive – Transitional Waters 2008 (The Central and regional Fisheries Board, 2009)

8.2.3.2 Consultations

The following organisations with relevance to ecology were consulted:

- The National Parks & Wildlife Service (NPWS) section of the Department of Culture, Heritage and the Gaeltacht (formerly the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs, and previous to that, the Department of Arts, Heritage and the Gaeltacht)
- Inland Fisheries Ireland (IFI)
- Bat Conservation Ireland (BCI)
- BirdWatch Ireland (BWI)
- Botanical Society of Britain & Ireland (BSBI)
- Kate McAney of the Vincent Wildlife Trust, and
- Other members of the public with local knowledge/records (e.g. relating to bat roosts).

A summary of consultations with the NPWS Section of the Department of Culture, Heritage and the Gaeltacht (formely Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs and previous to that Department of Arts, Heritage and the Gaeltacht)/NPWS and IFI is provided below. Species or plant records are included under the relevant headings in **Section 8.3 Receiving Environment**.

8.2.3.2.1 Department of Culture, Heritage and the Gaeltacht (NPWS)

Six meetings have been held with the NPWS: on 2 July 2014, 26 March 2015, 24 February 2016, 29 March 2017, 18 April 2017 and 03 August 2017. A formal consultation response related to the informal EIS Scoping Report was received from the Department of Arts, Heritage and the Gaeltacht on the 10 August 2016 and two documents related to the EIAR and NIS on the 16 and 18 January 2018 (Ref. G Pre00241/2016 – a copy of this is included in **Appendix A.8.2**). The NPWS made the following comments/observations relevant to the preparation of the EIAR and also provided notes on a draft of the EIA Biodiversity Chapter:

- The EIAR must address likely significant effects on European sites. The EIAR may align with and cross-reference or reflect content of the Natura Impact Statement but may not omit, overlook or exclude consideration of the likely effects on European sites. Issues which were raised by the NPWS specifically of relevance to Appropriate Assessment are listed separately in the Natura Impact Statement and are not repeated here
- The EIAR must assess likely significant effects on Natural Heritage Areas and proposed Natural Heritage Areas which are selected for certain ecological features and these should be used to inform the scope of the scientific assessment and analysis in the EIAR. It must also assess likely significant effects on non-statutory sites such as local biodiversity areas
- Existing guidance on EIA should be followed when preparing the EIAR, while also being cognisant of changes in interpretation and application of the EU Nature Directives and national legislation arising from case law. Terminology used should align with the legislation and case law, and in particular the specific tests of the assessment process
- The EIAR should consider key ecological receptors and should present data, information and analysis specific and relevant to the proposed road development, including characterisation of habitats as Annex I/Annex I priority habitat types (or not as the case may be) with scientific justification and supporting evidence (such as vegetation community data) to support conclusions reached. Botanic surveys should survey for presence of protected or rare species known from or potentially occurring within the locality (e.g. *Pseudorchis albida* and *Allium schoenoprasum*). Assessment of impacts on Annex I habitat types should assess the likely effects on habitat structure and function and should assess whether habitat loss could result in unfavourable or worsening national conservation status
- The EIAR must include a full and detailed description of all elements of the proposed road development
- The EIAR must assess potential cumulative impacts, in particular on existing and permitted proposed developments, along with the details of any mitigation measures that apply. The assessment of cumulative impacts should examine effects arising from existing or historic developments which may have resulted in impacts since the date from which EIA requirements existed
- Full details of mitigation measures should be provided and shown on maps. The likely effects of mitigation measures themselves should also be assessed and mitigated where necessary. Mitigation measures should be demonstrated to be effective in addressing the effects arising and should be demonstrated to be feasible within the specific characteristics and constraints of the proposed development site
- Appropriate specialist supervision should be proposed as necessary to ensure the correct implementation of mitigation measures at all stages of the proposed road development, including advance works contract stages

- The assessments in the EIAR should suffice to support any application for licences or derogations that may be necessary to disturb strictly protected or protected species and their breeding or resting places
- The NPWS are in the process of updating the digital mapping datasets into the ITM projection on modern OSI mapping. For European sites where this has not yet been completed, presenting the boundary of European sites on mapping included in the EIAR/NIS should be based upon an interpretation of its location relative to its intended location on the official 6" mapping (relative to the topographical features it follows on that mapping dataset).

These observations and comments have been taken on board and implemented throughout the EIAR.

8.2.3.2.2 Inland Fisheries Ireland (IFI)

Two meetings were held with IFI to discuss the fisheries value of watercourses crossed by the proposed road development: the first on 14 August 2014 and the second on 15 September 2016.

During these meetings, and in correspondence related to same, IFI made the following observations.

- Overall the area which the proposed road development falls within avoids the more sensitive and important areas for fisheries
- The River Corrib is a nationally important river system for Atlantic salmon. The Bearna Stream supports Sea trout and Atlantic salmon and this watercourse would be one of the main sites for these species in the locality, and other than the River Corrib is the most important stream affected by the proposed road development. IFI recently undertook improvement works to the Bearna Stream, particularly for Sea trout. The Sea trout spawning area in the Bearna Stream is downstream of the proposed road development. The Knocknacarra Stream supports Sea trout and the Newpark Stream (north of Tonabrocky) has trout spawning habitat. The Terryland River has poor habitat for salmonids and has been heavily drained in recent times as part of flood prevention measures. Electrofishing of this watercourse found little or no salmonids or eels present. The Terryland River does have Pike
- IFI had no records of spawning grounds for salmonids at any of the proposed watercourse crossing points along the proposed road development
- The banks of the River Corrib have lamprey spawning sites. IFI have observed Sea lamprey scaling the Salmon Weir and spawning in the upper catchment at Cong – this contradicts some published sources which state that the species was thought to be restricted below the Salmon Weir in Galway City
- Eels are present in good numbers in the River Corrib and may be present in other affected watercourses in smaller numbers. Eel passage has successfully been provided at Salmon Weir to facilitate migration since the 1950s. Any barriers to migration of eel would be of concern

- Ballindooley Lough does not support salmonids or lamprey but is used for coarse fishing (i.e. Perch, Roach, Bream and Pike). This waterbody is sensitive from an angling rather than ecological perspective in terms of fisheries
- Angling and navigation on the River Corrib is of importance. The Coolagh Lakes are not widely fished
- White-clawed Crayfish are present in Lough Corrib (there are small numbers in the Clare River north of the proposed road development) and could also be present in the River Corrib
- Bio-security protocols will be very important for the proposed road development. *Lagarosiphon major* and the Zebra Mussel are significant problems in the Corrib system. IFI guidelines on bio-security will need to be followed for both surveys for the EIAR and at construction stage for the proposed road development
- Japanese Knotweed and Himalayan Balsam are present on both the Terryland River and River Corrib
- IFI's long term aim is to improve the quality of streams and rivers. The proposed road development should not impede the achievement of this aim. The Sea trout population in watercourses along the western section of the proposed road development have collapsed and the long term aim is to restore the species in this area
- Stormwater discharges, in particular direct discharges to watercourses, are of concern. This should be addressed in both the design and construction methodology for the proposed road development
- Fish passage should be provided by burying culverts below bed level, ensuring flow levels are not increased, including bristles or baffles, with maintenance of same where necessary
- Habitat restoration/reinstatement following instream works will be required
- IFI have requested to be present on-site during construction and in particular for any stream diversions. Electrofishing may be required to move any captured fish downstream of construction works
- IFI have requested a detailed method statement from the contractor in advance of instream works
- Instream works will only be permitted between 1 July and end of September in accordance with IFI guidelines (IFI, 2016)
- Access to the River Corrib should be maintained on both the eastern and western banks at the River Corrib crossing location
- Section 50 approval has been granted by OPW for the proposed culverts. These culverts are box culverts with 300mm gravel in the stream bed
- The proposed systems for treatment of surface water from the proposed road development are noted by IFI to generally work well

8.2.4 Study Area and Baseline Data Collection

8.2.4.1 Study Area

The term "scheme study area", when used in this chapter, refers to the wider study area at which ecological constraints were initially identified for the constraints and route selection studies for the project (see **Figures 8.1.1** and **8.1.2**). This is the geographic scale at which many of the EIA level ecological surveys were initially carried out. For many of the ecological receptors, surveys were also carried out within a more restricted study area, focussed on assessing potential impacts within the Zone of Influence (ZoI)[9] of the proposed road development. **Section 8.2.4.2** below, describes the study area(s) for each ecological receptor and, where relevant, these study areas are also shown on the accompanying **Figures 8.1.1** to **8.22.1**.

8.2.4.2 Field Surveys

This section outlines the various ecological survey methodologies used to collate baseline ecological information in the preparation of this chapter. The surveys carried out are summarised below in **Table 8.2** with the full description of the survey methodologies presented in **Appendix A.8.1**.

The scoping exercise undertaken for the constraints and route selection studies for the project identified numerous sensitive ecological receptors within the scheme study area that could potentially have been impacted by the proposed road development. As a result, EIA level surveys for many of these ecological receptors were undertaken at the route selection stage of the project in order to inform the selection of the emerging preferred route corridor, as due to their ecological value they were highly likely to affect the ranking of route options. However, many of these surveys were carried out over a larger survey area (see also **Section 8.2.4.1**) and at a resolution appropriate to gathering information to inform the constraints and route selection studies, hence the requirement to carry out additional surveys for the EIA stage of the project in subsequent seasons/years to supplement the information already gathered and fill any gaps, spatially, in the ecological baseline datasets. Under each section below, where different surveys relating to a particular ecological receptor (e.g. habitats) were undertaken over a number of survey seasons or covering different geographic locations along the route of the proposed road development, each of the surveys undertaken are described in chronological order.

[9] The 'zone of influence' for a development is the area over which ecological features may be subject to significant impacts as a result of the proposed development and associated activities (CIEEM, 2016) – see Section 8.3.1 for more detail on the ZoI as it relates to the proposed road development.

Table 8.2: Ecological Surveys and Survey Dates between 2013 and 2018

Survey	Survey Date(s)	Surveyor(s)
Habitat surveys[10]: • Lough Corrib cSAC – Selected Locations (RS) • Petrifying springs survey (RS) • Lough Corrib candidate Special Area of Conservation (cSAC) Study Area (RS) • Ecological Sites [11] (RS) • Aquatic habitats (RS) • Lackagh Quarry Petrifying spring survey (EIA) • EIA Habitat surveys (EIA)	July to September 2013 March to June 2014 May to September 2014 June to October, 2014 June to September, 2014 June 2015 September to December 2015 July to October 2016 May 2017 to January 2018	Botanical, Environmental & Conservation (BEC) Consultants Ltd., Scott Cawley Ltd. and various independent botanists including Dr Joanne Denyer, Dr John Conaghan, Dr Janice Fuller, Katharine Duff. Eamon O'Sullivan, Roger Goodwillie, Dr Cilian Roden, Michelle O'Neill and Mary O'Connor.
Protected plant species: • Slender naiad *Najas flexilis* (RS) • Varnished hook-moss *Hamatocaulis vernicosus* (RS)	June to September, 2014 September 2014	Dr Cilian Roden Dr Rory Hodd
Otter survey (River Corrib and Coolagh Lakes) (RS)	April and May 2014	Scott Cawley Ltd.
Mammal survey (excluding bats)	April to June and October/November 2015 October 2016 October/November 2017	Scott Cawley Ltd. and Dr Chris Peppiatt
Bat surveys: Winter hibernation surveys (RS and EIA) Building surveys (RS and EIA)	March 2014 & February 2015 & 2016, January 2018 July to October 2014 August /September 2015 July/August 2016	Scott Cawley Ltd., Greena Ecological Consultancy Ltd., Geckoella Ltd. and independent bat specialists including Conor Kelleher, Brian

[10] Some ecological surveys were carried out during the constraints and route selection studies of the project in 2014 and were carried out at a different spatial scale and without reference to any ZoI as it would relate to study area for the route of the proposed road development. These surveys later informed the EIA ecological surveys and for ease of reference are denoted with RS in parenthesis in **Table 8.2**. Those surveys carried out specific to the EIA assessment of the proposed road development and its ZoI are denoted with EIA in parenthesis.

[11] Ecological Sites, in this case, are sites of potential ecological value for the habitats present: i.e. determined to be at least of a Local Importance (higher value) (refer to National Roads Authority, 2009 for more detail). The boundaries of the Ecological Sites were initially defined based on interpretation of orthophotography and collation of available existing habitat information, in conjunction with a ground truthing exercise to verify the orthophotography interpretation. These boundaries were then refined, where appropriate, based on the findings of the various habitat surveys undertaken.

Survey	Survey Date(s)	Surveyor(s)
	June/July 2017 August 2018	Keeley, Isobel Abbott, Barbara McInerney, Caroline Shiel and Barry Ryan
Tree surveys (EIA)	April to November 2015	
Vehicle transect surveys (RS)	June/July 2014	
Walked transect surveys (RS)	June/July 2014	
Static detector activity surveys from 2014 to 2018 (RS and EIA)	August to November 2014 July to October 2015 July to August 2017 May 2018	
Radio-tracking studies (three studies in 2014, one study in 2015) (RS and EIA)	July/August 2014 August 2014 September 2014 May 2015	
Marking studies (RS and EIA)	July 2014 to August 2016	
White-clawed crayfish survey (RS)	September, 2014	Scott Cawley Ltd. and Dr Julian Reynolds
Molluscan surveys (includes Freshwater pearl mussel and *Vertigo* snail species surveys) (RS)	August 2014 October 2017 (two additional molluscan sites)	Dr Evelyn Moorkens and Dr Ian Killeen
Marsh fritillary surveys (RS and EIA)	September 2013 September/October 2014 September 2015 September 2016	Woodrow Environmental Consultants Ltd.
Red grouse survey (RS)	June to August, 2014	Dr Chris Peppiatt
Barn owl survey (RS and EIA)	June and July 2014 July 2015 June and July, 2016 May to September 2018	BirdWatch Ireland
Peregrine falcon survey (EIA)	June and July 2016 May to September 2018	BirdWatch Ireland
Breeding bird surveys (EIA)	May and June 2015 June 2016	Dr Chris Peppiatt, Gerry Murphy, John Small
Woodcock survey (EIA)	May/June 2015 & June 2016	Dr Chris Peppiatt
Wintering bird survey (RS)	September 2014 to March, 2015	Scott Cawley Ltd., Dr Chris Peppiatt, Gerry Murphy, John Small and Tom Cuffe.
Amphibian survey (EIA)	April to June 2015 June 2016	Scott Cawley Ltd. and Dr Chris Peppiatt
Reptile survey (EIA)	September/October 2015	Scott Cawley Ltd.
Fisheries surveys (including assessment of biological water quality status) (EIA)	September 2015	Triturus Environmental Services Ltd.

8.2.5 Impact Assessment Methodology

The biodiversity and ecological impacts of the proposed road development have been assessed using the following guidelines:

- *Environmental Impact Assessment of Projects, Guidance on the preparation of the Environmental Impact Assessment Report* (European Commission, 2017)
- *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)
- *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (Environmental Protection Agency, Draft August 2017)
- *Advice notes for Preparing Environmental Impact Statements* (Environmental Protection Agency, Draft September 2015)
- *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition* (CIEEM, 2016)
- *Guidelines for assessment of Ecological Impacts of National Road Schemes* (National Roads Authority, 2009)

Valuing the Ecological Receptors

Biodiversity receptors (including identified sites of biodiversity importance) have been valued with regard to the ecological valuation examples set out in the TII guidelines (National Roads Authority, 2009).

All Annex I habitats that lie outside of European sites, are valued as being of national importance, given that these habitats are of high conservation concern. However, priority Annex I habitat types are valued as being of international importance given that they are of the highest conservation concern at a European level (i.e. natural habitat types in danger of disappearance[12]).

Habitat areas within SACs are considered in the context of assessing impacts on the conservation objectives and site integrity of a given European site with regard to the Appropriate Assessment tests set out in Article 6(3) of the Habitats Directive. All European sites are valued as internationally important.

In accordance with TII guidelines (National Roads Authority, 2009), biodiversity features within the Zone of Influence (ZoI) of the proposed road development which are "both of sufficient value to be material in decision making and likely to be affected significantly" are deemed to be 'Key Ecological Receptors' (KERs). These are the biodiversity receptors which may be subject to likely significant effects from the proposed road development, either directly or indirectly. KERs are those biodiversity receptors with an ecological value of local importance (higher value) or greater.

Characterising and Describing the Impacts

[12] From the definition of "priority natural habitat types" in Article 1(d) of the Habitats Directive

The parameters considered in characterising and describing the magnitude or scale of the potential impacts of the proposed road development are outlined in **Table 8.3** below.

Table 8.3: Parameters used to characterise and describe the magnitude or scale of potential impacts

Parameter	Categories
Type of impact	Positive/Neutral/Negative May also include Cumulative Effects, 'Do Nothing Effects', 'Do Minimum Effects', Indeterminable Effects, Irreversible Effects, Residual Effects, Synergistic Effects, Indirect Effects and/or Secondary Effects
Extent	The size of the affected area/habitat and/or the proportion of a population affected by the effect
Duration	The period of time over which the effect will occur[13].
Frequency and Timing	How often the effect will occur; particularly in the context of relevant life-stages or seasons
Reversibility	Permanent/Temporary Will an impact reverse; either spontaneously or as a result of a specific action

The likelihood of an impact occurring, and the predicted effects, are also an important consideration in characterising impacts. The likelihood of an impact occurring is assessed as being certain, likely or unlikely; in some cases it may be possible to definitively conclude that an impact will not occur.

Professional judgement is used in considering the contribution of all relevant criteria in determining the overall magnitude of an impact.

Impact Significance

In determining impact significance, the NRA (2009) and CIEEM (2016) guidelines were followed, which requires examination of the following two key elements:

- Impact on the integrity of the ecological feature
- Impact on its conservation status within a given geographical area

Integrity

The term "integrity" should be regarded as the coherence of ecological structure and function, across the entirety of a site that enables it to sustain all of the biodiversity or ecological resources for which it has been valued (National Roads Authority, 2009).

The term 'integrity' is most often used when determining impact significance in relation to designated areas for nature conservation (e.g. SACs, SPAs or pNHA/NHAs) but can often be the most appropriate method to use for non-

[13] The following terms/definitions for describing the duration of impacts are provided in the Environmental Protection Agency guidelines (Draft August 2017): Momentary Effects - effects lasting from seconds to minutes; Brief Effects - effects lasting less than a day; Temporary Effects - effects lasting less than a year; Short-term Effects - effects lasting one to seven years; Medium-term Effects - effects lasting seven to fifteen years; Long-term Effects - effects lasting fifteen to sixty years; Permanent Effects - effects lasting over sixty years.

designated areas of biodiversity value where the component habitats and/or species exist with a defined ecosystem at a given geographic scale.

An impact on the integrity of an ecological site or ecosystem is considered to be significant if it moves the condition of the ecosystem away from a favourable condition: removing or changing the processes that support the sites' habitats and/or species; affect the nature, extent, structure and functioning of component habitats; and/or, affect the population size and viability of component species.

Conservation Status

The definitions for conservation status given in the EU Habitats Directive 92/43/EEC, in relation to habitats and species, are also used in the CIEEM (2016) and NRA (2009) guidance:

- For natural habitats, conservation status means the sum of the influences acting on the natural habitat and its typical species, that may affect its long-term distribution, structure and functions as well as the long-term survival of its typical species, at the appropriate geographical scale
- For species, conservation status means the sum of influences acting on the species concerned that may affect the long-term distribution and abundance of its populations, at the appropriate geographical scale

An impact on the conservation status of a habitat or species is considered to be significant if it will result in a change in conservation status.

After the definitions provided in the EU Habitats Directive 92/43/EEC, the conservation status of a habitat is favourable when:

- Its natural range and areas it covers within that range are stable or increasing
- The specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future
- The conservation status of its typical species is favourable as defined below under species

And, the conservation status of a species is favourable when:

- Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future
- There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis

According to the TII/CIEEM methodology, if it is determined that the integrity and/or conservation status of an ecological feature will be impacted on, then the level of significance of that impact is related to the geographical scale at which the impact will occur (i.e. local, county, national, international). In some cases an impact may not be significant at the geographic scale at which the ecological feature has been valued but may be significant at a lower geographical level. For example, a particular impact may not be considered likely to have a negative effect on the overall conservation status of a species which is considered to be internationally important. However, an impact may occur at a local level on this internationally important species. In this case, the impact on an internationally important species is considered to be significant at only a local, rather than international level.

8.3 Receiving Environment

The following section describes the receiving ecological environment and biodiversity within the Zone of Influence (ZoI) of the proposed road development.

The proposed road development extends around the north of Galway City from the Coast Road (R336), west of Bearna, to the existing N6 at Coolagh, Briarhill. There are four significant structures included in the design of the proposed road development, namely the River Corrib Bridge, Menlough Viaduct, Lackagh Tunnel and Galway Racecourse Tunnel. A full description of the proposed road development is presented in **Chapter 5, Description of the Proposed Road Development**.

The nature of the local receiving environment is heavily influenced by the underlying geology. Lands to the west of the N59 Moycullen Road are underlain by granite and are characterised by a mosaic of peatland habitats set amongst the local road network and associated linear residential development. This area slopes towards Galway Bay to the south and is drained by a network of small streams including Sruthán na Líbeirtí, the Trusky Stream, the Bearna Stream, the Tonabrocky Stream and the Knocknacarra Stream. Lands to the east of the N59 Moycullen Road are underlain by limestone which gives rise to a karst landscape. The NUIG Sporting Campus lie on the western side of the River Corrib. Moving east from the River Corrib the landscape is characterised by a mosaic of semi-natural woodland, scrub and exposed limestone rock as far as Lackagh Quarry. East of here, these habitats exist in more isolated patches amongst the improved agricultural fields and industrial/commercial developments that fringe the eastern edge of Galway City. In the eastern part of the study area the River Corrib (and it's tributary the Terryland River) are the only watercourses present. There are two wetland complexes associated with freshwater lake systems, Coolagh Lakes and Ballindooley Lough, both of which are influenced by the underlying karst groundwater regime.

Section 8.3.1 establishes the ZoI of the proposed road development. **Section 8.3.2** summarises the results of the desk study and consultations undertaken in the preparation of this chapter. **Section 8.3.4** to **Section 8.3.13** describe the ecological baseline as it relates to the ecological receptors recorded, or known from, the study area under the following headings: habitats, rare and protected plant species, non-native invasive plant species, mammals (excluding bats), bats, invertebrate species, bird species, amphibian species, reptiles and fish. **Section 8.3.14** provides a summary of the ecological valuation of each ecological receptor potentially affected by the proposed road development and identifies those which are Key Ecological receptors (KERs) and subject to impact assessment.

8.3.1 Zone of Influence

The Zone of Influence (ZoI), or distance over which a likely significant effect may occur will differ across the Key Ecological Receptors, depending on the potential impact pathway(s). The results of both the desk study and the suite of ecological field surveys undertaken has established the habitats and species present along the proposed road development. The ZoI is then informed and defined by the sensitivities of each of the ecological receptors present, in conjunction with the nature and potential impacts associated with the proposed road development.

The ZoI of the proposed road development in relation to terrestrial habitats is generally limited to the footprint of the proposed road development, and the immediate environs (to take account of shading or other indirect impacts, such as air quality). Hydrogeological/hydrological linkages (e.g. rivers or groundwater flows) between impact sources and wetland/aquatic habitats can often result in impacts occurring at significant distances. The unmitigated hydrogeological ZoI for the proposed road development is shown on **Figure 10.7.1** to **10.7.14** and **10.9.1** to **10.9.14**. In the western part of the study area, it generally follows the proposed development boundary plus a buffer of up to c.30m in places. East of the N59 Moycullen Road, the ZoI is more expansive, given the underlying karst geology and the potential for groundwater impacts within those groundwater bodies traversed by the proposed road development.

With regard to hydrological impacts, the distances over which water-borne pollutants are likely to remain in sufficient concentrations to have a likely significant effect on receiving waters and associated wetland/terrestrial habitats is difficult to quantify and highly site-specific and related to the predicted magnitude of any potential pollution event. Evidently, it will depend on volumes of discharged waters, concentrations and types of pollutants (in this case sediment, hydrocarbons, and heavy metals), volumes of receiving waters, and the sensitivity of the ecology of the receiving waters. In the case of the proposed road development, this includes all freshwater habitat downstream of the proposed watercourse crossings and Galway Bay.

The ZoI of air quality effects is generally local to the proposed road edge and not greater than a distance of 200m.

The ZoI for small mammal species, such as the Pygmy Shrew, would be expected to be limited to no more than 100m from the proposed development boundary due to their small territory sizes and sedentary lifecycle. The ZoI for Otters, Badgers, Stoat, and Hedgehogs may extend over greater distances than small mammal and bird species due to their ability to disperse many kilometres from their natal site. The ZoI of impacts for significant disturbance impacts to Badger and Otter breeding/resting places is 150m from the proposed development boundary.

The ZoI of potential impacts to bat roosts would not be expected to exceed 200m in most cases but as affects are dependent on many factors (such as species, roost type, surrounding habitat, commuting routes etc.), this is assessed on a case by case basis and the ZoI may increase/decrease from this distance accordingly. Given the large foraging ranges for some species[14], the ZoI of potential landscape scale impacts, such as habitat loss and severance, could extend for several kilometres from the proposed road development but the most significant effects are likely to occur within 1km of important roost sites (e.g. maternity roosts).

The ZoI of the proposed road development in relation to likely significant effects on most breeding bird species is generally limited to habitat loss within the footprint of the proposed road development, and disturbance/displacement during construction and disruption in territorial singing due to noise during operation. Disturbance effects may extend for several hundred metres from the proposed road development.

The ZoI in relation to direct impacts to wintering birds could extend up to 300m from the proposed road development for general construction activities, and as far as 800m where prolonged blasting will be carried out, as many species are highly susceptible to disturbance from loud and unpredictable noise during construction. However, as many estuarine bird species use inland habitat areas at distances from the coast, the ZoI for ex-situ impacts could extend a considerable distance from the proposed road development. In the case of the proposed road development, impacts to wintering birds within this 300m band could affect the use of potential ex-situ sites for bird species listed as Special Conservation Interests of the nearby Lough Corrib SPA and Inner Galway Bay SPA.

The ZoI in relation to amphibian species is likely to be limited to direct habitat loss with the proposed development boundary and/or indirect impacts to water quality in wetland habitats hydrologically connected to the proposed road development.

The ZoI in relation to the Common lizard is likely to be limited to direct habitat loss with the proposed development boundary and disturbance/displacement effects in the immediate vicinity during construction.

The ZoI for impacts to aquatic species, such as Atlantic salmon and lamprey species, is limited to those watercourses crossed by the proposed road development or waterbodies to which runoff from the proposed road development could drain to during construction (i.e. Coolagh Lakes). However, impacts could occur at significant distances downstream depending on the magnitude and duration of any pollution event; potentially even affecting species in Galway Bay.

The ecological ZoI of the proposed road development is shown on **Figure 8.12.1** and **Figure 8.13.1**.

8.3.2 Desk Study

The results of the desktop review are provided in **Appendix A.8.18** and are incorporated into the sections below under the relevant headings, as relevant. Additional discussion on local biodiversity areas from the draft *Galway City Biodiversity Action Plan 2014-2024* is also provided below.

---

[14] Leisler's bats have been recorded foraging up to 13km from maternity roost sites (Shiel et al., 1999)

8.3.2.1 Local Biodiversity Areas

The *Galway City Development Plan 2017–2023* and the most recent draft of the *Galway City Biodiversity Action Plan 2014–2024* include reference to a local network of biodiversity areas in the city. These areas are derived from sites identified in the *Galway City Habitats Inventory* (Natura, 2005) and were defined based upon habitat areas of high biodiversity value.

Some of these local biodiversity areas lie within the zone of influence of the proposed road development and, where relevant, the habitats present within these areas are discussed further below in **Section 8.3.4** and the potential impacts assessed in **Section 8.5.4**. The relevant local biodiversity areas are:

- Rusheen Bay – Barna Woods – Illaunafamona
- Cappagh – Ballymoneen
- Ballagh – Barnacranny Hill
- River Corrib and adjoining wetlands
- Menlough to Coolough Hill
- Ballindooley – Castlegar (which is linked to the River Corrib by the Terryland River)
- Galway Racecourse, Ballybrit
- Doughiska
- Mutton Island and nearby shoreline

Local biodiversity areas provide habitat for a range of species with the River Corrib corridor providing an important link between Galway Bay and the mosaic of habitats surrounding the city, which includes the wetland complex associated with Lough Corrib. Important fauna species noted in the most recent draft of the *Galway City Biodiversity Action Plan 2014–2024* include Pine marten *Martes martes*, Wood mouse *Apodemus sylvaticus*, Irish stoat *Mustela erminea hibernica*, Irish hare *Lepus timidus hibernicus*, Hedgehog *Erinaceus europaeus*, Pygmy shrew *Sorex minutus*, Harbour seal *Phoca* vitulina, Fox *Vulpes vulpes*, Bank vole *Myodes glareolus,* Otter *Lutra lutra*, Badger *Meles meles,* Lesser horseshoe bat *Rhinolophus hipposideros*, Leisler's bat *Nyctalus leisleri*, Common pipistrelle bat *Pipistrellus pipistrellus*, Soprano pipistrelle bat *Pipistrellus pygmaeus*, Brown long-eared bat *Plecotus auritus*, Daubenton's bat *Myotis daubentonii*, Natterer's bat *Myotis nattereri* and the Whiskered bat *Myotis mystacinus*. These species are discussed further below in **Section 8.3.7** and the potential impacts assessed in **Section 8.5.6**. The Flora (Protection) Order, 2015 listed species Slender cottongrass *Eriophorum gracile* and the Small white orchid *Pseudorchis albida* are also noted in the plan and are discussed further below in **Section 8.3.5** and the potential impacts assessed in **Section 8.5.5**.

8.3.3 Designated Areas for Nature Conservation

8.3.3.1 European Sites

Candidate Special Areas of Conservation (cSAC) are designated under the EC Habitats Directive (92/43/EEC) as amended, which is transposed into Irish law through a variety of legislation including the Birds and Habitats Regulations and the Planning Acts, for the protection of habitats listed on Annex I and/or species listed on Annex II of the Directive.

Special Protection Areas (SPAs) are designated under the Birds Directive (2009/147/EC) for the protection of protected bird species listed on Annex I of the Directive, regularly occurring populations of migratory species (such as ducks, geese or waders), and areas of international importance for migratory birds.

The proposed road development traverses through, and adjacent to, the Lough Corrib cSAC and there are three other European sites nearby (Lough Corrib SPA is upstream of the proposed road development and Galway Bay Complex cSAC, and Inner Galway Bay SPA are downstream) with a number of other European sites located at a greater distance from the proposed development boundary. There are 19 European sites (cSACs or SPAs) located within 15km[15] of the proposed development boundary (**Figure 8.12.1**) which encompasses all European sites within the ZoI of the proposed road development. **Table 8.4** below lists these sites, their distance from the proposed development boundary, and the sites Qualifying Interests/Special Conservation Interests.

Table 8.4: European Sites (cSACs and SPAs) within 15km of the proposed development boundary

Site Name	Distance[16]	Reasons for Designation – Qualifying Interests (QIs) or Special Conservation Interests (SCIs)
Candidate Special Areas of Conservation		
Lough Corrib cSAC [000297]	crossed by the proposed road develop-ment	[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] Varnished hook-moss *Drepanocladus (Hamatocaulis) vernicosus* [1833] Slender naiad *Najas flexilis* [3110] Oligotrophic waters containing very few minerals of sandy plains (*Littorelletalia uniflorae*)

[15] 15km used as an itial reference scale only and did not inform the definition of the ZoI nor did it influence the identification of designated sites at risk from potential impacts associated with the proposed road development

[16] Distance in km/m from the proposed road development

Site Name	**Distance**[16]	**Reasons for Designation –** **Qualifying Interests (QIs) or Special Conservation Interests (SCIs)**
		[3130] Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea* [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 [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
Galway Bay Complex cSAC [000268][17]	160m	[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*) [1355] Otter *Lutra lutra* [1365] Harbour seal *Phoca vitulina* [1410] Mediterranean salt meadows (*Juncetalia maritimi*) [3180] Turloughs* [5130] *Juniperus communis* formations on heaths or calcareous grasslands

[17] Inner Galway Bay is also a Ramsar site, under the Ramsar Convention (Ramsar site No. 838) and is a marine protected site under the OSPAR Convention - Galway Bay Complex MPA (O-IE-0002969)

Site Name	Distance[16]	Reasons for Designation – Qualifying Interests (QIs) or Special Conservation Interests (SCIs)
		[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
Connemara Bog Complex cSAC [002034]	6km	[1065] Marsh fritillary butterfly *Euphydryas* (*Eurodryas, Hypodryas*) *aurinia* [1106] Atlantic salmon *Salmo salar* (only in fresh water) [1150] * Coastal lagoons [1170] Reefs [1355] Otter *Lutra lutra* [1833] Slender naiad *Najas flexilis* [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 [6410] *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) [7130] Blanket bogs (* if active only) [7140] Transition mires and quaking bogs [7150] Depressions on peat substrates of the *Rhynchosporion* [7230] Alkaline fens [91A0] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles
Ross Lake and Woods cSAC [001312]	10.2km	[1303] Lesser horseshoe bat *Rhinolophus hipposideros* [3140] Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.
Black Head-Poulsallagh Complex cSAC [000020]	10.6km	[1170] Reefs [1220] Perennial vegetation of stony banks [1395] Petalwort *Petalophyllum ralfsii* [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)

Site Name	**Distance[16]**	**Reasons for Designation – Qualifying Interests (QIs) or Special Conservation Interests (SCIs)**
		[6510] Lowland hay meadows (*Alopecurus pratensis*, *Sanguisorba officinalis*) [7220] Petrifying springs with tufa formation (*Cratoneurion*) [8240] Limestone pavements [8330] Submerged or partially submerged sea caves
Lough Fingall Complex cSAC [000606]	11.1km	[1303] Lesser horseshoe bat *Rhinolophus hipposideros* [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) [7210] * Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* [8240] * Limestone pavements
Rahasane Turlough SAC [000322]	13.2km	[3180] * Turloughs
Gortnandarragh Limestone Pavement cSAC [001271]	13.4km	[8240] * Limestone pavements
Moneen Mountain cSAC [000054]	13.2km	[1065] Marsh fritillary butterfly *Euphydryas* (*Eurodryas*, *Hypodryas*) *aurinia* [1303] Lesser horseshoe bat *Rhinolophus hipposideros* [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
East Burren Complex cSAC [001926]	13.5km	[1065] Marsh fritillary butterfly *Euphydryas* (*Eurodryas, Hypodryas*) *aurinia* [1303] Lesser horseshoe bat *Rhinolophus hipposideros* [1355] Otter *Lutra lutra* [3140] Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. [3180] * Turloughs

Site Name	Distance[16]	Reasons for Designation – Qualifying Interests (QIs) or Special Conservation Interests (SCIs)
		[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*)
Kiltiernan Turlough cSAC [001285]	13.8km	[3180] * Turloughs
Castletaylor Complex cSAC [000242]	14km	[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) [8240] * Limestone pavements
Ardrahan Grassland cSAC [002244]	15km	[4060] Alpine and Boreal heaths [5130] *Juniperus communis* formations on heaths or calcareous grasslands [8240] * Limestone pavements
Ballyvaughan Turlough cSAC [000996]	15km	[3180] * Turloughs
Special Protection Areas		
Lough Corrib SPA [004042]	203m	Greenland White-fronted Goose (*Anser albifrons flavirostris*) [A395] - wintering Gadwall (*Anas strepera*) [A051] - wintering Shoveler (*Anas clypeata*) [A056] - wintering Pochard (*Aythya ferina*) [A059] - wintering Tufted Duck (*Aythya fuligula*) [A061] - wintering

Site Name	Distance[16]	Reasons for Designation – Qualifying Interests (QIs) or Special Conservation Interests (SCIs)
		Common Scoter (*Melanitta nigra*) [A065] - breeding Hen Harrier (*Circus cyaneus*) [A082] – post-breeding/roost Coot (*Fulica atra*) [A125] - wintering Golden Plover (*Pluvialis apricaria*) [A140] - wintering Black-headed Gull (*Chroicocephalus ridibundus*) [A179] - breeding Common Gull (*Larus canus*) [A182] - breeding Common Tern (*Sterna hirundo*) [A193] - breeding Arctic Tern (*Sterna paradisaea*) [A194] – breeding Wetlands & Waterbirds [A999]
Inner Galway Bay SPA [004031]	1.1km at Oranmore Bay and Rusheen Bay	Great Northern Diver (*Gavia immer*) [A003] - wintering Cormorant (*Phalacrocorax carbo*) [A017] - breeding 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 & Waterbirds [A999]
Cregganna Marsh SPA [004142]	4km	Greenland White-fronted Goose (*Anser albifrons flavirostris*) [A395] - wintering
Connemara Bog Complex SPA [004181]	9.2km	Cormorant (*Phalacrocorax carbo*) [A017] - breeding Merlin (*Falco columbarius*) [A098] - breeding Golden Plover (*Pluvialis apricaria*) [A140] - breeding Common Gull (*Larus canus*) [A182] - breeding
Rahasane Turlough SPA [004089]	13.2km	Whooper Swan (*Cygnus cygnus*) [A038] - wintering Wigeon (*Anas penelope*) [A050] - wintering

Site Name	Distance[16]	Reasons for Designation – Qualifying Interests (QIs) or Special Conservation Interests (SCIs)
		Golden Plover (*Pluvialis apricaria*) [A140] - wintering Black-tailed Godwit (*Limosa limosa*) [A156] - wintering Greenland White-fronted Goose (*Anser albifrons flavirostris*) [A395] - wintering Wetlands & Waterbirds [A999]

A summary of the biodiversity baseline for each of these European sites is provided below, with more detailed baseline information on each of these sites presented in Section 9 of the Natura Impact Statement (NIS).

8.3.3.1.1 Lough Corrib cSAC

The proposed road development and its boundary overlaps with, i.e. traverses through or adjacent to one Euroepean site, namely Lough Corrib cSAC at four locations: at the termination of the proposed drainage outfall from the N59 Link Road North at Kentfield; at the site of the proposed River Corrib Bridge between Dangan and Menlough; to the west of the Coolagh Lakes (Ch. 9+850 to Ch. 10+100); and, to the west and north of Lackagh Quarry where the proposed road development will consist of a tunnel (Lackagh Tunnel) and approach road infrastructure.

The full results of the habitat surveys carried out in Lough Corrib cSAC in 2014 are presented in *N6 Galway City Transport Project – Habitat mapping and assessment of a section of Lough Corrib cSAC and surrounding areas* (Barron et al., 2017), which is included in **Appendix A.8.5**.

In summary, a total of 16 Annex I habitats, covering c.155.2ha, were recorded during the survey of Lough Corrib cSAC between Coolanillaun and Galway City, not all of which were located within Lough Corrib cSAC:

- Dystrophic lakes [3160]
- Wet heaths [4010]
- Dry heaths [4030]
- Alpine and Boreal heaths [4060]
- Calcareous grasslands [6210]
- Orchid-rich calcareous grasslands [*6210]
- *Molinia* meadows [6410]
- Hydrophilous tall-herb communities [6430]
- *Cladium* fens [*7120]
- Blanket bog (inactive) [7130]
- Blanket bog (active) [*7130]
- Transition mires and quaking bogs [7140]
- Alkaline fens [7230]

- Limestone pavement (exposed) [*8240]
- Limestone pavement (wooded) [*8240]
- Alluvial forests [*91E0]

The majority of these habitat types form part of, and are supported by, the wetland complex along the River Corrib corridor and associated with the Coolagh Lakes. The drier heath, grassland and exposed limestone rock habitats are predominantly located on the slopes of an elevated hill to the north of the Coolagh Lakes (the Coolagh Lakes also supports smaller areas of these habitat types beyond the wetland margins).

The River Corrib itself was classified as a Depositing/lowland river (FW2) as part of aquatic habitat surveys carried out in 2014 (**Appendix A.8.20**). The River Corrib channel in the vicinity of the proposed road development, or further downstream, does not correspond with any Annex I habitat type.

Downstream of the proposed River Corrib Bridge, the habitats present within Lough Corrib cSAC along the river banks consists of a mosaic of Wet grassland (GS4) and Reed swamp (FS1). Scrub (WS1), Dry calcareous and neutral grassland (GS1) and woodland (WD1, WN2 and WN6) are also present between the proposed crossing point for the River Corrib Bridge and the Coolagh Lakes. Many of these habitat types correspond with the Annex I habitat types[18] Calcareous grassland [6210], Residual alluvial forests [*91E0], *Cladium* fen [*7210], Hydrophilous tall herb [6430] and Transition mires [7140]. Although only Calcareous grassland and *Cladium* fen are QI habitats for Lough Corrib cSAC, many of the other wetland habitats are likely to provide a supporting role to these habitats within this mosaic.

The proposed drainage outfall from the N59 Link Road North will discharge to a drainage ditch in Lough Corrib cSAC at Kentfield. Habitats in this area included Treeline (WL2), Scrub (WS1) and Dry meadows and grassy verges (GS2), Wet grassland and Reed and large sedge swamp/Tall-herb swamp/Wet grassland (FS1/FS2/GS4). A patch of *Phragmites australis* Reed swamp (FS1) and an area of Rich fen and flush (PF1) are immediately to the east of the proposed development boundary. The fen area corresponds with the PF1_RFLU1a [19] vegetation community (*Carex viridula oedocarpa* - *Pinguicula vulgaris* - *Juncus bulbosus* flush; brown moss sub-community) of the Annex I habitat type *Alkaline fens* [7230].

The drainage ditch, to which the drainage outfall discharges, drains to the north-west for c.380m before turning north-east where it connects with the River Corrib after a further c.130m. Along or close to the drainage ditch, within the boundary of Lough Corrib cSAC, are Wet grassland (GS4), Wet heath (HH3), Transition mire (PF3) and Wet willow-alder-ash woodland (WN6) habitats. Some of these

[18] Where abbreviated Annex I habitat names are used throughout this report, nomenclature follows that of *The Status of EU Protected Habitats and Species in Ireland. Overview Volume 1.* (National Parks & Wildlife Service, 2013a)

[19] Alkaline fen vegetation community classification as per the classification system described in Perrin, P.M., Barron, S.J., Roche, J.R. & O'Hanrahan, B. (2014). *Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79.* National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

correspond with Annex I habitat types: *Molinia* meadow [6410], Wet heath [4010], Transition mire [7140] and Residual alluvial forests [*91E0], respectively.

The Coolagh Lakes correspond with the Annex I Hard water lakes [3140] habitat type and support a wetland complex of Wet grassland (GS4), Wet heath (HH3), Fen (Pf1 and PF2) and Reed swamp (FS1). Many of these habitat types correspond with the Annex I habitat types[20] Residual alluvial forests [*91E0], *Cladium* fen [*7210], Alkaline fen [7230], Hydrophilous tall herb [6430], *Molinia* meadow [6410], Wet heath [4010] and Transition mires [7140]. Although only Calcareous grassland and *Cladium* fen are QI habitats for Lough Corrib cSAC, many of the other wetland habitats are likely to provide a supporting role to these habitats within this mosaic.

The area to the west of the Coolagh Lakes and to the north and east towards Lackagh Quarry consisted of a mosaic of Exposed calcareous rock (ER2), Dry calcareous and neutral grassland (GS1), Oak-Ash-Hazel Woodland (WN2) and Scrub (WS1). Some of these areas corresponded with the Annex I habitats Calcareous grassland [*6210/6210] and Limestone pavement [*8240].

Otter use the River Corrib Corridor (although no holt or couch sites were present in the vicinity of the proposed road development). The River Corrib is an important salmonid watercourse, supporting both Atlantic salmon and Brown trout. There are records of Sea lamprey spawning below the Salmon Weir in Galway City (O'Connor, 2007) and the species has also been recorded by IFI spawning in the upper catchment in Cong, Co. Mayo. Brook lamprey have been recorded widely throughout the River Corrib catchment (O'Connor, 2007). No suitable lamprey ammocoete nursery habitat was recorded in the vicinity of the proposed River Corrib Bridge, or the proposed drainage outfalls to the river.

Whilst there are no records of Atlantic salmon or Sea lamprey at the proposed River Corrib Bridge crossing, the River Corrib provides important habitat for Atlantic salmon, and both lamprey species, particularly in the context of its function as a migration corridor from the sea to the spawning areas for Atlantic salmon and Sea lamprey.

8.3.3.1.2 Galway Bay Complex cSAC

The proposed road development does not traverse the Galway Bay Complex cSAC and given that it lies downstream of the proposed road development, the description here is focussed on the downstream coastal and marine habitats, and the QI species they support, which are the QIs which fall within the zone of influence of the proposed road development. The descriptions are based upon the information presented in the conservation objectives for Galway Bay Complex cSAC, and the relevant supporting documents, and presents summary of the site as a whole.

Galway Bay is classified as the Annex I habitat Large shallow inlets and bays [1160], associated with which are Reefs [1170], Tidal mudflats [1140], Lagoons [*1150], Salicornia mud [1310], Perennial vegetation of stony banks [1220] and Atlantic salt meadows [1330]. These habitats are also supported by a network of

[20] Where abbreviated Annex I habitat names are used throughout this report, nomenclature follows that of *The Status of EU Protected Habitats and Species in Ireland. Overview Volume 1.* (National Parks & Wildlife Service, 2013a)

other habitat types including the freshwater rivers and streams that flow into the bay, the transitional waters of the estuary and terrestrial habitat along the coastline.

Rusheen Bay, to which some of the rivers/streams crossed by the proposed road development will drain (Bearna Stream catchment and the Knocknacarragh Stream), comprises a mosaic of most of these habitat types: Large shallow inlets and bays [1160], associated with which are Reefs [1170], Tidal mudflats [1140], Perennial vegetation of stony banks [1220] and Atlantic salt meadows [1330].

The habitats within Galway Bay also support Qualifying Interests (QI) populations of Otter and Harbour seal.

8.3.3.1.3 Lough Corrib SPA

Lough Corrib SPA is a vast site comprising Lough Corrib, most of its islands, and much of the wetland habitat that surrounds the lake margin. The proposed road development does not traverse the Lough Corrib SPA. However, the closest areas of such wetland habitat to the proposed road development are at Tonacurragh and Coolanillaun where there is a wetland mosaic of bog, heath, reed swamp, marsh and wet grassland habitats.

Although this SPA lies outside, and upstream of, the proposed road development, many bird species listed as Special Conservation Interests (SCIs) of the SPA were recorded at winter bird survey sites across the scheme study area. The habitat types associated with these sites ranged from natural/semi-natural lakes and wetland complexes (Ballindooley Lough, Coolagh Lakes and Lough Inch), the River Corrib, and upland mosaics of bog, heath, wet and acid grasslands, to improved and intensively managed habitats such as agricultural fields and amenity areas within Galway City (e.g. NUIG Sporting Campus).

There were two bird species recorded during the breeding bird surveys which are SCIs of Lough Corrib SPA for their breeding population: Common tern and Black-headed gull. This is generally consistent with the findings of the surveys carried out along the River Corrib corridor in 2005/2006 for the N6 Galway City Outer Bypass Scheme (RPS, 2006), where these species were recorded frequently over the summer months along the river, but in low numbers. The 2005/2006 surveys also recorded another breeding SCI species frequently on the River Corrib during the summer months; Common gull.

Seven bird species which are listed as wintering SCI species for Lough Corrib SPA were recorded at winter bird survey sites within the ZoI of the proposed road development:

- Black-headed gull
- Common gull
- Coot
- Golden plover
- Hen harrier
- Shoveler

- Tufted duck

8.3.3.1.4 Inner Galway Bay SPA

As Inner Galway Bay SPA covers approximately the same area as Galway Bay Complex cSAC, refer to the habitat description above in **Section 8.3.3.1.2**. The habitats within the SPA support the SCI bird species, providing nesting, foraging and roosting sites which include open water, intertidal and terrestrial habitats.

As noted above for Lough Corrib SPA, bird species listed as winter SCI species of the Inner Galway Bay SPA were recorded at many of the winter bird survey sites across the scheme study area, the majority of which are remote from the SPA itself.

There were two bird species recorded during the breeding bird surveys which are listed as SCIs of Inner Galway Bay SPA for their breeding population: Common tern (along the River Corrib) and Cormorant (flying overhead in the vicinity of the River Corrib corridor and in the western part of the scheme study area).

These results are generally consistent with the findings of the surveys carried out along the River Corrib corridor in 2005/2006 for the N6 Galway City Outer Bypass project (RPS, 2006), where these species were recorded frequently over the summer months along the river, but in low numbers.

Twelve bird species which are listed as winter SCI species for Inner Galway Bay SPA were recorded within winter bird survey sites within the ZoI of the proposed road development:

- Bar-tailed godwit
- Black-headed gull
- Common gull
- Cormorant
- Curlew
- Golden plover
- Grey heron
- Lapwing
- Redshank
- Shoveler
- Teal
- Wigeon

8.3.3.2 Natural Heritage Areas & proposed Natural Heritage Areas

National Heritage Areas (NHAs) are designations under Section 16 of the Wildlife Acts to protect habitats, species or geology of national importance.

In addition to NHAs there are proposed NHAs (referred to as pNHAs), which are also sites of significance for wildlife and habitats and were published on a non-statutory basis in 1995, but have not since been statutorily proposed or designated. Proposed NHAs are offered protection in the interim period under the county or city development plans which requires that planning authorities give due regard to their protection in planning policies and decisions[21].

Many of the pNHA sites, and some of the NHAs, in Ireland overlap with the boundaries of European sites.

Only one of these, Lough Corrib pNHA is crossed by the proposed road development. There are three NHAs and 18 pNHAs located within 15km of the proposed development boundary (**Figure 8.13.1**). **Table 8.5** below lists these sites, their distance from the proposed development boundary, and the ecological features for which the sites are designated/proposed.

Table 8.5: Natural Heritage Areas (and proposed Natural Heritage Areas) within 15km of the proposed development boundary

Natural Heritage Areas		
Site Name	**Distance[22]**	**Features of Interest**
Moycullen Bogs NHA [002364]	80m at Na Foraí Maola Thiar Immediately adjacent to the proposed development boundary at Ballagh	Peatland [T010]
Cregganna Marsh NHA [000253]	4km	Birds [12] - see Cregganna Marsh SPA above
Oughterard District Bog NHA [002431]	15km	Peatland [T010]
Proposed Natural Heritage Areas		
Site Name	**Distance**	**Description**
Lough Corrib pNHA [000297]	crossed by the proposed road development	See above under Lough Corrib cSAC and Lough Corrib SPA
Galway Bay Complex pNHA [000268]	190m	See above under Galway Bay Complex cSAC and Inner Galway Bay SPA
Furbogh Wood pNHA [001267]	2.3km	Oak woodland

[21] For example, Policy 4.2 of the *Galway City Development Plan 2017-2023* includes a commitment to “Protect, conserve and promote the nationally designated sites of ecological importance, including existing and proposed Natural Heritage Areas (NHAs and pNHAs) in the city”.
[22] Distance in km/m from the proposed road development

Proposed Natural Heritage Areas		
Site Name	**Distance**	**Description**
Kiltullagh Turlough pNHA [000287]	2.2km	Turlough feature
Ballycuirke Lough pNHA [000228]	4.6km	Lake and associated wetland habitats - part of Lough Corrib cSAC
Connemara Bog Complex pNHA [002034]	6km	See above under Connemara Bog Complex cSAC and Connemara Bog Complex SPA
Killarainy Lodge, Moycullen pNHA [002083]	7.2km	Natterer's bat nursery roost
Drimcong Wood pNHA [001260]	8.2km	Mixed broadleaved and coniferous woodland
Ross Lake and Woods pNHA [001312]	10.2km	See above under Ross Lake And Woods cSAC
Black Head-Poulsallagh Complex pNHA [000020]	10.6km	See above under Black Head-Poulsallagh Complex cSAC
Lough Fingall Complex pNHA [000606]	11.1km	See above under Lough Fingall Complex pNHA
Rahasane Turlough pNHA [000322]	13.3km	See above under Rahasane Turlough SAC and Rahasane Turlough SPA
Gortnandarragh Limestone Pavement pNHA [001271]	13.4km	See above under Gortnandarragh Limestone Pavement cSAC
Moneen Mountain pNHA [000054]	13.3km	See above under Moneen Mountain cSAC
East Burren Complex pNHA [001926]	13.5km	See above under East Burren Complex cSAC
Kiltiernan Turlough pNHA [001285]	13.9km	See above under Kiltiernan Turlough cSAC
Castletaylor Complex pNHA [000242]	14km	See above under Castletaylor Complex cSAC
Turloughcor pNHA [001788]	15km	Wetland site supporting wintering bird populations

8.3.4 Habitats

Overview

The results of the habitat surveys along the route of the proposed road development are described below by habitat type, after Fossitt (2000, see also **Appendix A.8.6**), and where relevant include a description of any corresponding Annex I habitat types that were present (see also **Appendix A.8.3** and **Appendix A.8.4** for results of habitat surveys). The habitats described below relate to habitat polygons within or adjacent to the proposed road development, as shown on **Figures 8.14.1** to **8.14.15** and **Figures 8.15.1** to **8.15.15** along with the full habitat survey results. Full species lists for each habitat type are provided in **Appendix A.8.19**. In general, habitats are described from east to west under the headings below.

The results and summary of the findings of the aquatic habitat surveys have been incorporated into the relevant habitat descriptions below. A full description and species lists are provided in **Appendix A.8.20**.

The habitat types recorded along the route of the proposed road development, and discussed in this section, are as follows:

- Flower beds and borders (BC4)
- Buildings and artificial surfaces (BL3)
- Spoil and bare ground (ED2)
- Recolonising bare ground (ED3)
- Active quarries and mines (ED4)
- Exposed siliceous rock (ER1)
- Exposed calcareous rock (ER2), including the priority Annex I habitat *8240
- Limestone/marl lakes (FL3), including the Annex I habitat 3140
- Mesotrophic lakes (FL4)
- Eutrophic lakes (FL5)
- Turloughs (FL6), which corresponds with the priority Annex I habitat *3180
- Other artificial lakes and ponds (FL8)
- Calcareous springs (FP1), including the priority Annex I habitat *7220
- Reed and large sedge swamps (FS1), including the priority Annex I habitats *7210 and the Annex I habitat 6430
- Tall-herb swamps (FS2), including the Annex I habitats 6430/*7210
- Eroding/upland rivers (FW1)
- Depositing/lowland rivers (FW2)
- Drainage ditches (FW4)
- Improved agricultural grassland (GA1)
- Amenity grassland (improved) (GA2)

- Marsh (GM1)
- Dry calcareous and neutral grassland (GS1), including the priority Annex I habitat *6210/Annex I habitat 6210
- Dry meadows and grassy verges (GS2), including the Annex I habitat 6510
- Dry-humid acid grassland (GS3), including the priority Annex I habitat *6230
- Wet grassland (GS4), including the Annex I habitat 6410
- Dense bracken (HD1)
- Dry siliceous heath (HH1), which corresponds with the Annex I habitat 4030
- Dry calcareous heath (HH2), which corresponds with the Annex I habitat 4030
- Wet heath (HH3), which corresponds with the Annex I habitat 4010
- Rich fen and flush (PF1), including the Annex I habitats 7230/*7210
- Poor fen and flush (PF2)
- (Mixed) broadleaved woodland (WD1)
- Mixed broadleaved/conifer woodland (WD2)
- (Mixed) conifer woodland (WD3)
- Scattered trees and parkland (WD5)
- Hedgerows (WL1)
- Treelines (WL2)
- Oak-ash-hazel woodland (WN2), including the priority Annex I habitat *8240
- Wet willow-alder-ash woodland (WN6), including the priority Annex I habitat *91E0
- Scrub (WS1), including the priority Annex I habitat *8240
- Immature woodland (WS2)
- Ornamental/non-native shrub (WS3)
- Recently-felled woodland (WS5)

Summary of Underlying Geology and Habitat Type

As a consequence of the underlying geology, with the western part of the study area underlain by granite and the eastern by limestone, the nature of the habitats present across the study area were generally acidic west of the N59 Moycullen Road and calcareous to the east.

West of the River Corrib, the habitats generally consisted of a mosaic of agricultural fields, peatland/heath habitats, and scrub, separated into distinct habitat blocks of varying sizes by the local road network and the associated linear residential development. The character of the agricultural fields varied from intensively managed farmland through to abandoned fields overgrown with scrub and bracken. The peatland habitat blocks consisted of predominantly wet heath, dry heath and bog mosaics, with those habitat patches closest to the proposed road development either the edges of larger peatland habitat blocks or smaller, more isolated, remnant patches. Small areas of fen and transition mire were also present. Given the close proximity of Galway City there were also large expanses of urban and residential development adjacent to the proposed road development, particularly around Ballyburke/Rahoon area and where the proposed road development crosses the N59 Moycullen Road at Dangan.

East of the River Corrib, there were two distinct habitat zones; from the River Corrib to the N84 Headford Road comprised of a patchwork of semi-natural woodland, limestone pavement, scrub and calcareous grassland fields. East of the N84 Headford Road was predominantly improved agricultural grasslands surrounded by residential and industrial development in Parkmore, Ballybrit, Briarhill and Doughiska. There were also two wetland complexes of note in this section: the Coolagh Lakes and Ballindooley Lough. There were also some isolated patches of semi-natural habitats, calcareous grassland and limestone pavement, in the Coolagh/Doughiska area.

8.3.4.1 Flower beds and borders (BC4)

This habitat type was widespread along the proposed road development and included ornamental planting associated with residential gardens, commercial developments or industrial complexes/ business parks. The majority of this habitat type is captured on the habitat map by the *Residential* classification (see **Section 8.3.4.34** below).

8.3.4.2 Stone walls and other stonework (BL1)

Stone walls were generally present as either field or property boundaries. In the western part of the study area, many of the stone wall field boundaries were overgrown with scrub and bracken. Plant species recorded in association with the stone walls included: *Asplenium trichomanes*, *Hedera helix*, *Polypodium vulgare*, *Frullania dilatata*, the moss species *Brachythecium rutabulum*, *Dicranum scoparium*, *Homalothecium sericeum*, *Hypnum cupressiforme*, *Isothecium myosuroides*, *Mnium hornum*, *Racomitrium fasciculare* and lichens such as *Cladonia* spp. and other crustose lichens.

8.3.4.3 Buildings and artificial surfaces (BL3)

This classification included buildings (domestic, commercial and industrial), roads, car parks, artificial recreation surfaces (e.g. Astroturf pitches) and other concrete/hard standing areas (e.g. quarrying infrastructure at Lackagh Quarry). Aside from residential properties/developments, the largest expanses of this habitat type within, or adjacent to, the proposed road development were associated with the business parks at Ballybrit, Parkmore and Briarhill, and at the Galway Racecourse. In the case of residential properties, the majority of this habitat type is captured on the habitat map by the *Residential* classification (see **Section 8.3.4.34** below).

8.3.4.4 Spoil and bare ground (ED2)

Across the study area, this habitat type consisted of small areas of bare ground associated with access tracks (either permanent and maintained lanes, or recently cleared ground) or, in the case of the larger expanses at Ballyburke and adjacent to the N59 Link Road North near Bushypark, lands which had been recently cleared for development.

8.3.4.5 Recolonising bare ground (ED3)

Generally small areas of disturbed ground were recorded along the route of the proposed road development but there were a number of larger areas associated with development sites, or larger scale scrub clearance of agricultural fields.

Along the western part of the proposed road development, the cover and composition of recolonising bare ground vegetation varied widely, dependant on the soil type and surrounding drainage. Species included tree/shrub species such as Salix cinerea and Ulex europaeus; the grasses Agrostis capillaris, Agrostis stolonifera, Holcus lanatus and Poa annua; rush and sedge species such as Juncus effusus and Carex disticha; and herb species including Achillea millefolium, Anagallis arvensis, Centaurea nigra, Cirsium arvense, Daucus carota, Hypericum pulchrum, Hypochaeris radicata, Lotus corniculatus, Plantago lanceolata, Plantago major, Potentilla anserina, Senecio jacobaea and Tussilago farfara. Where soils were more acidic/peaty in nature (e.g. at Ch. 4+900 to Ch. 5+000), recolonising ground was characterised by heath species such as Calluna vulgaris, Molinia caerulea, Carex panicea and Ulex gallii in places.

Along the eastern part of the proposed road development, recolonising bare ground included the following species, many of which reflected the calcareous nature of the surrounding habitats in this area: the grasses *Agrostis canina*, *Anthoxanthum odoratum*, *Arrhenatherum elatius*, *Cynosurus cristatus*, *Dactylis glomerata*, *Festuca rubra* and *Poa pratensis*; and herb species such as *Achillea millefolium*, *Centaurium erythraea*, *Euphrasia officinalis* agg., *Hypericum perforatum*, *Lotus corniculatus*, *Leontodon autumnalis*, *Leucanthemum vulgare*, *Linum catharticum*, *Medicago lupulina*, *Odontites verna*, *Potentilla reptans*, *Primula veris*, *Prunella vulgaris*, *Ranunculus repens*, *Senecio jacobaea*, *Succisa pratensis*, *Tussilago farfara* and *Ulex europaeus*.

8.3.4.6 Active quarries and mines (ED4)

Lackagh Quarry was the only quarry site within the proposed development boundary and is an inactive quarry. The quarry was surrounded on the west, north, and eastern sides by high, vertical cliff faces and, despite being sparsely vegetated for the most part, had a diverse assemblage of plant species reflecting the calcareous nature of the substrate and the damp areas created by the seepage lines from the quarry walls: tree/shrub species including *Acer pseudoplatanus*, *Alnus incana* and *Salix cinerea*; and herb species such as *Agrostis stolonifera*, *Anagallis arvensis*, *Asplenium ruta-muraria*, *Blackstonia perfoliata*, *Carex flacca*, *Centaurea nigra*, *Epilobium montanum*, *Epipactis helleborine*, *Equisetum fluviatile*, *Hypericum pulchrum*, *Hypericum tetrapterum*, *Leontodon hispidus*, *Leucanthemum vulgare*, *Linum catharticum*, *Lotus corniculatus*, *Mycelis muralis*, *Petasites fragrans*, *Phyllitis scolopendrium*, *Pimpinella major*, *Plantago lanceolata*, *Potentilla sterilis*, *Senecio jacobaea* and *Solidago virgaurea*. The spring sites in the quarry are discussed separately below under *Calcareous springs*.

8.3.4.7 Exposed siliceous rock (ER1)

Outcropping granite was recorded along the western sections of the proposed road development; most often in association with patches of dry heath on higher ground but also found on raised ground in less intensively managed agricultural fields, and in some residential gardens. Where it was recorded in a mosaic with heath habitats it is mapped and valued as the associated Annex I habitats. Where associated with improved grasslands or exposed rock slabs in residential gardens it is valued as being of a local importance (lower value).

8.3.4.8 Exposed calcareous rock (ER2)

Exposed limestone was recorded widely across the eastern part of the scheme study area. The highest concentrations were present in the area between Menlough Village, Coolough Village, Coill Uachtair and the area surrounding Lackagh Quarry. There was also a relatively large area adjacent to the southern boundary of the Roadstone Quarry at Two-mile-ditch with more isolated, scattered patches in the local area between here and the existing N6 – the most notable of which lay to the south-east of the existing Coolagh Junction.

At all locations, bar the area at Business Park Junction 2, these areas corresponded with the exposed limestone pavement group of the priority Annex I habitat *Limestone pavements* [*8240]. The exposed calcareous rock at Business Park Junction 2 comprised the vertical limestone rock faces in a small abandoned quarry and therefore, did not correspond with the Annex I habitat type.

Limestone pavement consisted of both the ‘block’ and ‘shattered’ variants of Limestone pavement (after Wilson & Fernandez, 2013), with the shattered type being most frequent. The exposed variant also included areas of limestone pavement which were being invaded by scrub (almost invariably *Corylus avellana*) which was not yet forming a continuous canopy and was less than 3m in height. The main vascular species included scattered low-growing woody species (e.g. *Hedera helix*, *Rosa spinosissima* or *Rubus fruticosus* agg., or immature *Corylus avellana* or *Ilex aquifolium*) and herbaceous species like *Carex flacca*, *Carlina vulgaris*, *Geranium robertianum*, *Mycelis muralis*, *Senecio jacobaea*, *Sesleria caerulea* and *Teucrium scorodonia*. A suite of calcicole ferns was usually found comprising *Asplenium ruta-muraria*, *Ceterach officinarum* and, in the deeper clefts (grykes), the shade-loving *Phyllitis scolopendrium*. Characteristic bryophytes were *Ctenidium molluscum*, *Neckera crispa* and *Tortella tortuosa*.

The exposed variant of the Annex I Limestone pavement habitat type (LPE) within the ZoI of the proposed road development is summarised below in **Table 8.6** below.

Table 8.6: Areas of the exposed variant of the Annex I habitat Limestone pavement [*8240] within the potential ZoI of the proposed road development

Area	Vegetation Community[23]
South of Bóthar Nua at Ch. 10+040 (outside of any European site)	LPE_1b *Teucrium scorodonia - Sesleria caerulea* pavement
North of Bóthar Nua at Ch. 10+200 – Ch. 10+250 (outside of any European site)	LPE_1b *Teucrium scorodonia - Sesleria caerulea* pavement
Within Lough Corrib cSAC Western and northern boundaries of Lackagh Quarry between Ch. 10+900 and Ch. 11+800	LPE_1b *Teucrium scorodonia - Sesleria caerulea* pavement LPE_1d *Mycelis muralis - Fissidens dubius* pavement 1e *Corylus avellana - Neckera crispa* pavement
Along the eastern boundary of Lackagh Quarry (outside of any European site)	LPE_1b *Teucrium scorodonia - Sesleria caerulea* pavement
South-east of the Coolagh Junction (between N6 and R446) (outside of any European site)	LPE_1e *Corylus avellana - Neckera crispa* pavement

8.3.4.9 Limestone/marl lakes (FL3)

There were two distinct lake complexes present in the vicinity of the proposed road development: Coolagh Lakes and Ballindooley Lough. All of the lakes that make up the Coolagh Lakes complex, and the main waterbody at Ballindooley, corresponded with this habitat classification and the Annex I habitat type *Hard oligo- mesotrophic waters with benthic vegetation of charophytes* [3140]. The full description and aquatic plant species lists for these lakes – and all others surveyed as part of the aquatic habitat survey – are provided in **Appendix A.8.20**.

Coolagh Lakes

The upper lake contained some flowering plants including *Hippuris vulgaris*, *Myriophyllum spicatum*, *Nuphar lutea* and *Elodea canadensis* (which grew at the base of the euphotic zone at about 4m, as did some *Lemna trisulca*). However, *Chara rudis* or *Chara hispida* dominated most of the euphotic zone.

The lower lake also contained large stands of *Chara hispida* and *Chara rudis*, but flowering plants were more abundant with *Lemna trisulca* forming a zone at the base of the euphotic zone (4m) and *Elodea canadensis* intermixed with the *Chara* species. Other species included *Potamogeton lucens*, *Sparganium* sp., *Myriophyllum spicatum* and *Utricularia cf. vulgaris*. Two other species of charophyte, *Chara contraria* and *Chara vulgaris* occurred in small quantities. The lower lake however, was considered to be the borderline eutrophic type FL5 (and not an exceptionally good example of the habitat type), due to the increased

[23] The vegetation communities are assigned based upon the plant species recorded and with reference to the vegetation types described in *National survey of limestone pavement and associated habitats in Ireland. Irish Wildlife Manuals, No. 73* (Wilson, S. and Fernández, F., 2013)

presence of *Elodea canadensis* and *Lemna trisulca* (most likely as a result of eutrophication) and the presence of the non-native invasive Zebra mussel *Dreissena polymorpha*.

Ballindooley Lough

The sub-littoral vegetation was dominated by charophyte algae. *Chara rudis* was exceptionally abundant from 0-3m with some other species occurring in very shallow water including *Chara aspera*, *Chara aculeolata* and *Chara curta*. Flowering plants were rare, as is often the case in marl lakes, with only *Elodea canadensis* and *Utricularia* cf. *vulgaris* observed. The complete dominance of *Chara rudis* however, probably indicates some degree of eutrophication. The rather turbid lake water would support this conclusion. Most of the lake was deeper than the euphotic depth of about 4m and no plants were found.

8.3.4.10 Mesotrophic lakes (FL4)

The smaller circular pond (531194 728778 ITM) at Ballindooley – the northernmost of the three small lakes present – corresponded with this habitat type. It had floating plant species present including *Potamogeton natans*, *Nymphaea alba* and *Sparganium natans*. Sublittoral species included abundant *Chara virgata and Utricularia cf. vulgaris*.

There was also a more transient small lake along the eastern edge of the main lake complex at the Coolagh Lakes (which was dry when surveyed). The aquatic plant species *Typha latifolia* and *Hippuris vulgaris* were present.

8.3.4.11 Eutrophic lakes (FL5)

Two of the small lakes at Ballindooley corresponded with this habitat type. The oval shaped pool nearest the residential houses (ITM grid reference 531244 728619) was shallow with a sublittoral flora of *Elodea canadensis*, *Lemna trisulca* and *Fontinalis antipyretica*. Floating species included *Nymphaea alba*. The abundance *of Lemna* and *Elodea* indicated a eutrophic pond.

The smallest water body, directly south of the main lake (531473 728626 ITM), had *Potamogeton natans*, *Hippuris vulgaris*, *Elodea canadensis*, *Alisma plantago-aquatica* and *Ranunculus trichophyllus* present; suggestive of eutrophic conditions.

8.3.4.12 Turloughs (FL6)

There is one turlough feature within the ZoI of the proposed road development: between Bóthar Nua and Seanbóthar in the Menlough area at Ch. 10+320. Turloughs are depressions, generally in limestone areas, which are intermittently inundated with groundwater and support wetland habitats.

The turlough feature at Menlough corresponded with the priority Annex I habitat type *Turloughs* [*3180] and the *Potentilla anserina-Carex nigra* vegetation community (Waldren, 2015, Ed.). The vegetation was typical turlough marsh vegetation including the following species: *Potentilla anserina*, *Apium inundatum*, *Eleocharis palustris*, *Caltha palustris*, *Rumex crispus*, *Agrostis stolonifera*, *Ranunculus repens*, *Senecio aquaticus*, *Prunella vulgaris*, *Myosotis aquatica*, *Persicaria amphibia*, *Mentha aquatica*, *Glyceria fluitans*, *Filipendula ulmaria*, *Urtica dioica*, *Persicaria maculata*, *Rumex obtusifolius*, *Equisetum palustre* and *Veronica catenata*. Although not associated directly with the ground vegetation, the moss species *Cinclidotus fontinaloides* – a characteristic turlough species – was recorded on stone walls within the turlough feature.

The Turlough habitat within the ZoI of the proposed road development is summarised below in **Table 8.7** below.

Table 8.7: Areas of the Annex I habitat Turloughs [*3180] within the potential ZoI of the proposed road development

Area	Vegetation Community24
Between Bóthar Nua and Seanbóthar in the Menlough/Coolough area at Ch. 10+320 outside a European site	6b Wet Carex nigra vegetation community (Goodwillie, 1992) Potentilla anserina-Carex nigra vegetation community (Waldren, 2015, Ed.)

8.3.4.13 Other artificial lakes and ponds (FL8)

Artificial ponds were present at the proposed Coolagh Junction (road drainage attenuation ponds) and in Lackagh Quarry (associated with the gravel washout area). The plant species associated with the attenuation ponds are described below under the FS1 habitat descriptions; there was no vegetation associated with the gravel washout ponds at Lackagh Quarry.

8.3.4.14 Calcareous springs (FP1)

A total of 27 calcareous springs/seepage lines were recorded in Lackagh Quarry. Of these, 23 had vegetation associated with the seepage line. The most frequently recorded vascular plant species associated with the springs/seepage lines were *Tussilago farfara*, *Leontodon hispidus*, *Carex flacca*, *Epilobium parviflorum*, *Festuca rubra*, *Sonchus oleraceus*, *Holcus lanatus*, *Lotus uliginosus* and *Sesleria caerulea*; the most frequently recorded moss species were *Dicranella varia*, *Didymodon tophaceus*, *Fissidens adianthoides* and *Pellia endiviifolia*.

Six of the springs/seepages (all located on the west face of the quarry) conformed to the priority Annex I habitat *Petrifying springs with tufa formation (Cratoneurion)* [*7220], as the following indicator species for the Annex I habitat type were recorded growing in conjunction with tufa deposits on the cliff faces: *Didymodon tophaceus*, *Pellia endiviifolia*, *Festuca rubra*[25]. The Petrifying springs present were

---

[24] The vegetation communities are assigned based upon the plant species recorded and with reference to the vegetation types described in *Turloughs over 10 ha: vegetation survey and evaluation* (Goodwillie, R., 1992) and *Turlough Hydrology, Ecology and Conservation* (Waldren, S. 2015, Ed.)

[25] Although these indicator species recorded are not listed as such in the *Interpretation manual of European Union Habitats* EUR28 (CEC, 2013), in an Irish context they are considered by the NPWS to be indicator species for [*7220] (NPWS, 2013b)

generally species poor and considered marginal examples of the habitat type, lacking many of the key indicative species and generally limited in extent; in some cases, occurring only in the immediate vicinity of cushions of *Didymodon tophaceus*. They are also only present due to human activity, with the quarrying of limestone resulting in the creation of suitable habitat for their formation.

The full results of the Petrifying spring survey at Lackagh Quarry are provided in **Appendix A.8.21**.

8.3.4.15 Reed and large sedge swamps (FS1)

Along the western part of the proposed road development, there were scattered small patches of species poor reed swamp in the vicinity of the proposed road development; mostly located along the margins of peatland areas. The vegetation was typically dominated by *Phragmites australis*.

Along the banks of the River Corrib and around parts of the Coolagh Lakes, reed swamp habitat was typically dominated by *Phragmites australis* with species such as *Phalaris arundinacea*, *Typha latifolia*, *Sparganium erectum*, *Equisetum fluviatile*, *Menyanthes trifoliata*, *Epilobium hirsutum*, *Calystegia sepium*, *Lycopus europaeus*, *Lysimachia vulgaris*, *Mentha aquatica*, *Angelica sylvestris*, *Valeriana officinalis*, *Filipendula ulmaria* and *Lythrum salicaria* also present.

Two small areas of reed swamp on the margins of the Coolagh Lakes corresponded with the Annex I habitat type *Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels* [6430], where herb species indicative of this habitat type such as *Calystegia sepium*, *Epilobium hirsutum* and *Equisetum fluviatile* were more abundant amongst the reed stands.

Where *Cladium mariscus* was more dominant, reed swamps corresponded with the priority Annex I habitat type *Calcareous fens with Cladium mariscus and species of the Caricion davallianae* [*7210]. This habitat was abundant around the Coolagh Lakes, but was also recorded to a lesser extent along the backwater to the east of Jordan's Island and in small patches along the banks of the River Corrib. Other plant species associated with this Annex I habitat type included: *Phragmites australis*, *Calystegia sepium*, *Equisetum fluviatile*, *Lysimachia vulgaris*, *Epilobium hirsutum*, *Mentha aquatica* and *Schoenus nigricans*.

At Ballindooley Lough, *Phragmites australis*, *Schoenoplectus lacustris* and *Cladium mariscus* were the typical species in the reed swamp habitat around the lakes' margins. As above, the *Cladium mariscus* swamp, which was present at two locations at Ballindooley Lough, corresponded with the priority Annex I *Cladium* fen habitat type.

The existing N6 attenuation ponds at Briarhill supported a relatively species rich wetland for such a man-made feature, including: *Phragmites australis*, *Typha latifolia*, *Sparganium erectum*, *Schoenoplectus lacustris*, *Apium nodiflorum*, *Nasturtium officinale*, *Lemna minor* and *Epilobium hirsutum*.

8.3.4.16 Tall-herb swamps (FS2)

The majority of the tall-herb swamp was recorded along the banks of the River Corrib and around the margins of the Coolagh Lakes – where larger areas were present in the wetland extending north from the lakes, either side of Bóthar Nua.

The most frequently recorded species were *Carex disticha*, *Epilobium hirsutum*, *Equisetum fluviatile*, *Filipendula ulmaria*, *Calliergonella cuspidata*, *Festuca arundinacea*, *Lysimachia vulgaris*, *Phragmites australis*, *Mentha aquatica*, *Valeriana officinalis* and *Galium palustre*. Other typical species present included *Calystegia sepium*, *Iris pseudacorus*, *Menyanthes trifoliata*, *Sparganium erectum*, *Angelica sylvestris*, *Berula erecta* and *Lythrum salicaria*.

The majority of the FS2 areas corresponded with the Annex I habitat type *Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels* [6430].

Due to the abundance of *Cladium mariscus* a single polygon of reed-swamp, c.700m downstream of the proposed River Corrib Bridge on the west bank of the river, corresponded with the *Cladium* fen priority Annex I habitat type [*7210].

In the western part of the study area (Ch. 3+400), there was also a vegetated drain, with *Apium nodiflorum*, *Iris pseudacorus* and *Epilobium hirsutum*, recorded near An Chloch Scoilte Junction which corresponded with the FS2 classification.

8.3.4.17 Eroding/upland rivers (FW1)

The following are the eroding upland rivers crossed by the proposed road development: Sruthán na Líbeirtí (Liberty Stream), Trusky Stream, the Bearna Stream (and tributary), Tonabrocky Stream and the Knocknacarra Stream.

Many of these streams are seasonal in their upper reaches, where they are crossed by the proposed road development. Instream vegetation is generally absent, and in the vicinity of the proposed crossings for the proposed road development, is overgrown with scrub and rank vegetation from the adjacent terrestrial habitats. Where present, coverage is limited and included the following species: *Apium nodiflorum*, *Fontinalis antipyretica*, *Fontinalis squamosa*, *Hyocomium armoricum*, *Mentha aquatica*, *Nasturtium officinale* and *Ranunculus flammula*.

The physical characteristics of the various stream/river channels are described in the fisheries report in **Appendix A.8.17**. Details of the fisheries value of these watercourses is also presented in **Appendix A.8.17** and discussed in **Section 8.3.12** below.

8.3.4.18 Depositing/lowland rivers (FW2)

Two of the watercourses present within the scheme study area were classified as depositing/lowland rivers: the River Corrib and the Terryland River.

River Corrib, from Tonacurragh to Menlo Castle

The vegetation in this section of the river was dominated by charophyte algae in many places, especially *Chara rudis.* In the upper river near the junction of the Friar's Cut, the shore included backwaters dominated by reed swamp and open water with *Chara curta*, *Chara virgata annulata* and cyanobacterial crust on stones, as on the shore of Lough Corrib and other calcareous lakes. In deeper water (1m) *Chara rudis* was dominant with emergent vegetation including *Schoenoplectus lacustris* and *Phragmites australis*. *Chara rudis* extended to 2m depth along with *Zannichella palustris*, *Potamogeton lucens,* a little *Potamogeton crispus* and *Myriophyllum spicatum,* while *Chara globularis* extended to 3m along with some *Nuphar lutea* and abundant Zebra mussels. At this depth a white, shelly marl replaces the dark peat and mud of shallower water. In the main channel the river shelved very steeply and *Potamogeton perfoliatus* occurred.

Midway between the Friar's cut and Menlo Pier the river was divided by a long narrow bank vegetated with swamp (527715 728520 ITM) with species present including *Eleocharis palustris, Hippuris vulgaris, Lythrum salicaria, Ranunculus flammula, Valeriana officinalis, Iris pseudacorus, Schoenoplectus lacustris, Sparganium* sp., *Menyanthes trifoliata, Calystegia sepium* and *Myosotis laxa*[26].

The shallower western channel, to a depth of 2m, contained reed swamp followed by *Chara virgata annulata*, *Lemna trisulca*, *Elodea canadensis* and *Nuphar lutea* in 1m depth water, and *Potamogeton perfoliatus* beds at 2m. In places, bare areas of mud were colonized *by Nitella opaca*. The main channel shelved very steeply with *Potamogeton perfoliatus*, *Lemna trisulca*, and *Elodea canadensis*, followed by bare ground with Zebra mussels.

On the east bank *Chara rudis* was dominant with some *Potamogeton berchtoldii*, *Lemna trisulca* and *Elodea canadensis*.

Below Menlo Pier the river narrowed and deepened with little vegetation other than *Potamogeton perfoliatus* and *Potamogeton natans* along with some *Chara rudis* in shallow water close to the bank.

The depth of the river varied greatly, with many shallow inshore areas, but the main channel was cut into white marl which exceeded 8m depth in places. Vegetation was largely confined to water less than 4m, but Zebra mussels occurred deeper than this. A variety of flowering plants occurred, especially pond weeds (*Potamogeton* sp.). Nearly all shallow areas of any extent were occupied by *Schoenoplectus* and *Phragmites* reed swamp.

[26] Note that these species are provided here for information and do not appear in **Appendix A.8.20** as they were associated with the island habitat

River Corrib main channel, from Menlo Castle to the Salmon Weir

In this section of the river, vegetation was largely confined to shallow areas along the bank and was only found in depths of <2m; mainly as either reed swamp of *Phragmites australis* or *Equisetum fluviatile*, with some stands of *Potamogeton natans* and *Carex rostrata*. *Chara rudis* and some *Chara virgata* were common in the shallow sublittoral. Species composition was similar to, but less diverse than, the section upstream.

Backwater on the east side of Jordan's Island

This section consisted of small pools and channels cut through extensive *Phragmites australis*, *Schoenoplectus lacustris* and *Cladium mariscus* reed swamp. The area contained a diverse flora, especially of charophytes, but like all habitats surveyed showed signs of eutrophication. Species present include *Chara aspera, Chara contraria, Chara curta, Chara globularis, Chara rudis, Chara vulgaris and Chara virgata*. Other aquatic species included *Potamogeton pectinatus, Potamogeton perfoliatus, Potamogeton lucens, Potamogeton natans, Myriophyllum spicatum, Elodea canadensis, Berula erecta, Lemna trisulca, Nuphar lutea, Oenanthe aquatica*. Blanket weed or *Cladophora* sp. was common, suggesting eutrophication.

Terryland River

The Terryland River had a limited aquatic flora present including *Potamogeton natans*, *Callitriche* sp., *Alisma plantago aquatica*, *Chara hispida/rudis*, *Myriophyllum spicatum*, *Sparganium* sp. and *Elodea canadensis*. Large areas of bare mud and extensive development of blanket weed, *Cladophora* sp. indicated significant eutrophication and water quality was poor (see **Section 8.3.12** and **Appendix A.8.17** for the results of the macro-invertebrate water quality monitoring on the Terryland River).

8.3.4.19 Drainage ditches (FW4)

Drainage ditches were associated with agricultural fields, the margins of peatland sites, within and surrounding the Coolagh Lakes, at Ballindooley Lough, and at the Galway Racecourse.

Along the western part of the proposed road development, drainage ditches included species such as *Angelica sylvestris*, *Potamogeton polygonifolius*, *Ranunculus flammula* and *Ranunculus repens*.

Plant species associated with the drainage ditches surrounding the Coolagh Lakes included: *Apium nodiflorum*, *Lemna* sp., *Filipendula ulmaria* and *Lythrum salicaria*. The main channel connecting the Coolagh Lakes with the River Corrib was classified as a drainage ditch, fringed by very dense stands of *Phragmites australis* and *Cladium mariscus*. It was up to 1m deep with *Nuphar lutea*, *Menyanthes trifoliata*, *Elodea canadensis*, *Chara rudis*, and *Lemna trisulca* growing in the channel. *Ranunculus lingua* was conspicuous in the reed swamp on the channel edge.

The drainage ditches at Ballindooley Lough appeared to be regularly dredged and contained a limited flora of *Chara virgata*, *Chara aspera*, *Chara aculeolata*, *Chara rudis*, *Potamogeton coloratus* and *Lemna trisulca*.

The drainage ditches at the Galway Racecourse supported a diverse range of plant species including, *Equisetum fluviatile*, *Carex rostrata*, *Apium nodiflorum*, *Agrostis stolonifera*, *Potamogeton natans*, *Nasturtium officinale*, *Juncus articulatus*, *Typha latifolia*, *Glyceria fluitans*, *Sparganium erectum*, *Eleocharis palustris*, *Ranunculus flammula*, *Mentha aquatica*, *Galium uliginosum* and *Samolus valerandi*.

8.3.4.20 Improved agricultural grassland (GA1)

Improved agricultural grassland was present throughout, with larger areas recorded at Cappagh, between the Ballymoneen Road and Knocknabrona, around the Rahoon Road Junction, at Bushypark, in the vicinity of Bóthar Nua and Seanbóthar (Menlough/Coolough), and from the N84 Headford Road through to the existing Coolagh Junction. Characteristic species included: grass species such as *Lolium perenne*, *Agrostis stolonifera*, *Dactylis glomerata*, *Holcus lanatus*, *Poa annua*, *Poa trivialis* and *Cynosurus cristatus*; and herb species including *Trifolium repens*, *Trifolium pratense*, *Bellis perennis*, *Urtica dioica*, *Plantago lanceolata*, *Plantago major*, *Cerastium fontanum*, *Cerastium glomeratum*, *Cirsium arvense*, *Potentilla anserina*, *Ranunculus repens*, *Rumex obtusifolius*, and *Taraxacum officinale* agg.

8.3.4.21 Amenity grassland (improved) (GA2)

Other than amenity grasslands associated with residential gardens and landscaped areas in commercial/industrial complexes, the two largest areas of this habitat type were the playing fields at the NUIG Sporting Campus and the racetrack at the Galway Racecourse. Typical grass species included *Agrostis stolonifera*, *Agrostis capillaris*, *Cynosurus cristatus*, *Holcus lanatus* and *Lolium perenne*, along with the following herb species: *Bellis perennis*, *Cirsium arvense*, *Cirsium palustre*, *Cirsium vulgare*, *Plantago lanceolata*, *Plantago major*, *Potentilla anserina*, *Ranunculus repens*, *Rumex crispus*, *Rumex obtusifolius*, *Senecio jacobaea*, *Sonchus asper*, *Taraxacum officinale* agg. and *Trifolium pratense*.

8.3.4.22 Marsh (GM1)

The two small marsh areas at Na Foraí Maola Thoir (Ch. 1+100) were characterised by *Filipendula ulmaria*, *Lythrum salicaria*, *Juncus effusus* with *Ranunculus acris*, *Potentilla anserina*, *Mentha aquatica*, *Typha latifolia*, *Scrophularia auriculata* and *Angelica sylvestris* also present.

There was a small area of marsh habitat at Ballard West (Ch. 3+100). Typical marsh species such as *Lythrum salicaria*, *Mentha aquatica*, *Potentilla palustris*, *Myosotis scorpioides*, and *Hydrocotyle vulgaris* were present along with *Juncus articulatus*, *Carex panicea*, *Ranunculus acris*, *Leontodon autumnalis*, *Solidago virgaurea* and *Hypericum perforatum*.

To the north of Bearna Woods (c.55m east of the proposed development boundary at Ch. 3+900) there was a marsh near the east bank of the Tonabrocky Stream.

Species present included *Holcus lanatus*, *Festuca rubra*, *Molinia caerulea*, *Anthoxanthum odoratum*, *Filipendula ulmaria*, *Angelica sylvestris*, *Lythrum salicaria*, *Carex disticha*, *Carex nigra*, *Equisetum fluviatile*, *Valeriana officinalis*, *Potentilla palustris*, *Potentilla erecta*, *Calliergonella cuspidata* and *Juncus acutiflorus*.

The marsh area near the Rahoon Road Junction (west of Ch. 1+900 along the N59 Link Road South) was characterised by the following species: *Juncus effusus*, *Hydrocotyle vulgaris*, *Juncus acutiflorus*, *Agrostis stolonifera*, *Epilobium hirsutum*, *Typha latifolia*, *Epilobium palustre*, *Lotus pedunculatus*, *Filipendula ulmaria*, *Calliergonella* sp.

The marsh area at Castlegar (Ch. 13+000) is characterised by the following species: *Juncus acutiflorus*, *Agrostis stolonifera*, *Galium palustre*, *Carex nigra*, *Mentha aquatica*, *Comarum palustre*, *Calliergonella cuspidata*, *Epilobium palustre* and *Potentilla anserina*. Locally there is *Carex disticha*, *Carex panicea*, *Carex echinata* and *Carex rostrata* while *Cirsium palustre* is frequent throughout. Other species include *Juncus effusus, Luzula campestris, Menyanthes trifoliata, Hypericum tetrapterum, Filipendula ulmaria, Carex hirta, Molinia caerulea, Salix aurita, Anthoxanthum odoratum, Hydrocotyle vulgaris, Persicaria amphibia, Eleocharis palustris, Glyceria fluitans, Apium nodiflorum, and Ranunculus repens.* At the edges *Centaurea nigra*, *Briza media*, *Knautia arvensis*, *Leucanthemum vulgare* and *Ilex aquifolium* occurred.

8.3.4.23 Dry calcareous and neutral grassland (GS1)

There were scattered patches of neutral grassland present along the route of the proposed road development to the east of the River Corrib, generally associated with agricultural lands that are not intensively managed and subject to low intensity grazing. Typical grass species recorded included *Agrostis stolonifera*, *Agrostis capillaris*, *Holcus lanatus*, *Cynosurus cristatus*, *Anthoxanthum odoratum*, *Lolium perenne* and *Dactylis glomerata*. Herb species included *Achillea millefolium*, *Centaurea nigra*, *Prunella vulgaris*, *Lotus corniculatus*, *Trifolium repens*, *Trifolium pratense*, *Rumex acetosa*, *Urtica dioica*, *Senecio jacobaea*, *Ranunculus repens*, *Prunella vulgaris*, *Plantago lanceolata* and *Taraxacum officinalis* agg.

Given the underlying geology east of the River Corrib, this habitat was much more widespread to the east of the river and this was reflected in the greater species diversity, and in particular calcicole species, recorded.

The majority of calcareous grassland areas did not correspond with the Annex I habitat type *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)* [*6210/6210], due the lack of sufficient indicator species in the sward. Typical species recorded included *Cynosurus cristatus*, *Holcus lanatus*, *Festuca rubra*, *Dactylis glomerata*, *Agrostis stolonifera*, *Lolium perenne*, *Daucus carota*, *Lotus corniculatus*, *Galium verum*, *Linum catharticum*, *Centaurea nigra*, *Plantago lanceolata*, *Cirsium arvense*, *Senecio jacobaea*, *Prunella vulgaris*, *Trifolium repens*, *Ranunculus acris*, *Trifolium pratense* and *Taraxacum officinale* agg.

In many areas the calcareous grasslands did correspond with the Annex I Calcareous grassland habitat type due to the presence of sufficient high quality positive/positive indicator species (after O'Neill *et al.*, 2013). High quality indicator species recorded in Calcareous grassland within the ZoI of the proposed road development included *Antennaria dioica*, *Anthyllis vulneraria*, *Asperula cynanchica*, *Briza media*, *Campanula rotundifolia*, *Carex caryophyllea*, *Carlina vulgaris*, *Koeleria macrantha* and *Linum catharticum*. Positive indicator species recorded included *Carex flacca*, *Ctenidium molluscum*, *Daucus carota*, *Galium verum*, *Helictotrichon pubescens*, *Leontodon hispidus*, *Lotus corniculatus*, *Pilosella officinarum*, *Ranunculus bulbosus*, *Sesleria caerulea*, *Thymus polytrichus* and *Trisetum flavescens*.

Within Lough Corrib cSAC, calcareous grassland was recorded at three locations within the ZoI of the proposed road development: on the east bank of the proposed River Corrib Bridge crossing (Ch. 9+400 – Ch. 9+475), along the spring/valley leading to the Coolough Lakes (Ch. 9+950), and to the north and west of Lackagh Quarry (Ch. 11+000 – Ch. 11+800) - see **Figure 8.14.7** and **Figure 8.14.8**.

On the east bank of the proposed River Corrib Bridge crossing the grassland was of the *Cynosurus cristatus – Trifolium repens* (3c) vegetation community (westernmost field) and the *Cynosurus cristatus – Trifolium pratense* (3d) vegetation community (easternmost field) and did not correspond with any Annex I habitat types. There was an area of the Annex I habitat type *Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)* [*6210/6210] to the south-east.

Along the spring/valley leading to the Coolough Lakes (the Lough Corrib cSAC boundary here is adjacent to the proposed road development) the grassland was of the *Holcus lanatus – Lolium perenne* grassland (2c) vegetation community and did not correspond with any Annex I habitat types.

Around the margins of Lackagh Quarry and west to Ch. 11+000, the grasslands were of the *Briza media – Thymus polytrichus* grassland (3a) vegetation community. In many cases, particularly to the north and west of the quarry boundary, the *Briza media – Thymus polytrichus* grassland corresponded with both the priority and non-priority classifications of the Annex I Calcareous grassland habitat type. The thin soils supported a highly diverse sward typically containing *Briza media*, *Carex flacca*, *Sesleria caerulea*, *Potentilla erecta*, *Succisa pratensis*, *Centaurea nigra*, *Galium verum* and *Leucanthemum vulgare*. Bryophytes include *Scleropodium purum* and *Ctenidium molluscum*.

The Calcareous grassland habitat within the ZoI of the proposed road development is summarised below in **Table 8.8** below.

Table 8.8: Areas of the Annex I habitat Calcareous grassland [*6210/6210] within the potential ZoI of the proposed road development

Area	Vegetation Community[27]
Within Lough Corrib cSAC c.27m south of the proposed road development along the east bank of the River Corrib	3a *Briza media – Thymus polytrichus* grassland [6210]
Within Lough Corrib cSAC c.20m south of the proposed road development between Ch. 11+050 and Ch. 11+150	3a *Briza media – Thymus polytrichus* grassland [6210]
Within Lough Corrib cSAC above the proposed Lackagh Tunnel (Ch. 11+300) and along the western and northern boundary of Lackagh Quarry between Ch. 11+000 and Ch. 11+800	3a *Briza media – Thymus polytrichus* grassland [*6210]
Adjacent to the proposed development boundary at Ch. 12+000	3a *Briza media – Thymus polytrichus* grassland [6210]
West of the N84 Headford Road Ch. 12+075 – Ch. 12+125	3a *Briza media – Thymus polytrichus* grassland [6210]
Along proposed development boundary at AR 12/02	3a *Briza media – Thymus polytrichus* grassland [6210]
Northern end of Coolagh Junction between Ch. 16+200 – Ch. 16+275	3a *Briza media – Thymus polytrichus* grassland [6210]
Adjacent to the south-western end of the Coolagh Junction	3a *Briza media – Thymus polytrichus* grassland [6210]
Adjacent to southern boundary of the Coolagh Junction	3a *Briza media – Thymus polytrichus* grassland [6210]

8.3.4.24 Dry meadows and grassy verges (GS2)

This habitat type was present across the study area and included abandoned agricultural fields, fields managed for silage/hay, neglected grassed areas associated with residential gardens or waste ground, and roadside verges.

Typical grass species included, *Arrhenatherum elatius*, *Dactylis glomerata*, *Holcus lanatus*, *Festuca rubra*, *Phleum pratense*, *Alopecurus pratensis*, *Agrostis stolonifera*, *Anthoxanthum odoratum* and *Lolium perenne*. Herb species recorded included *Centaurea nigra*, *Heracleum sphondylium*, *Calystegia sepium*, *Urtica dioica*, *Plantago lanceolata*, *Cirsium arvense*, *Ranunculus repens*, *Ranunculus acris*, *Rumex acetosa* subsp. *acetosa*, *Rumex obtusifolius*, *Cerastium fontanum*, *Potentilla anserina*, and *Scorzoneroides autumnalis*.

Across the eastern part of the scheme study area[28], in some instances this habitat type corresponded with the Annex I habitat *Lowland hay meadows (Alopecurus*

[27] The vegetation communities are assigned based upon the plant species recorded and with reference to the vegetation types described in *The Irish semi-natural grasslands survey 2007-2012. Irish Wildlife Manuals, No. 78* (O'Neill et al., 2013)
[28] Almost all occurrences of the 6510 Annex I habitat type were recorded east of the River Corrib.

pratensis, *Sanguisorba officinalis)* [6510]. However, none of these areas are within the ZoI of the proposed road development.

8.3.4.25 Dry-humid acid grassland (GS3)

Dry-humid acid grassland was recorded widely along the western part of the proposed road development in less intensively managed agricultural fields, often on the margins of peatland/heath sites, and frequently in a mosaic with wet grassland. In many cases, the grasslands were noted as being species poor as a result of grazing. Characteristic species included: the grasses, *Agrostis capillaris*, *Cynosurus cristatus*, *Anthoxanthum odoratum*, *Lolium perenne*, *Nardus stricta* and *Festuca rubra*; herb species such as *Rumex acetosa*, *Succisa pratensis*, *Potentilla erecta*, *Galium saxatile*, *Veronica officinalis*, *Achillea millefolium*, *Trifolium pratense* and *Juncus articulatus*; and moss species such as *Hylocomium splendens*, *Hypnum cupressiforme*, *Rhytidiadelphus squarrosus* and *Pleurozium schreberi*. Of note was the record of *Botrychium lunaria*, a species listed as Near Threatened on the Irish Red List for Vascular Plants (Jackson et al., 2016) from Knocknabrona/Knocknafroska in 2015, in an area outside of the proposed development boundary.

At one location in the scheme study area – Carrach, between Bearna Village and Bearna Woods – Dry-humid acid grassland corresponded with the priority Annex I habitat type *Species-rich Nardus grasslands, on siliceous substrates in mountain areas (and submountain areas, in Continental Europe)* [*6230]. However, this area is not within the ZoI of the proposed road development.

8.3.4.26 Wet grassland (GS4)

Wet grassland was recorded across the scheme study area but more frequently west of Ballindooley Lough. It ranged in quality from species poor variants associated with lands managed for agriculture through to more diverse and species rich areas associated with the River Corrib/Coolagh Lakes and at Ballindooley Lough.

In the vicinity of the proposed road development, the more improved wet grassland fields, managed for agriculture, generally comprised rush species such as *Juncus effusus*, *Juncus articulatus* and *Juncus conglomeratus*, grass species including *Agrostis stolonifera*, *Arrhenatherum elatius*, *Holcus lanatus*, and *Lolium perenne*, and with fewer wet grassland herb species present than more semi-natural areas. Herb species recorded in wet grassland included *Angelica sylvestris*, *Carex flacca*, *Carex panicea*, *Cirsium palustre*, *Filipendula ulmaria*, *Galium palustre*, *Hydrocotyle vulgaris*, *Iris pseudacorus*, *Lotus pedunculatus*, *Lythrum salicaria*, *Mentha aquatica*, *Potentilla anserina*, *Potentilla erecta*, *Ranunculus acris*, *Ranunculus repens*, *Ranunculus flammula*, *Stachys palustris* and *Succisa pratensis*. Typical moss species included *Calliergonella cuspidata* and *Rhytidiadelphus squarrosus*.

A wet grassland type, dominated by *Molinia caerulea*, was also recorded in the western part of the scheme study area and was associated with the margins of some of the peatland areas in the vicinity of the proposed road development – at Na Foraí Maola Thiar (at Ar 0/04), at Troscaigh Thiar (Ch. 2+350) and at

Knocknabrona/Knocknafroska (Ch. 7+750). These grasslands corresponded with the 1d *Molinia caerulea – Potentilla erecta* grassland vegetation community (O'Neill et al., 2013). At the Foraí Maola Thiar site, *Potentilla erecta*, *Succisa pratensis*, *Anthoxanthum odoratum*, *Ranunculus acris*, *Ranunculus repens*, *Cirsium vulgare* and *Vicia sepium* were present in the sward but in low amounts. At Troscaigh Thiar, *Juncus acutiflorus* was abundant in the sward with *Sphagnum fallax*, *Succisa pratensis*, *Hylocomium splendens*, *Potentilla erecta*, *Anthoxanthum odoratum*, *Rhytidiadelphus loreus*, *Thuidium* sp., *Rumex acetosa* and *Calluna vulgaris* (rare) also present. At Knocknabrona/Knocknafrosca, Juncus acutiflorus, Sphagnum fallax, Carex panicea, Potentilla erecta, Succisa pratensis, Erica tetralix (rare), Lythrum salicaria and Calluna vulgaris (rare) were also present.

At two locations within the footprint of the proposed road development – at Na Foraí Maola Thiar and Ballindooley Lough – wet grassland corresponded with the Annex I habitat type *Molinia meadows on calcareous, peaty or clayey-silt laden soils (Molinion caeruleae)* [6410]. There was also an area of *Molinia* meadow habitat adjacent to the proposed development boundary at Ch. 3+800.

At Na Foraí Maola, the *Molinia* meadow was characterised by the following indicator species for this Annex I habitat type: *Juncus conglomeratus*, *Carex echinata*, *Carex flacca*, *Filipendula ulmaria*, *Galium palustre*, *Juncus articulatus*, *Lotus pedunculatus*, *Molinia caerulea*, *Potentilla erecta* and *Mentha aquatica*.

Ballindooley Lough is surrounded by a band of wet grassland which corresponds with the *Molinia* meadow Annex I habitat type. The vegetation was characterised by the high-quality positive/positive indicator species *Carex pulicaris*, *Cirsium dissectum*, *Achillea ptarmica*, *Carex echinata*, *Carex panicea*, *Carex nigra*, *Filipendula ulmaria*, *Juncus articulatus*, *Molinia caerulea* and *Potentilla erecta*. *Calliergonella cuspidata* was the main bryophyte species, but *Climacium dendroides and Rhytidiadelphus squarrosus* were also recorded towards the grazed habitat edges. At the edges of the wet meadows, where *Molinia caerulea* was very sparse or absent, other species occurring more frequently included *Potentilla anserina*, *Carex nigra*, *Holcus lanatus*, *Ranunculus repens*, *Galium palustre*, *Festuca arundinacea* and *Eleocharis palustris*. In these areas the grassland did not correspond to the Annex I habitat type. It was noted that the lack of grazing at the southern end has resulted in patches of *Molinia caerulea* becoming very tussocky and the habitat less species diverse. Drainage and drying out of the peat is also likely to be affecting the habitat composition around the lake to a degree.

The *Molinia* meadow habitat within the ZoI of the proposed road development is summarised below in **Table 8.9**.

Table 8.9: Areas of the Annex I habitat *Molinia* meadow [6410] within the potential ZoI of the proposed road development

Area	Vegetation Community[29]
Na Foraí Maola Thiar at Ch. 0+900	1c *Molinia caerulea – Succisa pratensis* grassland
North of Bearna Woods Ch. 3+800	1c *Molinia caerulea – Succisa pratensis* grassland
Ballindooley Lough Ch. 12+250 – Ch. 12+400	1d *Molinia caerulea – Potentilla erecta* grassland

8.3.4.27 Dense bracken (HD1)

This habitat type was most prevalent along the western part of the proposed road development, associated with *Pteridium aquilinum* dominating abandoned agricultural fields (in conjunction with bramble cover in many instances), the margins of less intensively managed agricultural fields, and around the edges of peatland sites in conjunction with dense gorse cover.

8.3.4.28 Dry siliceous heath (HH1)

Patches of dry siliceous heath were present all along the route of the proposed road development to the west of the N59 Moycullen Road, generally relatively small in area, and most often in association with, or forming mosaics with, wet heath, bog and acid grassland. All areas of dry heath vegetation communities recorded within the ZoI of the proposed road development corresponded with the *Ulex gallii - Erica cinerea* dry heath (DH1) vegetation community, characterised by the presence of *Ulex gallii* along with *Erica cinerea* or *Calluna vulgaris*.

Typical dry heath species recorded included the vascular plant species *Ulex gallii*, *Calluna vulgaris*, *Erica cinerea*, *Molinia caerulea*, *Daboecia cantabrica*, *Potentilla erecta*, *Arctostaphylos uva-ursi*, *Pteridium aquilinum*, *Carex binervis*, *Carex panacea*, *Carex echinata*, along with the moss species *Rhytidiadelphus squarrosus*, *Hypnum cupressiforme*, *Hypnum jutlandicum*, and *Pseudoscleropodium purum*, and the lichen *Cladonia* cf *portentosa*. Other species recorded included *Agrostis capillaris*, *Succisa pratensis*, *Teucrium scorodonia*, *Hylocomium splendens*, *Solidago virgaurea*, *Viola* sp., *Dicranum scoparium* and *Campylopus introflexus*.

All instances of dry siliceous heath corresponded with the Annex I habitat type *European dry heaths* [4030]. The siliceous Dry heath habitat within the ZoI of the proposed is summarised below in **Table 8.10**.

[29] The vegetation communities are assigned based upon the plant species recorded and with reference to the vegetation types described in *The Irish semi-natural grasslands survey 2007-2012. Irish Wildlife Manuals, No. 78* (O'Neill et al., 2013)

Table 8.10: Areas of the siliceous variant of the Annex I habitat Dry heath [4030] within the potential ZoI of the proposed road development

Area	Vegetation Community30
Bearna West Roundabout/R336 between Ch. 0+000 and Ch. 0+050	DH1 *Ulex gallii* - Erica cinerea dry heath
North of Bearna West Roundabout between Ch. 0+175 and Ch. 0+450	DH1 *Ulex gallii* - Erica cinerea dry heath
Na Foraí Maola Thiar between Ch. 0+625 and Ch. 0+700	DH1 *Ulex gallii* - Erica cinerea dry heath
Na Foraí Maola Thiar between Ch. 0+900 and Ch. 1+000	DH1 *Ulex gallii* - Erica cinerea dry heath
Na Foraí Maola Thiar at Ch. 1+075	DH1 *Ulex gallii* - Erica cinerea dry heath
Na Foraí Maola Thoir between Ch. 1+175 and Ch. 1+550	DH1 *Ulex gallii* - Erica cinerea dry heath
Troscaigh Thiar between Ch. 1+700 and Ch. 2+400	DH1 *Ulex gallii* - Erica cinerea dry heath
Ballard East between Ch. 3+450 and Ch. 3+550	DH1 *Ulex gallii* - Erica cinerea dry heath
Ballard East between Ch. 3+750 and Ch. 3+850	DH1 *Ulex gallii* - Erica cinerea dry heath
Cappagh between Ch. 4+725 and Ch. 5+250	DH1 *Ulex gallii* - Erica cinerea dry heath
N59 Link Road North between Ch. 0+550 and Ch. 0+600	DH1 *Ulex gallii* - Erica cinerea dry heath
Knocknafroska between Ch. 7+800 and Ch. 7+975	DH1 *Ulex gallii* - Erica cinerea dry heath

8.3.4.29 Dry calcareous heath (HH2)

Dry calcareous heath was recorded in the Menlough/Coolough area; sometimes in larger distinct habitat patches but most often in a mosaic with outcropping limestone, scrub and/or calcareous grassland. The two larger areas were to the north of An Seanbóthar and on higher ground near to the eastern shore of the northernmost of the Coolagh Lakes. Typical plant species recorded included the vascular plants *Calluna vulgaris*, *Molinia caerulea*, *Sesleria caerulea*, *Rubus fruticosus* agg., *Carex panicea*, *Carex flacca*, *Carex pulicaris*, *Succisa pratensis*, *Rosa spinosissima*, *Potentilla erecta*, *Hedera helix*, and mosses such as *Thuidium tamariscinum*, *Breutelia chrysocoma* and *Scleropodium purum*.

This habitat corresponded with the *Calluna vulgaris – Antennaria dioica* dry heath (DH5) vegetation community of the Annex I habitat type *European dry heaths* [4030]. The calcareous Dry heath habitat within the ZoI of the proposed road development is summarised below in **Table 8.11**.

[30] The vegetation communities are assigned based upon the plant species recorded and with reference to the vegetation types described in *Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79* (Perrin et al., 2014)

Table 8.11: Areas of the calcareous variant of the Annex I habitat Dry heath [4030] within the potential ZoI of the proposed road development

Area	Vegetation Community
North of Seanbóthar between Ch. 10+450 and Ch. 10+650	DH5 *Calluna vulgaris – Antennaria dioica* dry heath
Coolagh Lakes	DH5 *Calluna vulgaris – Antennaria dioica* dry heath

8.3.4.30 Wet heath (HH3)

Wet heath occurred predominantly across the western part of the scheme study area; with only a few small patches of this habitat type present east of the River Corrib around the margins of the Coolagh Lakes. Typical vascular plant species in those areas in the vicinity of the proposed road development included *Calluna vulgaris*, *Erica tetralix*, *Schoenus nigricans*, *Trichophorum germanicum*, *Ulex gallii*, *Eriophorum angustifolium*, *Eriophorum vaginatum*, *Myrica gale*, *Potentilla erecta*, *Succisa pratensis* and *Juncus articulatus*. Typical moss species recorded included *Cladonia* cf *portentosa*, *Hylocomium splendens*, *Sphagnum capillifolium* subsp. *rubellum*, *Sphagnum cuspidatum*, *Sphagnum denticulatum*, *Sphagnum tenellum*, *Pleurozia purpurea*, *Sphagnum compactum* and *Diplophyllum albicans*.

In all cases this habitat corresponded with the Annex I habitat type *Northern Atlantic wet heaths with Erica tetralix* [4010]. The Wet heath habitat within the ZoI of the proposed road development is summarised below in **Table 8.12**.

Table 8.12: Areas of the Annex I habitat Wet heath [4010] within the potential ZoI of the proposed road development

Area	Vegetation Community[31]
Na Foraí Maola Thiar between Ch. 0+600 and Ch. 0+700	WH7 *Molinia caerulea – Ulex gallii* wet heath
Na Foraí Maola Thoir between Ch. 0+900 and Ch. 1+400	WH3 *Calluna vulgaris - Molinia caerulea - Sphagnum capillifolium* wet/damp heath
Troscaigh Thiar – Ch. 1+850-Ch. 2+400	WH3 *Calluna vulgaris - Molinia caerulea - Sphagnum capillifolium* wet/damp heath
Ballard West – Ch .2+900 – Ch. 3+025	WH3 *Calluna vulgaris - Molinia caerulea - Sphagnum capillifolium* wet/damp heath
Ballard East – Ch. 3+450 – Ch. 3+825	WH3 *Calluna vulgaris - Molinia caerulea - Sphagnum capillifolium* wet/damp heath
Cappagh – Ch. 4+800 – Ch. 5+125	WH4b *Trichophorum germanicum- Eriophorum angustifolium* wet heath: *Calluna vulgaris* sub-community

[31] The vegetation communities are assigned based upon the plant species recorded and with reference to the vegetation types described in *Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79* (Perrin et al., 2014)

Area	Vegetation Community[31]
Coolagh Lakes	WH6 *Schoenus nigricans – Molinia caerulea – Myrica gale* wet heath

8.3.4.31 Lowland blanket bog (PB3)

Lowland blanket bog was recorded across the western part of the scheme study area, to the north of the proposed road development. This habitat type was only recorded within the ZoI of the proposed road development at Na Foraí Maola Thiar (Ch. 0+650 – Ch. 0+750) where it formed a mosaic with wet heath, dry heath and scrub at the southern extent of a much larger peatland site within Moycullen Bogs NHA. Approximately 10% of this habitat area corresponded with the Lowland blanket bog classification; although this habitat type did not occur within the proposed development boundary.

Typical vascular plant species present included *Calluna vulgaris*, *Molinia caerulea*, *Schoenus nigricans*, *Rhynchospora alba*, *Erica tetralix*, *Carex panicea*, *Eriophorum angustifolium*, *Eriophorum vaginatum*, *Narthecium ossifragum*, *Trichophorum germanicum*, *Drosera rotundifolia* and *Potentilla erecta*. Typical moss species included *Sphagnum capillifolium* ssp. *rubellum*, *Sphagnum papillosum*, *Sphagnum tenellum*, *Sphagnum cuspidatum*, *Aulacomnium palustre* and *Odontoschisma sphagni*.

Lowland blanket bog habitat corresponded with the Annex I habitat type *Blanket bogs* [*7130]. The Blanket bog habitat within the ZoI of the proposed road development is summarised below in **Table 8.13** below.

Table 8.13: Areas of the Annex I habitat Blanket bog [*7130] within the potential ZoI of the proposed road development

Area	Vegetation Community[32]
Na Foraí Maola Thiar between Ch. 0+650 and Ch. 0+750	BB3 *Eriophorum vaginatum – Sphagnum papillosum* bog

8.3.4.32 Rich fen and flush (PF1)

There was a large Rich fen complex present at Kentfield with one of the fen areas immediately adjacent to the proposed drainage outfall for the N59 Link Road North. This fen polygon corresponded with the RFLU1a vegetation community (*Carex viridula oedocarpa - Pinguicula vulgaris - Juncus bulbosus* flush; brown moss sub-community) of the Annex I habitat type *Alkaline fens* [7230]. *Carex panicea* and *Carex viridula* were the most abundant plant species present with *Molinia caerulea*, *Juncus bulbosus* and *Succisa pratensis* also frequently recorded. Other species recorded included *Hydrocotyle vulgaris*, *Agrostis stolonifera*, *Anagallis tenella*,

[32] The vegetation communities are assigned based upon the plant species recorded and with reference to the vegetation types described in *Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79* (Perrin et al., 2014)

Calliergonella cuspidata, *Carex flacca*, *Festuca rubra*, *Potentilla erecta*, *Prunella vulgaris*, *Anthoxanthum odoratum*, *Carex echinata* and *Drepanocladus cossonii*.

There were also areas of Rich fen amongst the fringing aquatic vegetation surrounding the Coolagh Lakes (along with a few isolated patches along the banks of the River Corrib, downstream of the proposed River Corrib Bridge) characterised by species such as: *Calliergonella cuspidata*, *Agrostis stolonifera*, *Carex nigra*, *Trifolium repens*, *Carex panicea*, *Potentilla anserina*, *Mentha aquatica*, *Festuca arundinacea*, *Filipendula ulmaria*, *Carex ovalis*, *Anthoxanthum odoratum*, *Cardamine pratensis*, *Epilobium palustre*, *Galium palustre*, *Juncus articulatus*, *Lythrum salicaria*, *Ranunculus flammula*, *Vicia cracca*, *Rhytidiadelphus squarrosus*, *Senecio aquaticus*, *Carex echinata* and *Equisetum fluviatile*. A number of these polygons corresponded with the RFEN1a vegetation community of the Annex I Alkaline fen habitat type due to the presence of the positive indicator species *Campylium stellatum*, *Carex panicea*, *Carex rostrata*, *Carex viridula s. brachyrrhyncha*, *Drepanocladus revolvens* and *Scorpidium scorpioides*[33]. Some Rich fen areas here corresponded with the priority Annex I habitat type *Calcareous fens with* Cladium *mariscus and species of the* Caricion davallianae [*7210], characterised by *Schoenus nigricans*, *Cladium mariscus*, *Campylium stellatum*, *Drepanocladus revolvens*, *Fissidens adianthoides*, *Molinia caerulea*, *Ctenidium molluscum*, *Filipendula ulmaria*, *Phragmites australis*, *Succisa pratensis* and *Carex panicea*.

At Ballindooley Lough, one of the areas of Rich fen corresponds with the RFLU4 vegetation community (*Schoenus nigricans – Scorpidium scorpioides* flush) of the Annex I Alkaline fen habitat type characterised by the following species: *Schoenus nigricans*, *Juncus subnodulosus*, *Molinia caerulea*, *Hydrocotyle vulgaris*, *Carex panacea*, *Carex lepidocarpa*, *Juncus articulatus*, *Ranunculus flammula*, *Cirsium dissectum*, *Parnassia palustris*, *Drosera anglica*, *Calliergonella cuspidata*, *Scorpidium scorpioides*, *Scorpidium cossonii*, *Campylium stellatum* and *Myrica gale*. Some fen areas here also corresponded with the priority Annex I habitat type *Calcareous fens with* Cladium *mariscus and species of the* Caricion davallianae [*7210]

The Alkaline fen and *Cladium* fen habitat within the ZoI of the proposed road development is summarised below in **Table 8.14**.

[33] Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. *Irish Wildlife Manuals, No. 79* (Perrin *et al.*, 2014)

Table 8.14: Areas of the Annex I habitat Alkaline fen [7230] and *Cladium* fen [*7210] within the potential ZoI of the proposed road development

Area	Vegetation Community
Kentfield, adjacent to drainage outfall	RFLU1a *Carex viridula oedocarpa - Pinguicula vulgaris - Juncus bulbosus* flush; brown moss sub-community [7230]
Coolagh Lakes	RFEN1a Carex rostrata fen; brown moss sub-community [7230] also *Cladium* fen [*7210]
Ballindooley Lough	RFLU4 *Schoenus nigricans – Scorpidium scorpioides* flush [7230] also *Cladium* fen [*7210]

8.3.4.33 Poor fen and flush (PF2)

There was an area of Poor fen at Na Foraí Maola Thiar (Ch. 0+700 – Ch. 0+800) characterised by the following species: *Juncus effusus*, *Juncus articulatus*, *Sphagnum denticulatum*, *Ranunculus flammula*, *Potamogeton polygonifolius*, *Juncus bulbosus*, *Philonotis fontana*, *Agrostis stolonifera*, *Lythrum salicaria*, *Calliergonella cuspidata* and *Sphagnum palustre*. This corresponded with the *Juncus effusus - Sphagnum cuspidatum/palustre* flush vegetation community (PFLU2). A second area to the north (near the proposed access track) was characterised by *Carex echinata*, *Juncus effusus*, *Juncus conglomeratus*, *Calliergonella cuspidata*, *Eriophorum angustifolium*, *Potentilla palustris*, *Angelica sylvestris*, *Sphagnum papillosum*, *Holcus lanatus*, *Anthoxanthum odoratum* and *Agrostis stolonifera*.

At Knocknafroska (Ch. 7+800 to Ch. 7+975) there were two areas of Poor fen recorded. The smaller area corresponded with the SW1 *Potamogeton polygonifolius* soakway vegetation community Other species present included *Sphagnum* spp., *Polytrichum commune*, *Carex panicea*, *Juncus effusus*, *Juncus bulbosus*, *Ranunculus flammula*, *Anagallis tenella*, *Menyanthes trifoliate* and *Hydrocotyle vulgaris*. The larger area to the north was heavily grazed and dominated by *Juncus effusus* with a layer of *Sphagnum* sp. underneath (including *Sphagnum palustre*). Other species recorded included *Calliergonella cuspidata*, *Holcus lanatus* and *Rumex acetosa*.

8.3.4.34 Residential

This non-Fossitt classification is used to represent residential properties along the proposed road development and generally consist of a mosaic of buildings and artificial surfaces (BL3), amenity grassland (GA2), flower beds and borders (BC4) and ornamental shrubs (WS3), with unmanaged rank grassland areas also occasionally present (GS2).

8.3.4.35 (Mixed) broadleaved woodland (WD1)

There were small stands of broadleaved woodland scattered along the route of the proposed road development from the western end of the proposed road development to the woodlands at Menlough. The largest area was at the NUIG Sporting Campus, where most of the woodland was planted for amenity purposes, and the woodlands at Menlough, which are long established (dating back to the 1800s).

At Na Foraí Maola Thiar (Ch. 0+800 – Ch. 1+000) there was a band of planted trees surrounding a residential garden which included *Acer pseudoplatanus*, *Fagus sylvatica*, *Quercus robur*, *Salix* sp., *Alnus cordata*, *Alnus glutinosa*, *Corylus avellana*, *Crataegus monogyna* and *Prunus* sp.

Along the eastern edge of the Na Foraí Maola Road was a stand of woodland comprising *Acer pseudoplatanus*, *Salix cinerea*, *Fagus sylvatica*, *Quercus robur*, *Alnus cordata*, *Alnus glutinosa*, *Sorbus aria*, *Lonicera periclymenum*, *Hedera helix*, *Dryopteris filix-mas*, *Urtica dioica*, *Blechnum spicant* and *Phyllitis scolopendrium*.

At An Chloch Scoilte Junction (Ch. 3+300 – Ch. 3+400) the woodland species comprised *Fraxinus excelsior*, *Acer pseudoplatanus*, *Rubus fruticosus agg*., *Phyllitis scolopendrium*, *Hedera helix*, *Heracleum sphondylium*, *Crataegus monogyna*, *Cotoneaster* sp., *Urtica dioica*, *Dryopteris filix-mas*, *Polypodium vulgare* and *Symphoricarpos albus*.

At the NUIG Sporting Campus (Ch. 8+725 – Ch. 9+250) there were many stands of maturing amenity broadleaved woodland planting including tree species such as *Acer pseudoplatanus*, *Fraxinus excelsior*, *Fagus sylvatica*, *Tilia cordata*, *Aesculus hippocastanum* and *Ulmus glabra*. The field layer contained species such as *Hedera helix*, *Geum urbanum*, *Vicia sepia*, *Torilis japonica*, *Rubus fruticosus agg*., *Arrhenatherum elatius* and *Brachypodium sylvaticum*.

There were two areas of mixed broadleaved woodland within the boundary of Lough Corrib cSAC, on the eastern bank of the River Corrib (Ch. 9+475 – Ch. 9+650). The main species that made up the woodland flora in the main block were *Fagus sylvatica*, *Fraxinus excelsior*, *Ilex aquifolium* and *Thamnobryum alopecurum*. Also recorded were *Arum maculatum*, *Hedera helix*, *Isothecium alopecuroides*, *Kindbergia praelonga*, *Neckera complanata*, *Radula complanata*, *Lejeunea cavifolia*, *Metzgeria furcata*, *Rhynchostegiella tenella* and *Tortella tortuosa*. The narrow linear strip to the east, at Ch. 9+500, was comprised of *Fagus sylvatica* with an *Ilex aquifolium* understory.

The linear strips of woodland at the City East Business Park Junction comprised *Fraxinus excelsior*, *Acer pseudoplatanus*, *Fagus sylvatica*, *Rubus fruticosus agg*. and *Urtica dioica*.

8.3.4.36 Mixed broadleaved/conifer woodland (WD2)

At the Troscaigh Road L5387 (Ch. 1+550 – Ch. 1+650) there was an area of planted broadleaved/conifer woodland associated with the residential properties. Tree species included *Acer pseudoplatanus*, *Fraxinus excelsior*, *Betula* sp., *Prunus* sp., *Pinus* sp., *Cupressus* sp. and *Rhododendron ponticum*.

A second small area of mixed broadleaved/conifer was present adjacent to the proposed road development at School Road in Castlegar (Ch. 13+150).

8.3.4.37 (Mixed) conifer woodland (WD3)

At the Troscaigh Road L5387 (Ch. 1+550 – Ch. 1+600) there was a small stand of *Pinus* sp. and *Cupressus* sp. mixed conifer woodland; *Rhododendron ponticum*, a non-native invasive plant species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations, 2011, was also present here.

In a field south of the N59 Moycullen Road (Ch. 8+500) there was a small mixed *Picea* sp. conifer stand.

8.3.4.38 Hedgerows (WL1)

Along the western part of the proposed road development, hedgerow features not associated with residential properties were scarce as most field boundaries were stone walls or formed the edge of larger scrub patches. Many of the hedgerows recorded were over grown stone walls dominated by *Rubus fruticosus* agg. The hedgerows here were generally quite species poor. Typical species included *Prunus spinosa*, *Crataegus monogyna*, *Fraxinus excelsior*, *Rubus fruticosus* agg., *Urtica dioica*, *Hedera helix*, *Calystegia sepium*, *Pteridium aquilinum*, *Lonicera periclymenum*, *Epilobium hirsutum*, *Filipendula ulmaria*, *Germanium robertianum* and *Phyllitis scolopendrium*.

Hedgerows were much more abundant along the eastern part of the proposed road development and included some older more mature hedges. Hedgerows here were often associated with stone walls and where associated with agricultural fields were often dominated by Rubus fruticosus agg. *Crataegus monogyna*, *Prunus spinosa*, *Hedera helix* and *Rubus fruticosus* agg. were the most abundant hedgerow species recorded. Other common species included *Ilex aquifolium*, *Fraxinus excelsior*, *Salix cinerea*, *Corylus avellana*, *Urtica dioica*, *Calystegia sepium*, *Lonicera periclymenum*, *Pteridium aquilinum*, *Lathyrus pratensis* and *Rosa canina*; and *Sorbus aria*, *Viburnum opulus*, *Euonymus europaeus*, *Salix caprea* and *Quercus robur* were recorded occasionally.

8.3.4.39 Treelines (WL2)

Along the western part of the proposed road development, treelines were generally scarce and where present the majority were associated with planting along residential property boundaries. Tree species included *Fraxinus excelsior*, *Acer pseudoplatanus*, *Alnus glutinosa*, *Alnus cordata*, *Populus* sp., *Cupressus* sp., *Pinus* sp. (including *Pinus contorta*), *Picea sitchensis*, *Sorbus aucuparia* and *Fagus sylvatica*.

Treelines were also recorded along the eastern part of the proposed road development but much less frequently, as most field boundaries consisted of stone walls or hedgerows.

8.3.4.40 Oak-ash-hazel woodland (WN2)

The majority of oak-ash-hazel woodland was recorded along the eastern part of the proposed road development, with the most extensive area present between the River Corrib and Lackagh Quarry and large areas also recorded adjacent to the proposed road development (Ch. 13+200 – Ch. 13+900), south of the Roadstone Quarry. Many woodland blocks were small and isolated outside of these areas with only a few patches of oak-ash-hazel woodland recorded along the western part of the proposed road development, including areas of amenity planting at the NUIG Sporting Campus.

Along with *Fraxinus excelsior* and *Corylus avellana*, woody species recorded in these woodlands included *Euonymus europaeus*, *Crataegus monogyna*, *Prunus spinosa*, *Ilex aquifolium*, *Sorbus aria* agg., *Sorbus aucuparia*, *Quercus robur*, *Populus tremula*, *Hedera helix*, *Lonicera periclymenum*, and *Rubus fruticosus* agg. The field layer contained species such as *Fragaria vesca*, *Circaea lutetiana*, *Geranium robertianum*, *Potentilla sterilis*, *Sesleria caerulea*, *Primula vulgaris*, *Geum urbanum*, *Rumex sanguineus*, *Viola* spp., *Phyllitis scolopendrium* and *Arum maculatum*.

The wooded variant of the priority Annex I habitat Limestone pavement [*8240] was recorded in some woodland areas. Wooded Limestone pavement were those areas having a closed canopy of trees at least 3m tall with at least 50% of the surface comprising bedrock at the surface (the bedrock was normally covered by mosses) and retaining some evidence of limestone pavement structure. In the [*8240] wooded limestone pavement habitats encountered, soil was generally present but was thin (< 2cm), though could be deeper in places, for example, in old grykes, due to a build-up of humus. Rocks were sometimes completely covered by bryophytes such as *Eurhynchium striatum*, *Neckera crispa* and *Thamnobryum alopecurum*, but soil was typically lacking underneath the moss growth. These areas often occurred in mosaic with non-Annex I WN2 woodland.

The wooded Limestone pavement habitat (LPW) within the ZoI of the proposed road development is summarised below in **Table 8.15**.

Table 8.15: Areas of the wooded variant of the Annex I habitat wooded Limestone pavement [*8240] within the potential ZoI of the proposed road development

Area	Vegetation Community[34]
Menlough between Ch. 9+840 and Ch. 9+900	LPW_2b *Fraxinus excelsior - Plagiomnium undulatum* woodland
Menlough at Ch. 9+975	LPW_2a *Corylus avellana - Ctenidium molluscum* low woodland
Within Lough Corrib cSAC Adjacent to the proposed road development between Ch. 9+950 and Ch. 10+050	LPW_2a *Corylus avellana - Ctenidium molluscum* low woodland
South of Bóthar Nua at Ch. 10+100	LPW_2a *Corylus avellana - Ctenidium molluscum* low woodland
Bóthar Nua to Seanbóthar between Ch. 10+150 and Ch. 10+500	LPW_2b *Fraxinus excelsior - Plagiomnium undulatum* woodland
Within Lough Corrib cSAC Along the proposed development boundary to the west and north of Lackagh Quarry between Ch. 10+800 and Ch. 11+800	LPW_2a *Corylus avellana - Ctenidium molluscum* low woodland LPW_2b *Fraxinus excelsior - Plagiomnium undulatum* woodland
Within/adjacent to the proposed road development between Ch. 13+200 and Ch. 13+550	LPW_2b *Fraxinus excelsior - Plagiomnium undulatum* woodland
Adjacent to the proposed development boundary between Ch. 13+800 and Ch. 13+875	LPW_2a *Corylus avellana - Ctenidium molluscum* low woodland
Coolagh Junction between Ch. 16+100 and Ch. 16+250	LPW_2a *Corylus avellana - Ctenidium molluscum* low woodland

8.3.4.41 Wet willow-alder-ash woodland (WN6)

Along the western bank of the River Corrib at the NUIG Sporting Campus (Ch. 9+275) there was a narrow linear band of *Salix cinerea* wet woodland (WN6-3c *Alnus glutinosa – Filipendula ulmaria* group, *Salix cinerea – Equisetum fluviatile* vegetation type). *Rubus fruticosus* agg. and *Centaurea nigra* were also prominent species in this section of woodland. This area of woodland did not correspond with the Residual alluvial forest [*91E0] Annex I habitat type. This was distinct from the large area of wet woodland (WN6_3e *Alnus glutinosa – Filipendula ulmaria* group, *Betula pubescens – Mentha aquatica* vegetation type) further downstream which corresponded with the priority Annex I habitat type *Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)* [*91E0].

A small patch of *Salix cinerea* wet woodland (WN6-3c *Alnus glutinosa – Filipendula ulmaria* group, *Salix cinerea – Equisetum fluviatile* vegetation type) was present within the proposed development boundary at Ch. 9+850 – Ch. 9+900;

[34] The vegetation communities are assigned based upon the plant species recorded and with reference to the vegetation types described in *National survey of limestone pavement and associated habitats in Ireland. Irish Wildlife Manuals, No. 73* (Wilson, S. and Fernández, F., 2013)

and immediately adjacent to the boundary of Lough Corrib cSAC. The woodland here corresponded with the Residual alluvial forest [*91E0] Annex I habitat type. The woodland was dominated by *Salix cinerea* subsp. *oleifolia*, with *Fraxinus excelsior*, *Agrostis stolonifera*, *Rubus fruticosus* agg., *Filipendula ulmaria* and *Eurhynchium striatum* recorded frequently. Other species present included: *Juncus effusus*, *Hedera helix*, *Lythrum salicaria*, *Galium palustre*, *Geranium robertianum*, *Crataegus monogyna*, *Prunus spinosa*, *Galium aparine*, *Rumex sanguineus*, *Equisetum fluviatile*, *Epilobium hirsutum*, *Corylus avellana*, *Ranunculus repens* and the moss species *Calliergonella cuspidatum*, *Eurhynchium striatum*, *Kindbergia praelonga* and *Thamnobryum alopecurum*.

The Residual alluvial forest habitat within the ZoI of the proposed road development is summarised below in **Table 8.16**.

Table 8.16: Areas of the Annex I habitat Residual alluvial forests [*91E0] within the potential ZoI of the proposed road development

Area	Vegetation Community[35]
Downstream of the proposed road development on west bank of River Corrib Ch. 9+250 – overlaps slightly with the south-eastern edge of the proposed development boundary	WN6-3c *Alnus glutinosa – Filipendula ulmaria* group, *Salix cinerea – Equisetum fluviatile* vegetation type
Adjacent to the proposed road development between Ch. 9+800 and Ch. 9+900	WN6-3c *Alnus glutinosa – Filipendula ulmaria* group, *Salix cinerea – Equisetum fluviatile* vegetation type

8.3.4.42 Scrub (WS1)

Patches of scrub were widespread along the proposed road development ranging in size from small isolated patches to larger expanses, where previously grazed land had been abandoned or where scrub is encroaching on semi-natural habitats. In the western part of the study area, the larger areas of scrub were generally associated with the margins of bog/heath areas where scrub is encroaching from adjoining low intensity or abandoned agricultural fields. Typical species (and in some cases the predominant species in some areas) were *Ulex europaeus*, *Prunus spinosa*, *Crataegus monogyna*, *Salix cinerea* and *Rubus fruticosus* agg. In the eastern part of the study area, the scrub was generally dominated by *Corylus avellana*, *Prunus spinosa* and/or *Crataegus monogyna*.

In some instances, polygons mapped as scrub corresponded with Annex I habitat types. In most cases the scrub is the dominant habitat in a mosaic with other Fossitt habitat types and it is those other habitats, not the scrub itself, that correspond with Annex I habitat types. As an example, scrub was often recorded in a mosaic with dry heath habitats which corresponded with the Annex I Dry heath habitat type but as scrub was dominant in the recorded polygon it was mapped as such. Where this

[35] The vegetation communities are assigned based upon the plant species recorded and with reference to the vegetation types described in *Results of monitoring survey of old sessile oak woods and alluvial forests. Irish Wildlife Manuals, No. 71* (O'Neill, F.H. & Barron, S.J., 2013)

was the case, these Annex I habitat areas are described under the appropriate sections – e.g. Dry heath [4130] is described under the *Dry siliceous heath (HH1)* heading above.

However, areas of limestone pavement that were being invaded by scrub (almost invariably *Corylus avellana*), where the scrub was not forming a continuous canopy and was less then 3m in height, corresponded with the exposed limestone pavement group (LPE) of the priority Annex I habitat type *Limestone pavements* [*8240]. The main vascular species include scattered low-growing woody species (e.g. *Rubus fruticosus*, *Rosa spinosissima*, *Hedera helix* or immature *Corylus avellana* or *Ilex aquifolium*) and herbaceous species like *Sesleria caerulea*, *Teucrium scorodonia*, *Mycelis muralis*, *Geranium robertianum*, *Senecio jacobaea*, *Carlina vulgaris* and *Carex flacca*. A suite of calcicole ferns is usually found comprising *Asplenium ruta-muraria*, *Ceterach officinarum* and, in the deeper clefts (grykes), the shade-loving *Phyllitis scolopendrium*. Characteristic bryophytes are *Ctenidium molluscum*, *Tortella tortuosa* and *Neckera crispa.*

The scrub covered Limestone pavement habitat within the ZoI of the proposed road development is summarised below in **Table 8.17**.

Table 8.17: Areas of the scrub covered variant of the Annex I habitat Limestone pavement [*8240] within the potential ZoI of the proposed road development

Area	Vegetation Community[36]
Within Lough Corrib cSAC Adjacent to the proposed road development between Ch. 10+000 and Ch. 10+050	LPE_1e *Corylus avellana - Neckera crispa* pavement
Within Lough Corrib cSAC Along the proposed development boundary to the west and north of Lackagh Quarry between Ch. 10+900 and Ch. 11+800	LPE_1e *Corylus avellana - Neckera crispa* pavement

8.3.4.43 Immature woodland (WS2)

There was one area of young planted *Alnus glutinosa* woodland near the Boleybeg Bóithrín (Ch. 4+650) that corresponded to this habitat type.

8.3.4.44 Ornamental/non-native shrub (WS3)

Areas of ornamental/non-native shrub were generally associated with amenity planting at residential properties, residential developments and areas infested with non-native invasive plant species such as *Fallopia japonica* (areas of invasive plant species are discussed in more detail below under the Non-Native Invasive Plant Species section).

[36] The vegetation communities are assigned based upon the plant species recorded and with reference to the vegetation types described in *National survey of limestone pavement and associated habitats in Ireland. Irish Wildlife Manuals, No. 73* (Wilson, S. and Fernández, F., 2013)

8.3.4.45 Recently-felled woodland (WS5)

There was one area of recently felled *Corylus avellana* woodland in close proximity to the proposed road development at Ballindooley (Ch. 12+450 – Ch. 12+500).

8.3.5 Rare and protected plant species

Slender cottongrass *Eriophorum gracile* was the only protected plant species recorded during the course of the habitat surveys. It was recorded at two locations: Tonabrocky Bog and in Coolanillaun. Its presence at Tonabrocky Bog is consistent with the findings of the desktop review; the location at Coolanillaun is a new record for the species. Neither location is within the ZoI of the proposed road development.

The Small white orchid *Pseudorchis albida* was not recorded at the Doughiska site during the habitat surveys in June of 2014.

Both of the above species are protected under the Flora (Protection) Order, 2015.

The presence of the Flora (Protection) Order, 2015 (FPO) listed bryophyte species Varnished hook-moss was confirmed at Gortachalla, 9.4km to the north of the scheme study area. This plant species is listed on Annex II of the Habitats Directive and listed as qualifying interest species of Lough Corrib cSAC.

Records of all rare or protected plant species known from the scheme study area, or recorded during the field surveys, are shown on **Figure 8.2.1**.

8.3.6 Non-native invasive plant species

There were three non-native invasive plant species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations, 2011 present within, or in close proximity to, the proposed road development. The locations of these non-native invasive plant species are summarised below in **Table 8.18** and shown on **Figures 8.15.1** to **8.15.15**.

Table 8.18: Summary of Non-native Invasive Plant Species Listed in the Third Schedule of the Birds and Habitats Regulations 2011 Recorded along or adjacent to the Proposed Road Development

Common Name	Scientific Name	Location
Japanese knotweed	*Fallopia japonica*	Along farm track, south of proposed Bearna West Roundabout, adjacent to the proposed road development Along eastern side of the Troscaigh Road (L5387) at Ch. 1+575 In rough grassland field with scrub, south-east of Ch. 5+250 near Ballyburke, outside of the proposed development boundary Adjacent to residential property located c.70m east of

Common Name	Scientific Name	Location
		the proposed drainage outfall at Rahoon In area of recolonising bare ground, north of Bóthar Diarmuida Junction, within the proposed development boundary between Ch. 0+325 and Ch. 0+425 along the N59 Link Road South In area of recolonising bare ground, between Ch. 8+350 and Ch. 8+400, within the proposed development boundary In woodland/scrub, between Ch. 8+800 and Ch. 8+950 at the NUIG Sporting Campus, adjacent to the proposed development boundary Along the Coolough Road In residential garden, and on adjacent rough grassland areas, within the proposed development boundary between Ch. 12+200 and Ch. 12+375 at the N84 Headford Road Junction
Himalayan knotweed	*Persicaria wallichii*	c.80m (east) and c.135m (west) from the proposed road development between Knocknafroska and the N59 Moycullen Road
Rhododendron	*Rhododendron ponticum*	In woodland within the proposed development boundary along eastern side of the Troscaigh Road (L5387) Adjacent to residential property located c.90m east of the proposed drainage outfall at Rahoon

8.3.7 Mammals

8.3.7.1 Otter

Otter, and their breeding and resting places, are protected under the Wildlife Acts. Otter are also listed on Annex II and Annex IV of the EU Habitats Directive.

Evidence of Otter *Lutra lutra* activity was abundant and widespread along the River Corrib corridor and the south-eastern shore of Lough Corrib. Otter were also recorded in the catchment of the Bearna Stream and the Tonabrocky Stream. The desktop review found that Otter have been recorded along the River Corrib corridor between the coast and Lough Corrib, along the coastline from Bearna to Oranmore, and at Ballindooley Lough[37].

One potential Otter holts and eight Otter couch sites were recorded within the study area. The potential holt site, and the majority of the couch sites, were recorded at Coolanillaun, along the southern shore of Lough Corrib and along the east bank of the River Corrib. Couch sites were also recorded at the Coolagh Lakes and on Jordan's Island. The status, description and distance from the proposed road development of each of these features are provided below in **Table 8.19**. The results of the Otter surveys are shown on **Figures 8.3.1** to **8.3.14**.

Table 8.19: Results of the Otter surveys – Otter holts and couches

Ref. No.	Feature	Status and description
H1	Couch site	Active couch site along river bank >1km from the proposed road development
H2	Couch site	Active couch site along river bank >1km from the proposed road development
H3	Couch site	Active couch site along river bank c.450m from the proposed road development
H4	Potential natal holt	Dense scrub patch with abundant Otter signs surrounding and in the vicinity, well-worn and used trails leading into scrub – evidence suggestive of juvenile Otter being present. >1km from the proposed road development
H5	Couch site	Active couch site along river bank >1km from the proposed road development
H6	Couch site	Active couch site along river bank >1km from the proposed road development
H7	Couch site	Active couch site along river bank >1km from the proposed road development

[37] At Ballindooley Lough, the mammal survey study area focussed on the southern section of this wetland complex (refer to **Figure 8.3.8** and **Figure 8.3.9**) and Otter were not recorded in this area during the survey.

Ref. No.	Feature	Status and description
H8	Couch site	Active couch site along river bank >1km from the proposed road development
H9	Couch site	Active couch site along river bank c.600m from the proposed road development

8.3.7.2 Bats

Bats, and their breeding and resting places, are protected under the Wildlife Acts. All bat species are also listed on Annex IV of the EU Habitats Directive; with the Lesser horseshoe bat also listed on Annex II.

Significant bat surveys were carried out in the preparation of this EIAR, and the results of these are set below. The results of these surveys are also presented in **Figures 8.4.1** to **8.4.2** and **Figures 8.17.1** to **8.22.1**.

Separate reports on the results of the radio-tracking studies undertaken in 2014 and 2015 are provided in **Appendix A.8.7**, **Appendix A.8.9** and **Appendix A.8.10**. A separate report on the full results of the static detector monitoring undertaken in 2014 are detailed in **Appendix A.8.8**.

The structure of this section is such that each bat species is described in turn. The results of the various surveys are presented to allow an understanding of each species in terms of its distribution across the scheme study area.

8.3.7.2.1 Lesser horseshoe bat Rhinolophus hipposideros

The results of the bat surveys as they relate to the Lesser horseshoe bat are shown on **Figure 8.18.1**.

Historical records

Prior to the commencement of the surveys to inform the Constraints and Route Selection Studies for the proposed road development, there were a small number of records of Lesser horseshoe bats from the scheme study area. They comprised records of the bat roosts at Menlo Castle, suspected night roosts at a barn in Menlough Village and two sheds in Coolough collected as part of the previous studies for the 2006 Galway City Outer Bypass (RPS, 2006). Menlo Castle has been regarded to be a key maternity colony for the area since it was found in August 2000 and has since been monitored annually by the NPWS. Ad-hoc observations during other bat surveys (e.g. BATLAS 2010) also noted Lesser horseshoe bat activity on the western side of the River Corrib at Dangan.

Surveys carried out for previous environmental assessments recorded Lesser horseshoe bats at NUIG (McCarthy, Keville and O'Sullivan, 2014a) and Killarainy near Moycullen (RPS, 2013a).

The general lack of historical roost records and ad-hoc observations for this species did not necessarily suggest their low density or absence from specific areas. It is more likely to have been due to both the lack of targeted surveys for this species and the tendency for it to be overlooked due to its very quiet and narrowly-focused echolocation calls, which allows it to be detected only at very close range.

Identification of locations used for winter hibernation

Unlike other Irish bat species, the Lesser horseshoe bat hibernates in the open, hanging from the ceiling of caves, cellars and other structures kept cool in winter. Therefore, it is much easier to find than other bat species at this time of year.

Following the collation of the historical data at the end of 2014, the examination of historical maps and records of caves and underground structures provided a list of locations that could be potential sites used for hibernation. **Figure 8.18.1** shows these locations. These included:

- Menlo Castle
- Merlin Castle
- Ballybrit Castle
- Roscam Round Tower
- Cooper's Cave
- Newry's Cave
- Dangan Ice House
- Souterrain in the townland of Lydican

The interior of Ballybrit Castle and Merlin Castle were inaccessible for the winter surveys that were undertaken in 2014 and therefore use of these castles by this species could not be ruled out. Evidence of Lesser horseshoe bats was only found in the rear of Cooper's Cave near Castlegar, where a small number of fresh droppings characteristic of this species were recorded, suggesting recent use.

Daytime visual inspections of accessible locations were also undertaken in February and March 2015. Six Lesser horseshoe bats were recorded within Cooper's Cave on the February 2015 visit. All bats were in a state of hibernation. It was noted that two of the bats were ringed. The ring numbers (which could be read without disturbing the bats) corresponded to the following bats ringed as part of the bat surveys in summer 2014: one was a male bat ringed and radio-tracked at Menlo Castle on the 30 August 2014; the other, a male bat ringed and radio-tracked at Cooper's Cave on the 1 September 2014. This confirmed that some of the individuals using the Menlo Castle summer roost also used the cave as a hibernation site, and that bats using Cooper's Cave in summer months also used the cave as a hibernation site.

Cooper's Cave was also checked again on 24 February 2016 and four Lesser Horseshoe bats were recorded in a state of hibernation. None of these bats were ringed. Surveys in January 2018 recorded six hibernating Lesser horseshoe bats present on the 8 January and three on the 11 January (including one ringed bat).

No bats were seen or otherwise recorded within Newry's Cave in Merlin Woods in 2015 and 2016. It became evident during visits in 2015 that this site floods via underground springs up to ceiling level and therefore would be unsuitable for hibernating bats.

Since Lesser horseshoe bats are known to travel outside their summer ranges to reach hibernation sites, it was necessary to examine similar potential hibernation sites outside of the scheme study area. Checks for bats (and particularly ringed bats) using other known underground sites were carried out in February 2015. Five Lesser horseshoe bats (not ringed) were found hibernating in Cloonnabinnia Cave, outside Moycullen. A large pile of Lesser horseshoe bat droppings were also found in Moycullen Cave suggesting that it is used as a roosting site but this may be used at other times of year. In 2018, winter surveys at Moycullen Cave and at Cloonnabinnia Cave recorded three Lesser horseshoe bats which were found hibernating at each location.

Attempts were made to gain access to land where the cave curiously named "Rhinolophus Retreat" is located; however, entry to lands was not possible. A souterrain near Athenry was also visited but found to be probably unsuitable for use by Lesser horseshoe bats as the entrance was blocked.

The results of the surveys of potential hibernation sites for this species of bat indicated that Cooper's Cave and Menlo Castle provide winter hibernation conditions, for several individuals, in the vicinity of the proposed road development. However, both sites are vulnerable to human disturbance or changes within the roosts due to rockfall. There is also the possibility that other concealed voids in limestone features could also host hibernating bats.

Identification of locations used in summer

Evidence of Lesser horseshoe bats was recorded at 15 structures, including Menlo Castle (PBR06) during the summer roost surveys in 2014 and 2015. Most roosts were located in the vicinity of Menlough and Castlegar. Outside these two areas, a day roost (PBR178) containing 9 bats, including 5 juvenile bats, was located in the garage of a house in the Aughnacurra residential estate, on the western side of the River Corrib, adjacent to the NUIG Sporting Campus. In August 2018, two counts were undertaken at this roost: twelve Lesser horseshoe bats were recorded on the first night, and ten on the second. Two of the lesser horseshoe bats present at the Aughnacurra roost on the 28 August 2018 were ringed, confirming the link between the roost sites at Menlo Castle, Cooper's cave and this satellite roost[38].

A night roost was also found in another garage in this estate (PBR210) (refer to **Figure 8.18.1** for these locations).

Other Lesser horseshoe bat roosts found on the western side of the city and surrounding environs included two night roosts in vicinity of Bearna Woods

[38] To the best of the author's knowledge, at the time of writing, the only Lesser horseshoe bat ringing programme undertaken locally in recent years was that undertaken in 2014 and 2015 as part of the N6 GCRR surveys, where bats captured at Menlo Castle and Cooper's Cave were ringed (see Appendix A.8.1, Section 1.4.9). Therefore, the ringed Lesser horseshoe bats observed at Aughnacurra are individuals ringed during the 2014/2015 studies at Menlo Castle and Cooper's Cave

(PBR124, PBR115), north of Bearna (PBR217) and a roost in the townland of Aubwee just off the N59 Moycullen Road to the north west of the city (PBR44). All "night roosts" were confirmed as such, when Lesser horseshoe bat droppings were recorded but the structure was deemed to be unsuitable as a day roost and no bats were seen in-situ.

On the eastern side of the city and surrounding environs, one Lesser horseshoe bat night roost (PBR21) was located adjacent to the Corinthian's Rugby Club off the N83 Tuam Road to the north east of the city, while a day roost with a single bat was found in a disused bungalow adjacent to Ballindooley Lough (PBR25).

Lesser horseshoe bats at Menlo Castle (PBR06) were monitored from 2006-2017 by the NPWS and more recently by surveyors from Scott Cawley Ltd. (see **Table 8.20** below for count results). Lesser horseshoe bats can be very difficult to count on emergence as they tend to fly in and out of the roost entrance. Monitoring of the roost in 2016, 2017 and 2018 used infra-red cameras and reflects the most accurate count for this roost.

Table 8.20: Numbers of Lesser Horseshoe bats recorded emerging from Menlo Castle

Date	Count	Source	Comments
16/06/2006	2	NPWS	-
24/06/2009	26	NPWS	-
07/07/2009	38	NPWS	-
29/6/2012	23	NPWS	-
02/07/2012	27	NPWS	-
13/06/2013	21	NPWS	-
04/06/2014	18	NPWS	-
18/06/2014	35	NPWS	-
29/06/2015	32	NPWS	-
29/06/2015	32	Scott Cawley Ltd	-
09/07/2015	29	NPWS	-
09/07/2015	29	Scott Cawley Ltd	Inclement weather
20/08/2015	28	NPWS	-
20/08/2015	28	Scott Cawley Ltd	Two bats did not emerge
29/08/2016	35	Scott Cawley Ltd	Counted from infra-red video camera footage. 2-3 bats may have remained in the roost.
11/08/2017	43	Scott Cawley Ltd	Counted from infra-red video camera footage. 1 bat exited from small chimney.
22/08/2018	20	Scott Cawley Ltd.	Counted from infra-red video camera footage.
27/08/2018	15	Scott Cawley Ltd.	Counted from infra-red video camera footage.

The roost numbers showed considerable variability in the counts but averaged 27 bats over the last ten years. This may be explained by bats using different (unknown) exit points on some nights, difficulties in counting in low light conditions, and weather conditions in preceding nights which may have forced some bats to use alternative roosts. Infra-red footage suggested that bats fly out at very low levels at high speeds and could have been easily overlooked by conventional emergence monitoring techniques.

Additional data on the roosts used by this species was collected during the radio-tracking in 2014 and 2015. Thirteen Lesser horseshoe bats were captured and fitted with radio-transmitters in the first radio-tracking session in August 2014. Ten of these (seven females and three males) were caught at the Menlo Castle roost (PBR06) and three (all males) were caught at Cooper's Cave (PBR112). Five bats were captured and fitted with radio-transmitters in the September session; one (female) was caught in Menlough Woods and four (three males and one female) were captured at Cooper's Cave (PBR112). The radio-tracking in August 2014 resulted in the identification of six day roosts and 11 night roosts for this species. Three of the six daytime roosts and seven of the 11 night roosts had already been identified as Lesser horseshoe roosts from the building inspections undertaken in 2014. Nine additional daytime roosts and eight additional night roosts were subsequently identified in the September 2014 session of radio-tracking. Only three roosts (Menlo Castle PBR06, Cooper's cave PBR112 and a shed in Angliham Quarry PBR126) were used by bats during both tracking sessions. All roosts used by radio-tracked bats were located in the vicinity of Menlough Village, Coolough, Castlegar and Angliham Quarry.

To conclude, the surveys found Lesser horseshoe bats using several roosts in the daytime in summer including those consistently used such as Menlo Castle and Cooper's Cave. Inspections of other structures and radio-tracking recorded other day roosts and a network of night roosts (**Figure 8.18.1**).

Eborhall House and Ballymaglancy Cave, located to the north of Lough Corrib, are both important roost sites for breeding and hibernating Lesser horseshoe bats respectively. Eborhall House is the "qualifying" roost for the Lough Corrib cSAC whilst the nearby Ballymaglancy Cave is a cSAC in its own right (No. 000474) and is thought to provide hibernation roosts for the bats from Eborhall House.

As part of the assessment of the potential movement of this bat species across the landscape, it was deemed important to determine if any of the ringed bats[39] that were roosting near the proposed road development were also using these "qualifying" roosts, even though they are located a considerable distance to the north (more than 30km).

Surveys were undertaken at Eborhall House and Ballymaglancy Cave to determine the presence of Lesser horseshoe bats that were ringed at roosts within the study area. These were undertaken under licence DER/BAT 2015-03, DER/BAT 2016-09, DER/BAT 2016-28 and DER/BAT 2017-06) on 21 October 2015, 23 August 2016 and 14 July 2017. Surveys in 2015 were undertaken by Paul Scott (Scott Cawley Ltd) with Mr John Higgins (NPWS Local Conservation Ranger) and in

[39] See the species accounts in this section for details on bats that were ringed.

2016 by Dr Daniel Buckley and in 2017 by Paul Scott. Daytime visual surveys were undertaken to count and identify any marked bats. Only the October 2015 surveys included Ballymaglancy Cave. No ringed bats from the study area were recorded during these visits.

Evidence of bat activity

This section summarises the results of the various surveys that recorded Lesser horseshoe bat activity across the scheme study area (**Figure 8.18.1**). Survey methods included vehicle transects, walked transects and use of static detectors at fixed locations in 2014 and 2015 covering both summer, autumn and winter seasons. The results of the radio-tracking are also summarised separately in this section.

Lesser horseshoe bats were not recorded during the vehicle transect surveys but would not normally be expected to be easily detected using that survey methodology, due to their quiet and directional echolocation calls. However, the walked transect surveys recorded this species at Menlo Castle and Cooper's Cave. Static bat detectors deployed during the walked transects recorded them by a culvert on the existing N6 (where the Terryland River flows under the road), by the Coolagh Lakes and by Ballindooley Lough.

The static bat detectors deployed in 2014 (**Figure 8.4.1**, **Figure 8.4.2** and **Figure 8.22.1**), recorded Lesser horseshoe bats at 14 locations. Sites S5, S6 and S21 recorded the highest amount of activity for this species, which was not surprising as these locations are all in close proximity to Menlo Castle (see summary of radio-tracking studies below). Beyond the Menlough area, Lesser horseshoe bats were also recorded at a woodland edge in the Ballindooley area (S2), close to a known roost identified during the building surveys, in the hazel scrub-limestone pavement complex east of Menlough (S4 and S22), within the grounds of Glenlo Abbey Hotel (S8), in Castlegar Valley (S10), on three sites on the north western edge of Galway City (S11, S13 and S15), the outskirts of Bearna Village (S19), and two sites on the north eastern edge of Galway City just to the north of Galway Technology Park (S1, S24).

The static detectors deployed in 2015 along the route of the proposed road development (at that time) recorded Lesser horseshoe bats at 15 locations. Activity was recorded within the known foraging area of the Menlough roost as suggested by the radio-tracking results (see below), including along the woodland edges, south of Menlo Castle, within the limestone pavement area between Menlough and the N84 Headford Road, Lackagh Quarry and on field boundaries north of Castlegar Village, into the area south of Castlegar Village where Cooper's Cave is located.

Lesser horseshoe bat activity was also recorded within the grounds of NUIG, east of Galway Racecourse and on the Bearna Stream, north of Bearna Woods.

For the crossing point surveys, possible recordings of Lesser horseshoe bats that were made on both microphones, that could suggest bats flying across the proposed road development, were recorded at two sites for Lesser horseshoe bat: CP7 and CP9. CP7 had one potential crossing record, while CP10 had 35 potential crossing records.

Monitoring of bat activity at Cooper's Cave, Newry's Cave and the City Centre Railway Tunnel took place in the autumn of 2014 and late winter in 2015. A small number of Lesser horseshoe bat calls were recorded on the 26 and 28 September 2014 in Newry's Cave. A large number of Lesser horseshoe bat calls were recorded throughout September 2014 and October 2014 in Cooper's Cave, which would suggest that Cooper's Cave is used in the mating season by this species. Lesser horseshoe bat activity was recorded at Cooper's Cave and Menlo Castle but not at any of the other locations during the late winter activity seasons in 2015. Therefore, based on these activity surveys it was concluded that Lesser horseshoe bats use Menlo Castle and Cooper's Cave throughout the year – Menlo Castle for breeding and hibernation and Cooper's Cave for mating and hibernation.

The radio-tracking surveys allowed the patterns of foraging and flight paths to be identified for this species. In August 2014, the maximum foraging distance from Menlo Castle ranged from 0.59km up to 5.15km, with the average maximum distance of foraging area from the roost being 2.93km. On average, males foraged slightly further afield, with the average maximum distance from the roost 3.68km, while females averaged a maximum distance of 2.29km.

In September 2014, the maximum foraging distance from the roost ranged from 1.11km up to 4.4km with the average maximum distance of foraging from the roost being 3.39km. On average, males foraged a maximum distance from the roost of 2.88km, while females averaged a maximum distance of 4.16km.

The overall foraging area in August 2014 comprised 21.75km^2 (MCP[40]) or 13.7km^2 (MLP[41]), whilst it was 56.10km^2 (MCP) or 26.46km^2 (MLP) in September 2014. Foraging areas recorded in both August and September 2014, overlapped in woodland and field boundaries in the Menlo Castle and Menlough Village areas; suggesting that these areas were core foraging areas. See Figures 57 and 58 in **Appendix A.8.7**. The area of overlapping areas from August and September 2014 was 11.96km^2 (MCP) or 8.1km^2 (MLP). Field systems and quarries north-east and east of Menlo Castle and field systems north of Cooper's Cave also served as foraging areas. The majority of Lesser horseshoe bat foraging areas in August and September 2014 overlapped in the area of the River Corrib, field boundaries and woodland around Menlo Castle and Menlough Village, limestone pavement, woodland, scrub and lake around Coolough and Menlough Village, field boundaries and scrub around Castlegar and Ballindooley Lough, and an abandoned quarry in Angliham.

None of the foraging areas recorded in 2014 extended south of the existing N6, towards Galway City.

In May 2015, four bats were captured and tagged. Two of the bats had been captured, tagged and ringed in 2014. Rings were placed on the new bats.

Three day roosts were identified during the radio-tracking session in 2015. Three out of the four bats consistently used the maternity roost in Menlo Castle (PBR06). One bat utilised a previously-unknown roost in a boulder field located in an abandoned quarry just south of Coolagh Lakes (PBR218) over several days before

[40] MCP = Minimum convex polygon
[41] MLP = Multilateral polygon

returning back to Menlo Castle (PBR06). Another bat used a void within a natural limestone structure located within Menlough Woods to roost (PBR219). All of these daytime roosts were also used for short periods of resting at night.

The overall foraging area of Lesser horseshoe bats tracked in 2015 covered 16km^2 (MCP) or 10.22km^2 (MLP). The core foraging area of all bats extended over 1.25km^2. The majority of foraging areas overlapped in the area of Menlo Castle, Menlough Woods and Menlough Village in a similar pattern recorded in 2014. This was considered to be the core foraging area from where bats travelled both, north towards Lough Corrib and south following the River Corrib, in some cases all the way to the coast of Galway.

The overall foraging area in 2015 was smaller than recorded in the late summer/early autumn tracking periods in 2014. It is likely that the low night-time temperatures in 2015 resulted in shorter foraging periods and shorter travel distances.

Based on the results of the radio-tracking studies carried out in 2014 and 2015, it was concluded that Lesser horseshoe bats utilised existing woodlands, field boundaries and watercourses for foraging and navigating during this period. Areas of scrub over limestone pavement were often used as foraging areas for prolonged periods of time. Quarries in the Galway area appeared to be of importance to Lesser horseshoe bats with records of bats spending time both feeding and night roosting there. Areas used both during the late maternity period in summer as well as for foraging in preparation for hibernation in late summer are regarded to be crucial in supporting the local Lesser horseshoe bat population.

The radio-tracking studies confirmed a strong link between the maternity roost present at Menlo Castle (PBR06) and Cooper's Cave (PBR112). Although there was a direct connection between both sites via the River Corrib and Terryland River, the radio-tracked bats tended not to utilise this potential commuting route and instead travelled overland via Lackagh Quarry to the Terryland River Valley, via a small area of green space around Castlegar Village. Bats were regularly recorded commuting between the roosts and have been confirmed to be a part of the same Lesser horseshoe bat population.

Radio-tracking data also suggested that Cooper's Cave (PBR112) is an important roosting site for male Lesser horseshoe bats in summer and an important autumn mating site in the area, as well as a hibernation site, for this species.

In order to record and assess bat activity within the lands proposed for habitat enhancement, four SM2BAT+ ultrasound detectors were placed along hedgerows from 28 July - 11 August 2017. Detectors were also placed in hedgerows on the bóithrín at Menlo which is crossed by the proposed road development. Lesser horseshoe bats were recorded at both locations with 132 recordings made in the proposed habitat enhancement lands and 81 recording made along the bóithrín. An SM2BAT+ detector was also deployed from 2 – 15 May 2018 at one of the same locations within the lands proposed for habitat enhancement and two detectors were also deployed in the field to the south toward the River Corrib in order to measure usage of different areas over the same time period. On this second occasion, Lesser horseshoe bats were recorded at all three locations with 102 recordings made by the two detectors in the fields to the south and only 12 recordings in the proposed habitat enhancement lands.

These results demonstrated that the proposed habitat enhancement area was accessible for Lesser horseshoe bats and is a suitable area for increasing the amount of foraging habitat within it.

Analysis of the relative importance of Menlo Castle

Counts of Lesser horseshoe bats made at Menlo Castle were compared to other roost counts in County Galway and beyond to determine the level of importance of Menlo Castle. Based on counts from 2006 - 2016, the maternity roost at Menlo Castle makes up approximately 0.6% (min 0.1% - max 0.6%) of the summer population of Lesser horseshoe bats for the national population of this species and 6% (min 2% - max 6%) of the County Galway summer population. Therefore, while the roost at Menlough does not meet the threshold of representing 1% of the national population to make it of National Importance (National Roads Authority, 2009), it does exceed this threshold at the county level and therefore is regarded to be of County Importance.

Based on the distribution of maternity roosts in the range of this species in Ireland, the Menlo Castle maternity roost and the local population it supports meets the criteria of being of National Importance, whereby “a smaller population may qualify as nationally important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle.” (National Roads Authority, 2009).

There are only six known maternity roosts in and around Lough Corrib, with the majority of roosts concentrated on the northern shores near Cong. Only two roosts are located on the southern end: Ross Lake Gatehouse and Menlo Castle. These southern roosts may be an important stepping-stone for long-term movements and gene flow between bat populations in North Galway and Mayo and populations in South Galway and Clare. Recent counts from Ross Lake Gate House have shown that this roost has undergone significant deterioration resulting in decline in numbers from 150 bats in 1994 to five bats in 2011 (Rebecca Teesdale pers. comm., 2014 and p44 in Roche et al, (2015)). A decline in the Ross Lake roost could potentially increase the relative importance of the roost at Menlo Castle as a stepping stone roost as it would be the only significant maternity colony at the southern end of Lough Corrib. There is no evidence to suggest that Menlo Castle Lesser horseshoe bat population is connected to the Eborhall Lesser horseshoe bat population, which is the qualifying interest (QI) population for Lough Corrib cSAC. Any predicted impacts on Lesser horseshoe bats associated with the proposed road development will not affect the conservation objectives of the Lough Corrib cSACs QI Lesser horseshoe bat population, nor the QI Lesser horseshoe bat populations of any other European sites.

The numbers of bats using Cooper’s Cave (PBR112) is hard to quantify due to the lack of access to roosting areas underground and the seasonal and gender specific variability in its use. It clearly is used by males and females some of which roost there in summer and also use it for mating. The cave system also supported a small population of hibernating Lesser horseshoe bats (usually averaging 4 bats) although the cave system could not be accessed in its entirety, so more bats could have been present further underground. The surveys have indicated that Menlo Castle and Cooper's Cave provide hibernation conditions for the local population although since both locations cannot be fully accessed to count individuals, the population size cannot be fully determined. Given the lack of other maternity roosts in the locality which could otherwise be a source of additional bats to occupy hibernacula, it is very unlikely that the winter roost population differs from the summer roost population in the Menlo Castle-Cooper's Cave complex.

8.3.7.2.2 Leisler's bat Nyctalus leisleri

The results of the bat surveys as they relate to Leisler's bat are shown on **Figure 8.19.1**.

Historical records

Leisler's bats have been recorded across the scheme study area as bat detector records and have also been recorded using bat boxes in Rusheen Bay, which are the only previous roost records for this species. Detector records include NUIG (A.P. McCarthy Planning Consultants (2007a), McCarthy, Keville & O'Sullivan (2014a) McCarthy, Keville & O'Sullivan (2014b)), Moycullen and Ballycuirke Lough (Galway County Council/Roscommon National Roads Design Office (2011). Since this bat can travel long distances from its roost each night, detector records do not necessarily suggest that bats are roosting nearby.

Identification of Roosts

No winter roost sites were recorded in any of the surveys for the proposed road development. Radio-tracking of three bats captured in 2014 and 2015 provided locations of four day roosts (PTR45, PB134, PBR139, PBR146).

In 2014, a single male Leisler's bat was captured and tagged in Menlough Woods. Radio-tracking indicated that the maximum distance that this individual was recorded travelling was 4.85km over a foraging area of 8.96km^2 that encompassed the southern area of Lough Corrib, the River Corrib and the Menlough area. Two roosts used by this individual were also located; a large modern house along the N84 Headford Road near Ballinfoyle and an Ash tree at the edge of Menlough Woods (PTR45).

Another two male Leisler's bats were captured, ringed and tagged in Bearna Woods in the second session in 2014. However, data was only collected for one of these bats as the second could not be located. The bat that could be tracked was found to roost during the day at two modern dwelling houses on the Cappagh Road (PBR139, PBR146). This bat had a recorded foraging area of 13.62km^2 (MCP) that encompassed the southern area of Lough Corrib, along the River Corrib corridor and the Menlough area.

Evidence of bat activity

Leisler's bats were recorded widely across the scheme study area during the walked and vehicle transect surveys. However, few calls were recorded within the city limits. The species was recorded at every static detector location.

The static detectors deployed in 2015 recorded Leisler's bats at 32 locations (out of a total of 42) along the route of the proposed road development. The highest levels of activity were recorded over the River Corrib (RS7) and Lackagh Quarry (RS13).

During the crossing point surveys, indications of potential crossings were recorded at 6 sites for Leisler's bat; CP5, CP6, CP8, CP10, CP14, CP15. It is reasonable to assume that the approach taken for detecting bat crossings of the proposed road development by this species is not as effective as it might be for other species. The Leisler's bat loud echolocation calls would be received by both microphones simultaneously and crossings would not be possible to prove. However, since this is a fast and high-flying bat it is regarded to be less impeded by severance of features at ground level (an "open airspace species" according to Elmeros et al, 2016).

8.3.7.2.3 Common pipistrelle bat Pipistrellus pipistrellus

The results of the bat surveys as they relate to the Common pipistrelle bat are shown on **Figure 8.21.1**.

Historical records

Common pipistrelle bats have been recorded across the scheme study area including the grounds of NUIG (A.P. McCarthy Planning Consultants (2007a), McCarthy, Keville & O'Sullivan (2014a) McCarthy, Keville & O'Sullivan (2014b)). None of these would appear to be records of roost sites and are generally records from bat detector surveys.

Identification of locations used in summer

Building inspections carried out in 2014 and 2015 identified four roosts used by Common pipistrelle bats. One was located in an outbuilding in the Ballindooley area (PBR07), a small roost of 3-4 bats was found in a large shed adjacent to the N83 Tuam Road in Cappanabornia (PBR228) and single bats were observed at the stable block in Galway Racecourse in Ballybrit (PBR205) and an abandoned bungalow to the north of Bearna Village (PBR220).

Six Common pipistrelle bats were captured during the radio-tracking session in 2014; two at NUIG, two at the NUIG Sporting Campus, and two at Menlough Woods. The male and female bats captured in NUIG were tagged, ringed and tracked to their day roosts. The female was found to roost in two modern buildings in a housing estate at Ballymoneen (PBR141, PBR147) on the north western edge of the city, while the male was found to roost in two modern agricultural barns in Cloonacauneen (PBR148, PBR149), to the north of the Roadstone Quarry.

No winter roosts for this species have been recorded.

Evidence of bat activity

Common pipistrelle bats were recorded widely across the scheme study area during the walked and vehicle transect surveys. However, very few calls were recorded within the city limits, apart from areas adjacent to the River Corrib. The species was recorded at every static detector location in 2014.

The static detectors deployed along the proposed road development recorded Common pipistrelle bats at 34 locations. The highest level of activity was recorded in Lackagh Quarry (RS13), a hedgerow in a field adjacent the N83 Tuam Road (RS26), a hedgerow adjacent to the existing N6 roundabout (RS29) and along a hedgerow bordering the Barr Aile Road, north of Bearna Village (RS40).

During the crossing point surveys, possible crossing records were recorded at 16 sites for Common pipistrelle bats. Seven sites recorded more than 10 possible crossings for this species; CP6, CP9, CP10, CP11, CP14, CP15, CP16. Relatively high number of possible crossings were recorded at CP9 (88 possible crossings) and CP10 (630 possible crossing records).

8.3.7.2.4 Soprano pipistrelle bat *Pipistrellus pygmaeus*

The results of the bat surveys as they relate to the Soprano pipistrelle bat are shown on **Figure 8.21.1**.

Historical records

This species has been previously recorded across the scheme study area and included records at Dangan, (A.P. McCarthy Planning Consultants, 2007a), Merlin Park (Browne and Fuller, 2009), Bearna Woods (Browne et al, 2009), Ballyquirke (Galway County Council/Roscommon National Roads Design Office, 2011) and NUIG (McCarthy, Keville and O'Sullivan, 2009a, 2014a, 2014b). A historical record was also provided by the NPWS of a roost from Menlough Village in 2014 (R. Teasdale, pers. comm, 2015) a single bat was known to roost in Menlo Castle in 2000 (RPS, 2006)

Identification of locations used in summer

Building inspections carried out in 2014, 2015 and 2016 identified 13 roosts of this species. These were located in Aubwee, Ballybrit, Ballindooley, Letteragh, Gortacleva, Roscam, Bearna Woods, Bearr Aile, Truskey West, Aughnacurra and Coolagh. Seven of these roost sites were at locations with unoccupied farm buildings and houses (PBR196, PBR205, PBR237, PBR241, PBR42, PBR44, PBR49), and roosts were found in occupied buildings in Bearna Woods (PBR222), Aughnacurra residential estate (PBR177, PBR255) and Coolagh (PBR179).

A single Soprano pipistrelle bat was observed emerging from an oak tree (PTR40) in a field located to the south of Menlo Castle in the summer of 2015.

Evidence for bat activity

Soprano pipistrelle bats were recorded widely across the scheme study area during the walked and vehicle transect surveys. However, very few calls were recorded within the more developed areas within Galway City apart from areas adjacent to the River Corrib. This species was recorded at all 24 static detector locations deployed in 2014.

The static detectors deployed in 2015 recorded soprano pipistrelle bats at 37 (out of a total of 42) locations along the route of the proposed road development. The highest levels of activity were recorded near the River Corrib (RS1 and RS2), in proximity to a confirmed roost in Aughnacurra Housing Estate (RS8) and a hedgerow adjacent to the existing Coolagh Roundabout (RS29).

During the crossing point surveys, bat activity suggesting possible crossings was recorded at all 21 survey locations for soprano pipistrelle bats. Thirteen sites along the route of the proposed road development recorded more than 10 possible crossing records for this species.

8.3.7.2.5 Nathusius' pipistrelle bat *Pipistrellus nathusii*

The results of the bat surveys as they relate to Nathusius' pipistrelle bat are shown on **Figure 8.20.1**.

Historical records

This is the only bat species that has not been previously recorded in the scheme study area. Only one record exists at a county level for an ad-hoc observation made in Oughterard in 2007, according to the Bat Conservation Ireland database.

No roosts were found for this species.

Evidence for bat activity

Nathusius' pipistrelle bats were recorded during the walked and vehicle transect surveys in 2014 but on a much rarer basis than the other two *Pipistrellus* species. They were recorded in an area of farmland east of Galway Technology Park, Bearna Woods, Coolagh Lakes and Letteragh.

The species was recorded at 20 (out of a total of 24) static detector locations in 2014, although they again were much less frequent than the other *Pipistrellus* species but suggested that the species was more widespread than was shown by the walked and vehicle transects. Sites with highest numbers of calls included S20, S16, S21 and S06, which were located around the River Corrib.

The static detectors deployed in 2015 along the route of the proposed road development recorded Nathusius' pipistrelle bats at one (out of a total of 42) location, in Lackagh Quarry (RS13), where two calls were recorded.

During the crossing point surveys, evidence for Nathusius' pipistrelle bats crossing the route of the proposed road development were recorded at CP14 and CP20 (2 out of a total of 21). Only single "passes" were recorded.

8.3.7.2.6 Unidentified Pipistrelle Species *Pipistrellus* sp.

The results of the bat surveys as they relate to Pipistrelle bats, not identified to species level, are shown on **Figure 8.21.1**.

Common pipistrelle bats have their peak echolocation call strength at 45kHz and Soprano pipistrelle bats at 55kHz. Pipistrelle bat species that echolocate between 48 and 52kHz cannot be accurately identified by their calls and are described as "unidentified" Pipistrelle bat species.

Identification of locations used in summer

No winter roosts for this species were recorded.

Two unidentified Pipistrelle bat roosts were recorded during building inspections in 2014 and 2015. A roost of unknown number was found in a farm house to the west of Bearna Village (PBR224) during an internal survey whilst an old unidentified Pipistrelle bat dropping was found in a bungalow within the grounds of Galway Racecourse in Ballybrit (PBR242).

An unidentified Pipistrelle bat was observed with an endoscope in a crevice in an ash tree (PTR54) in hazel scrub on limestone pavement located to the north of Coolagh Lakes in 2015.

Evidence for bat activity

Bat calls that could not be assigned to either Common or Soprano pipistrelle bats were recorded widely across the study area during the walked and vehicle transects undertaken in 2014. The static detectors deployed in 2015 recorded unidentified Pipistrelle bats at 32 locations along the route of the proposed road development. The highest activity was recorded near the River Corrib (RS1), Lackagh Quarry (RS13) and along a hedgerow near Castlegar Village (RS19).

The static detectors deployed in 2015 recorded unidentified Pipistrelle bats at 32 (out of a total of 42) locations along the route of the proposed road development. During the crossing point surveys, bat activity suggesting possible crossings were recorded at 14 (out of a total of 21) sites for unidentified Pipistrelle bat species. Two sites recorded more than 10 possible crossing records for this species group: CP9 and CP10.

8.3.7.2.7 Brown long-eared bat *Plecotus auritus*

The results of the bat surveys as they relate to the Brown long-eared bat are shown on **Figure 8.20.1**.

Historical records

Baseline data, presented in documentation supporting planning applications in the scheme study area, have recorded a Brown long-eared bat roost of more than 20 bats in Menlo Castle (RPS, 2006) although this was not recorded during the current series of surveys. This commonly-occurring and widespread species is known to occur in Merlin Woods (Browne and Fuller, 2009), NUIG Campus (McCarthy, Keville and O'Sullivan. (2014a)), Clydagh Bridge and Ballyquirke (north of the scheme study area) (Galway County Council/Roscommon National Roads Design Office. (2011). Bat Conservation Ireland records for this species show a small number of records in the scheme study area.

Identification of locations used in summer

27 roosts of this species were recorded during the building inspections in 2014-2017. Seven of the roosts could support maternity colonies; a period house on the Letteragh Road (PBR49), Merlin Castle (PBR51), an abandoned bungalow on the R338 to Oranmore (PBR89), a barn on the R399 east of Ballybrit (PBR100), the

attic of two houses in Aughnacurra Housing Estate (PBR178, PBR256) and a modern house in the Heath Housing Estate (PBR173).

Twelve additional roosts were also classified as night roosts, while the remaining eight were not classified. The night roosts were found in the following locations; an abandoned house adjacent to the Corinthians RFC (PBR21), an abandoned house in Rockmount (PBR15), an abandoned three outbuildings near Ballindooley Lough (PBR17, PBR25, PBR111), an outbuilding and archway in Menlough (PBR82, PBR156), an unfinished modern house in Gortacleva (PBR138), a shed in Barr Aile (PBR217), and a shed in Garraun (PBR194), cottage in Ballintemple (PBR105).

During the radio-tracking in August 2014, four brown long-eared bats were captured; two bats at Bearna Woods, one bat at Menlough Woods, and one bat at Cooper's Cave. The female brown long-eared captured at Cooper's Cave was fitted with a radio transmitter and tracked to its daytime roost; a bungalow in Castlegar (PBR145). An emergence count carried out on this building observed six bats leaving the roost. As this bat was an adult female it is likely that this building was being used as a maternity roost. This bat was also tracked during the September radio-tracking session and was found to repeatedly roost in the same bungalow. On one night the bat was recorded night roosting in a stone arch between Menlough Village and Menlo Castle (PBR156) during heavy rain. The maximum commuting distance recorded for this individual in a single night was approximately 4.07km. The foraging area of 2.18km^2 (MCP) mainly encompassed the valley where Cooper's Cave was located but also around Ballindooley Lough.

Evidence for bat activity

Brown long-eared bats were only recorded at two locations during the walked and vehicle transects but these results are typical for this bat species which echolocates very quietly and is therefore difficult to pick up on a heterodyne bat detector on a moving transect. However, they were recorded at 18 (out of a total of 24) static detector locations in 2014, indicating that the species is quite widespread in the scheme study area, consistent with the findings of the summer roost surveys.

The static detectors deployed in 2015 recorded brown long-eared bats at only two (out of a total of 42) sites along the route of the proposed road development, adjacent to the River Corrib (RS1 and RS7).

8.3.7.2.8 *Myotis* bat species

The results of the bat surveys, as they relate to bats identified to the *Myotis* genus level, are shown on **Figure 8.20.1**.

The *Myotis* genus includes three bat species resident in Ireland: Daubenton's bat *Myotis daubentonii*, Natterer's bat *M. nattereri* and the Whiskered bat *M. mystacinus*. There can be difficulty in differentiating between the bats using their echolocations calls as there can be similarity between them. Therefore, they have been grouped together for the purposes for reporting these results.

Historical records

Previous bat studies have reported in excess of 20 Daubenton's bats recorded roosting in southern façade of Menlo Castle in 2000. There was no roost recorded in 2005 and 2006, but bats were recorded foraging. Less than 30 Natterer's bats were recorded roosting in outbuildings of Menlo Castle in 2000 but no roost was recorded in 2005 and 2006 ((RPS, 2006). Myotis bats were recorded on the NUIG Campus (McCarthy, Keville & O'Sullivan (2014). There was also an historical record of a roost of Natterer's bats at St James's Church, Bushypark. Natterer's bats were also recorded as part of the surveys carried out for the proposed R336 to N59 Road Scheme (RPS, 2013a). Daubenton's bats have been recorded on the River Corrib from the NUIG campus (McCarthy, Keville and O'Sullivan. (2014a, 2014b)) and also in most watercourses within the city and around its environs. This species is regularly sighted around the Galway Cathedral during bat walks by Galway Bat Group (C. Carlin, pers comm 2015).

Whiskered bats are rarely recorded across the area and only *ad-hoc* records from Bat Conservation Ireland exist.

Identification of locations used in summer

Four Natterer's bat roosts were recorded during the inspections of buildings in 2015 (PBR17, PBR20, PBR64, PBR82). These roosts were confirmed based on the presence of droppings, which were analysed using DNA sequencing to confirm the species identity.

An emergence survey of Menlo Castle (PBR06), carried out on the 8 July 2014, found Daubenton's bats to be still roosting in the castle. Numbers of bats were estimated to be less than 20 bats.

During the radio-tracking in August 2014, nine Daubenton's bats (one female and eight males) were captured in Menlough Woods and a single male Daubenton's bat was captured at Cooper's Cave. One of the male Daubenton's bats captured in Menlough Woods was tagged and tracked. It was found to roost in a stonewall structure on the eastern bank of the River Corrib (PBR133). An emergence count undertaken shortly after recorded 25 Daubenton's bats to be roosting in the wall, suggesting that this was likely to be a maternity roost for this species.

During the second radio-tracking session in August, ten Daubenton's bats were captured (one from Merlin Wood, three from NUIG, and six from Menlough Woods) and four were tagged (one female from Merlin Wood, two females and one male from NUIG). Roosting information was recorded for three of the Daubenton's bats tracked during the second August session. They were found to roost in three buildings (PBR142, PBR143, PBR144) and two bridges (PBR150, PBR152) in Galway City Centre. Foraging data was recorded in the September tracking session for two Daubenton's bats that were captured during the second August session. One bat travelled a maximum distance of 1.06km and had a foraging area of 0.26km^2 (MCP) encompassing Merlin Woods and the Coolagh lakes. The other had a maximum distance of 2.48km and had a foraging area of 0.55km^2 (MCP) encompassing the River Corrib from Menlo Castle into Galway City Centre.

Two male whiskered bats were captured and tagged during the second radio-tracking session in August 2014 (one from NUIG and one from Merlin Woods). However, the bat caught in Merlin Woods could not be relocated after tagging. The other Whiskered bat was found to roost in two modern dwelling houses (PBR140, PBR151) in a residential estate by the Sports Centre, near Bearna Woods. Foraging data for this individual was gathered during the September radio-tracking session. The maximum distance this bat travelled was 3.71km and had a foraging area of 2.02km^2, encompassing areas of scrub and rough grassland in the Bearna area.

A Natterer's bat was captured in Menlough Woods in August 2014 but was not prioritised for tracking at that time and hence not fitted with a radio-tag. Another male Natterer's bat was captured, ringed and tagged in Menlough Woods during the September radio-tracking session; however, no data was recorded from this bat, possibly due to the bat leaving the area, or transmitter failure.

Evidence of bat activity

During the walked and vehicle transect surveys and the static detector surveys in 2014 and 2015, the majority of *Myotis* calls were not identified by species due to the overlap in call characteristics between species when analysed. However, on a number of occasions, *Myotis* species were confirmed by visual observations coinciding with echolocation calls. Natterer's bats were recorded at Bearna Woods and Daubenton's bats were seen foraging on the River Corrib and the Terryland River. The majority of *Myotis* bat calls were recorded along the River Corrib and Terryland River during the walked and vehicle transects but were infrequently recorded across the rest of the scheme study area.

Myotis calls were recorded across all 24 static detector locations in 2014, although at a lower frequency than pipistrelle species. Location S07 recorded the highest amount of *Myotis* activity. This site was close to the River Corrib and the known Daubenton's maternity roost.

The static detectors deployed in 2015 along the route of the proposed road development recorded *Myotis* bats at 25 (out of a total of 42) locations. Activity levels for this species at static locations along the route of the proposed road development was low for this species group but the highest activity was recorded along the River Corrib (RS1), Lackagh Quarry (RS13), an area of woodland adjacent to the N84 Headford Road near Ballindooley and along a stream surrounded by fields and scrub in Ballard East.

During the crossing point surveys, possible crossing records were recorded at 7 (out of a total of 21) sites for *Myotis* bat species, with 1-3 possible crossings recorded at each of these sites.

8.3.7.2.9 Survey Limitations

A total of 230 structures and 62 trees were assessed as part of the collection of baseline data on the bat populations within the area of the proposed road development. This unprecedented level of surveying allowed a detailed picture of the species assemblage present in the study area and informed the constraints and route selection studies, the design of the proposed road development and the preparation of this EIAR.

All structures within the proposed development boundary which may be affected, either directly or indirectly, were surveyed to record potential usage by bats. In most cases it was possible to carry out internal and external checks for signs of bats in daytime as well as dusk and/or dawn surveys. Inevitably in a few cases, access to inside the structure was not possible. In such cases, surveys at night were undertaken to record any bats emerging from or returning to the structure.

Some surveys (e.g. radio-tracking surveys in 2015) may have been affected by cool night time temperatures and may have forced bats to reduce foraging time. Overall, the repeated surveys carried out since 2014 have allowed bats to be surveyed over multiple seasons which reduce the bias caused by suboptimal weather conditions.

8.3.7.3 Badger

Badger, and their breeding and resting places, are protected under the Wildlife Acts.

Evidence of Badger *Meles meles* activity was found across the study area from Na Foraí Maola to the N83 Tuam Road. The highest concentrations of badger activity were recorded in the Menlough area and the area between Lackagh Quarry and the N84 Headford Road. The survey results show a much greater distribution of Badgers across the study area than suggested by the findings of the desktop review. There was a single 2km grid squares (M32I) where the National Biodiversity Data Centre (NBDC) database had a record for Badger but the species was not recorded in that overlapping portion of the mammal survey study area and M32I. However, the survey did record Badger 50m to the north.

A total of 17 badger setts were identified both within and in the vicinity of the study area. The majority of setts were recorded as part of the 2015 multidisciplinary survey but some records for setts further from the proposed road development were recorded in 2014, during the course of other survey work. Sixteen were active at the time of the survey with the remaining sett (S1) showing no signs of recent use. The status, description and distance from the proposed development boundary of each of the setts is provided below in **Table 8.21**. The results of the mammal survey are shown in **Figures 8.3.1** to **8.3.14**.

Table 8.21: Results of the Badger survey – Badger setts

Ref. No.	Type of sett[42]	Status and description
S1	Disused sett	Inactive sett located beneath blackthorn tree. Single entrance. c.160m south-east of the proposed road development at Ch. 3+930
S2	Potential main sett	Active sett located in area of scrub along field boundary;

[42] Main sett = breeding sett, focus of most badger activity; Annexe sett = large sett, usually within 50m of the main sett; Subsidiary sett = smaller sett, not peripheral, within territory of badger social group; Outlier sett = small sett, usually on periphery of group territory; Minor sett = incidental sett, not on periphery of group territory.

Ref. No.	Type of sett[42]	Status and description
		numerous tunnels/pathways into the undergrowth c.90 m north-west of the N59 Link Road South at Ch. 1+800
S3	Main sett	Active sett located in woodland near field boundary wall. Single entrance sett with abundant fresh spoil, bedding and latrines. Adjacent to (<5m from) the proposed road development at Ch. 9+500
S4	Annex sett	Active sett located amongst holly bushes under limestone boulder. Single entrance with fresh spoil, bedding and latrine. c.85m south-east of the proposed road development at Ch. 9+500
S5	Subsidiary sett	Active sett located along field boundary. Single entrance with bedding and latrine. c.430m south-east of the proposed road development at Ch. 9+500
S6	Main sett/Annex sett	Active sett located in area of scrub. At least two entrances fresh spoil, bedding. >500m from the proposed road development
S7	Main sett/Annex sett	Active sett located under limestone. Two entrances fresh spoil, bedding. >500m from the proposed road development
S8	Main	Active sett located between limestone boulders. 10 plus entrances. Latrines and abundant activity signs. c.55m south of proposed road development (Bóthar Nua tie-in) at Ch. 10+200
S9	Potential main sett	Active sett located in hazel woodland at base of boulder pile. Single entrance. Large spoil heap, fresh spoil and bedding present. Within proposed development boundary at Ch. 11+810

Ref. No.	Type of sett[42]	Status and description
S10	Subsidiary sett	Active sett with two entrances, located under scrub along field boundary. Fresh spoil and bedding. c.45m north-east of the proposed road development at Ch. 11+810
S11	Subsidiary sett	Active sett located in dense scrub at field boundary. Single entrance. Within proposed development boundary at Ch. 12+025
S12	Main	Active sett located in scrub along field boundary. Six entrances. >500m from the proposed road development
S13	Subsidiary sett	Active sett located within improved grassland field. Single entrance. Recent digging. c.130m south of proposed development boundary at Ch. 13+425
S14	Subsidiary sett	Active sett located along field boundary. Two entrances. Recently digging. Within proposed development boundary at Ch. 13+775
S15	Subsidiary sett	Active, single entrance. Recent digging. c.100m north-west of AR 13/03
S16	Subsidiary sett	Active, single entrance. Recent digging and fresh spoil/bedding present. c.150m to the west of the proposed N59 drainage
S17	Subsidiary sett	Active, two entrances. Latrines, recent digging and fresh spoil/bedding. c.52m north of the proposed N59 drainage

Survey Limitations

Due to the presence of dense vegetation/scrub cover there were some locations within the study area, and within the proposed development boundary, which could not be fully accessed during the survey. These are shown on **Figures 8.3.1** to **8.3.14**. No evidence of Badger activity was recorded around the perimeter, or in the vicinity of, any of the inaccessible areas directly affected by the proposed road development.

The inaccessible areas have been considered in determining the impact significance and are reflected in the mitigation strategy. Sufficient data was gathered to reliably inform the impact assessment despite not being able to fully access these areas.

8.3.7.4 Other Mammal Species

Pine marten *Martes martes* were recorded along the Monument Road in Menlough and would be expected to be present in woodlands in the area. Pine marten have also been recorded in Bearna Woods and at Mincloon (NBDC on-line database records).

Evidence of Wood mouse *Apodemus sylvaticus* and Red squirrel *Sciurus vulgaris* was recorded east of the River Corrib, in woodlands east of Menlough Village, around Lackagh Quarry west of the proposed N84 Headford Road Junction, and south of the Roadstone Quarry at Two-mile-ditch. Red squirrel is known from the Menlough area, Merlin Park Woods, Ballygarraun/Two-mile-ditch, and woodlands in the Ardaun area (NBDC on-line database records).

An Irish stoat *Mustela erminea hibernica* was recorded on Bóthar Nua (roadkill). Irish hare *Lepus timidus hibernicus* was recorded in various habitat types (i.e. scrub, wet/improved grassland) in the western part of the study area; including lands within the proposed development boundary. Both species have been recorded in the study area previously (NBDC on-line database records and McAney, 2010).

Other terrestrial mammal species protected under the Wildlife Acts and likely to be present and widespread given the habitat types and existing land uses, and existing records from the NBDC's online database, include the Hedgehog *Erinaceus europaeus* and the Pygmy shrew *Sorex minutus*. Based upon the findings of the desktop review, Galway Bay supports a diverse range of marine mammal species, including: Harbour seal *Phoca vitulina*, Grey seal *Halichoerus grypus*, Common dolphin *Delphinus delphis* and Harbour porpoise *Phocoena phocoena*. All cetacean species are also protected under the Habitats Directive (Annex IV).

Evidence of Fox *Vulpes vulpes* and Rabbit *Orytolagus cuniculus* were also recorded across the study area. Evidence of Mink *Mustela vison* was recorded along the western bank of the River Corrib (*i.e.* north and south of Ch. 9+250) and a drainage ditch located near Ballindooly Lough (*i.e.* between Ch. 12+250 and Ch. 12+300). Bank vole *Myodes glareolus* and Wood mouse were recorded along a stream within the NUIG Sporting Campus. Although these species are not afforded legal protection under the Wildlife Acts, they form part of the local biodiversity resource and are noted here in that context.

8.3.8 Invertebrates

The following section presents the results of the baseline invertebrate surveys carried out to inform the impact assessment. Dedicated surveys were carried out for these species because they are legally protected (i.e. all are listed on Annex II of the Habitats Directive with the White-clawed crayfish and the Freshwater pearl mussel also protected under the Wildlife Acts) and, in the case of the Marsh fritillary butterfly and *Vertigo antivertigo*, that they are rare in Ireland[43] and at particular risk of habitat loss impacts associated with the proposed road development.

8.3.8.1 White-clawed crayfish

There were no White-clawed crayfish recorded at any of the survey sites within the scheme study area. No other evidence of the presence of the species within the scheme study area was observed (i.e. Otter spraints will commonly contain crayfish remains if they form part of their diet).

The survey was carried out in September 2014 during a period of low water levels, considered to aid in indicating those streams suitable of supporting White-clawed crayfish, and relatively high water temperatures, which would be expected to encourage crayfish activity.

All watercourses in the western part of the scheme study area were considered unsuitable to support the species, the water chemistry being too acidic and the lack of suitable habitat and/or quality; many of these streams were small or intermittent.

The Terryland River and the River Corrib appeared to be suitable for White-clawed crayfish but none were recorded. The Merlin Park Stream was considered unsuitable.

8.3.8.2 Freshwater pearl mussel

There were no populations, or individual records, of the Freshwater pearl mussel recorded within the scheme study area. The full results of the Freshwater pearl mussel surveys are provided in **Appendix A.8.11**.

The watercourses present were found to be poor habitat for the species, and although the Bearna Stream had good potential, no mussels were found. While the Lough Inch River itself had poor habitat and was affected by various pressures, this watercourse was upstream of, and in direct connectivity with, the Knock River - the confluence of the Lough Inch River and the Knock River is upstream of a known Freshwater pearl mussel population. The Knock/Lough Inch catchment is shown on **Figure 8.5.1**.

Although no freshwater pearl mussel were present with the ZoI of the proposed road development, impacts to salmonid fish species could indirectly affect the Freshwater pearl mussel population in Lough Corrib cSAC; the QI population is in the Owenriff River, c.23km to the north.

8.3.8.3 Other Annex II molluscan species

A total of 39 molluscan species were recorded during the molluscan survey, none of which were nationally or internationally rare or protected, with a range of between one and twelve species per surveyed site. The species assemblage recorded in some areas (e.g. Wetland habitats associated with the Coolagh Lakes and some

[43] The Marsh fritillary butterfly is listed as Vulnerable in *Ireland Red List No. 4 – Butterflies* (Regan et al., 2010) and *Vertigo antivertigo* as Vulnerable, in *Ireland Red List No. 2 – Non-Marine Molluscs* (Byrne et al., 2009)

Calcareous grassland habitat nearby) was considered to be of local interest. The full results of the molluscan surveys are presented in **Appendix A.8.12**. Species are listed according to the nomenclature of Anderson (2005).

There were no legally protected *Vertigo* species recorded during the survey. Three other Vertigo species (*Vertigo pygmaea*, *Vertigo antivertigo* and *Vertigo substriata*) were recorded, suggesting that the habitat conditions were not quite even in wetness and/or calcareous enough for the three Annex II *Vertigo* species. The remainder of the species recorded were typical of wet grassland, reed bed, riparian fringe, and fen habitats. Together the sites displayed a good range of species assemblage with good variety across the sites, reflecting the level of variation in wetness and vegetative succession of different areas. It should be noted that the Marsh whorl snail *Vertigo antivertigo* is listed as vulnerable in the Irish Red Data List of molluscs (Byrne *et al*., 2009). This species was recorded in wetland habitat on the east bank of the River Corrib between Menlo Castle and Menlo Graveyard and north of the outflow channel from the Coolagh Lakes, in the fringing wetland habitat along the western side of the Coolagh Lakes, at Ballindooley Lough and at the marsh in Castlegar.

The highest quality molluscan habitat was found towards the southern end of the Coolagh Lakes, concentrated in the high quality fen and transitional habitat areas (see **Figure 8.5.1** and the full survey report in **Appendix A.8.12**). Here the most concentrated searches for *Vertigo geyeri* were undertaken but no individuals of this species were found in the field or in samples removed for laboratory analysis.

The Marsh whorl snail population is valued as being of Local Importance (higher value).

8.3.8.4 Marsh fritillary

2013 Survey

The survey was conducted from 23 – 27 September 2013, covering 57 survey sites and approximately 491.8ha. Suitable Marsh fritillary habitat was recorded at 29 of those sites, unsuitable habitat at 17 sites, and the remaining 11 were not surveyed due to access restrictions. The area of suitable habitat accounted for 61.2ha, or 12.4% of the sites surveyed.

Two larval webs were recorded at a single site during the survey. However, two locations found to support relatively large concentrations of larval webs in 2014 were not surveyed in 2013. The full results of the 2013 Marsh fritillary survey are provided in **Appendix A.8.14**; the location of the larval webs are shown on **Figures 8.6.1** and **8.6.8**.

2014 Survey

A total of 196 polygons were surveyed in 2014, comprising a total area of 936ha. A total of 105 areas of suitable Marsh fritillary habitat were mapped, comprising a total area of 80.6ha. The quality of habitat ranged from marginal sparse through to good condition. Many areas were fairly rank and were likely to be limited in their longevity, with management often apparently abandoned or affected by access due to development in the vicinity.

A total of 111 webs were located within around 40 areas of suitable habitat. Eleven of the webs were located in four different areas identified as suitable habitat in the 2013 surveys but with no webs recorded in that year. The rest of the webs were recorded in areas that had not previously been surveyed. Webs located included both active webs and hibernation webs.

The full results are discussed in the 2014 Marsh fritillary survey report in **Appendix A.8.13**, and shown on **Figures 8.6.1** and **8.6.8**.

2015 Survey

In 2015, the survey switched from the larger scale of the scheme study area to a more focussed survey of suitable habitat patches within, and in the vicinity of, the proposed development boundary (see **Figures 8.6.1** and **8.6.8**). A total of 42.7ha were surveyed, comprising around 3ha within the proposed development boundary.

The majority of areas surveyed comprised suitable habitat, although levels of suitability varied (largely related to management issues specific to 2015). The exception to this was one area, comprising 1.15ha of suitable habitat in 2014 and holding Marsh fritillary webs, which was found to be largely lost due to infilling. It was noted that some areas that were of limited suitability in 2014 (largely due to heavy grazing), comprised suitable habitat in 2015. Conversely, some areas that were in good condition in 2014 were found to be overgrazed in 2015. In addition, one area that was considered to be suitable habitat in 2014 (though marginal) was considered to fall outside that classification due to ongoing agricultural improvement in 2015.

A total of 12 webs were located across five polygons within the survey areas (see **Figures 8.6.1** and **8.6.8**). This compares with 39 webs recorded with those same areas in 2014. No webs were recorded within the proposed development boundary. Webs located included both active webs and hibernation webs.

In 2014, webs were more widely spread throughout suitable habitat, while webs in 2015 were more limited in distribution. This may be attributable, in part at least, to the difference in weather in the two years. A relatively warm and settled summer in 2014 would allow for a good emergence season and distribution of adult females to new areas. Weather in 2015 provided sub-optimal conditions for the species both during the flight period and the early part of the larval stage. This has the potential to both limit distribution of the species at the adult stage and survival of the species at the early larval stage.

2016 Survey

A total of 42.4ha were surveyed on the 14, 15 and 26 September 2016, of which c.6.1ha was within the proposed development boundary.

A total of 56 webs were located within the survey areas in 2016 (see **Figures 8.6.1** and **8.6.8**), which compares with 12 webs recorded with the area in 2015 and 39 webs in 2014. In 2016, a total of 13 webs were recorded within the proposed development boundary, with a further 33 webs recorded within 50m of the proposed development boundary and 6 within 100m.

The section between Ch. 0+700 and Ch. 1+600 comprised a wide-ranging area of good quality habitat. Many areas in the eastern part were in better condition for the species than in the previous 2 years; possibly due to reduced grazing pressure. Despite this, webs were only recorded in the western part of the survey area.

The habitat area between Ch. 2+200 and Ch. 2+550 held an active and core population with the number of larval webs increasing from two in 2014, to seven in 2015 and to 35 in 2016. Although high quality habitat, the area between Ch. 2+900 to Ch. 3+050 only supported a single web in 2015 and again in 2016. The high-quality habitat area between Ch. 3+550 and Ch. 3+800 held 14 larval webs in 2016; compared with three in 2014 and a single web in 2015. The quality of the habitat in the area between Ch. 4+700 and Ch. 5+100 has deteriorated year on year over the survey period due to infilling and overgrazing and no larval webs were recorded here in 2016. No larval webs have been recorded in the suitable habitat areas at Ballagh (Ch. 7+700 to Ch. 8+000).

Overall, the Marsh fritillary butterfly population is valued as being of County Importance.

8.3.9 Birds

8.3.9.1 Breeding birds

All wild birds, and their nests and eggs, are protected under the Wildlife Acts. Some bird species are also listed on Annex I of the EU Birds Directive (see **Table 8.22** for those Annex I bird species recorded during the breeding bird surveys).

The results of the various breeding bird surveys carried out to inform this assessment are summarised below.

Breeding Bird Survey

The general breeding bird surveys recorded a total of 62 species across the study area, including; 3 species listed as SCIs for nearby SPAs, 2 Birds Directive Annex I species, 6 Red list[44], 23 Amber list and 33 Green list bird species.

Table 8.22 below provides a summary of the findings of the breeding bird surveys[45] with respect to those species which are of conservation concern and are considered to be Key Ecological Receptors (KERs):

- Special Conservation Interests (SCIs), for a breeding population, of nearby SPAs
- Species listed under Annex I of the Birds Directive (2009/147/EC)
- Red and Amber BoCCI species listed for their breeding populations
- The results of the breeding bird surveys are shown on **Figures 8.7.1** to **8.7.14** with the full list of bird species recorded provided in **Appendix A.8.22**. The full

[44] Birds of Conservation Concern in Ireland (BoCCI) after Colhoun & Cummins, 2013

[45] Surveys were also carried out to establish the local Barn owl breeding population (a BoCCI Red List species), which confirmed a nest site at Menlo Castle, and this species is also included in **Table 8.22**.

results of the desktop review are presented in **Appendix A.8.18**. Of note in that regard are the results of the bird surveys carried out in 2005/2006 as part of the N6 Galway City Outer Bypass project (RPS, 2006) which demonstrates the importance of the River Corrib corridor for bird species

Table 8.22: Breeding Birds of Conservation Concern Recorded during the Breeding Bird Survey[46]

Common name / *Latin name*/BoCCI Code	**Distribution in the study area**	**Conservation Importance**		
		BoCCI (breeding)	**Annex I**	**SCI[1]**
Barn owl *Tyto alba* (BO)	One nest site known at Menlo Castle	Red	-	-
Black-headed gull *Larus ridibundus* (BH)	Widespread throughout	Red	-	Lough Corrib SPA
Curlew *Numenius arquata* (CU)	Observed once at Ballindooley Lough	Red	-	-
Grey wagtail *Motacilla cinerea* (GL)	Observed once west of the Galway Racecourse	Red	-	-
Herring gull *Larus argentatus* (HG)	Widespread throughout, more frequent west of the River Corrib	Red	-	-
Meadow pipit *Anthus pratensis* (MP)	Widespread west of the River Corrib, and between Ballybrit and the existing N6	Red	-	-
Whinchat *Saxicola rubetra* (WC)	Ballagh area (single record)	Red	-	-
Cormorant *Phalacrocorax carbo* (CA)	Widespread west of the River Corrib	Amber	-	Inner Galway Bay SPA & Connemara Bog SPA
Common tern *Sterna hirundo* (CN)	Observed once at the proposed River Corrib Bridge	Amber	√	Inner Galway Bay SPA & Lough Corrib SPA
Coot *Fulica atra* (CO)	Observed between the River Corrib and Bóthar Nua, and once near Ballybrit	Amber	-	-
Great black-backed gull *Larus marinus* (GB)	Observed west of Bearna, at the River Corrib, and once at Ballindooley Lough	Amber	-	-

[46] Note that some of the species listed are also KERs for their wintering populations—see **Table 8.23**

Common name / *Latin name*/BoCCI Code	Distribution in the study area	Conservation Importance		
		BoCCI (breeding)	Annex I	SCI[1]
Goldcrest *Regulus regulus* (GC)	Widespread west of the River Corrib	Amber	-	-
Greenfinch *Carduelis chloris* (GR)	Widespread west of the River Corrib and east of the River Corrib, only recorded at Ballybrit	Amber	-	-
House martin *Delichon urbicum* (HM)	Observed near the Letteragh Road and between Ballindooley Lough and Ballybrit	Amber	-	-
House sparrow *Passer domesticus* (HS)	Observed near the Letteragh Road and at Ballybrit	Amber	-	-
Kestrel *Falco tinnunculus* (K.)	Observed near Bearna Woods, Letteragh Road, Lackagh Quarry and the existing N6	Amber	-	-
Lesser black-backed gull *Larus fuscus* (LB)	Observed once near Ballymoneen	Amber	-	-
Little grebe *Tachybaptus ruficollis* (LG)	Observed at the proposed River Corrib Bridge and Ballindooley Lough	Amber	-	-
Linnet *Carduelis cannabina* (LI)	Widespread throughout	Amber	-	-
Mistle thrush *Turdus viscivorus* (M.)	Observed at Ballard West, Knocknafroska, Menlough and Lackagh Quarry	Amber	-	-
Peregrine *Falco peregrinus* (PE)	Observed near Lackagh Quarry and the N83 Tuam Road	Green	√	-
Robin *Erithacus rubecula* (R.)	Widespread throughout	Amber	-	-
Skylark *Alauda arvensis* (S.)	Observed at Troscaigh Thiar, Cappagh and Ballybrit	Amber	-	-
Stonechat *Saxicola torquata* (SC)	Observed west of Bearna, near Cappagh, Knocknafroska and between Ballybrit and the existing N6	Amber	-	-

Common name / *Latin name*/BoCCI Code	Distribution in the study area	Conservation Importance		
		BoCCI (breeding)	Annex I	SCI[1]
Stock dove *Columba oenas* (SD)	Observed once near Clybaun Road	Amber	-	-
Starling *Sturnus vulgaris* (SG)	Widespread throughout	Amber	-	-
Sparrowhawk *Accipiter nisus* (SH)	Observed once at Galway Racecourse	Amber	-	-
Swift *Apus apus* (SI)	Observed twice near the NUIG Sports Campus	Amber	-	-
Swallow *Hirundo rustica* (SL)	Widespread west of the River Corrib, and observed near Ballybrit	Amber	-	-
Sand martin *Riparia riparia* (SM)	Observed around Lackagh Quarry and Ballindooley Lough	Amber	-	-
Wheatear *Oenanthe oenanthe* (W.)	Rahoon area (single record)	Amber	-	-

[1] Listed as SCIs for their breeding populations

Of note, was that Ringed plover were recorded twice during the breeding bird surveys, once in late May 2015 and once in late June 2015, exhibiting breeding behaviour near the western edge of Galway Racecourse.

Barn Owl Survey

A total of 76 sites were surveyed in 2014 for the presence of Barn owl within the study area for the proposed road development. A total of 47 (63%) sites were considered to be entirely unsuitable for Barn owl (Category 0). Of the remaining 29 (27%) sites which could potentially be used by Barn owl, 11 (14%) offered potential for roosting but not for nesting (Category 1). Five (6%) were assessed as having likely roosting and/or nesting opportunities (Category 2) and the remaining 13 (15%) offered excellent roosting and nesting opportunities (Category 3). The locations of the surveyed sites, and their suitability for Barn owl, are shown on **Figures 3.3** and **3.4** of the Barn owl survey report in **Appendix A.8.15**.

The presence of Barn owl was confirmed at five of these sites which are within the scheme study area. These included two castles (nest sites at Menlo Castle and Ardfry House), a ruined mansion (roost site at Rinville House), a derelict two-story farmhouse and a quarry (both roost sites). The distribution of these sites is shown on **Figure 8.8.1**. Two sites, Ardfry Castle and Menlo Castle, were confirmed as nest sites. A ruined mansion (Rinville House) was classed as regular roosts which are likely to be associated with both nesting pairs, and an independent occasional roosting site in a derelict farm house was also recorded. Monitoring revealed that both nesting sites failed to breed in 2014.

All sites which were classed as suitable for Barn owl during the 2014 survey (Category 2 and Category 3; 20 sites in total), were re-visited between June and August in both 2015 and 2016. Two sites (a farmhouse and cottage) which were previously classified as suitable (both Category 3) in 2014 had been demolished and were no longer available to Barn owl. All remaining 18 sites were deemed still suitable for Barn owl. Evidence of Barn owl occupation was recorded at two sites in 2015, namely Menlo Castle and Rinville House, both of which had been active in 2014. There were no signs to indicate recent use of Ardfry Castle, a farmhouse at Carnmore, or at Angliham Quarry where evidence of Barn owl had been recorded in 2014. In addition, a farmhouse with adjacent outbuildings at Ballard, where a Barn owl had been reported by a member of the public in the winter of 2015, showed no evidence of recent use in July 2015. Evidence of Barn Owl occupation was confirmed at a single site in 2016 (Rinville House).

Figure 4.7 and Table 4.2 in **Appendix A.8.15**, shows the distribution and suitability of all sites surveyed in 2015. As with 2014, no breeding sites were confirmed in either 2015 or 2016.

Barn Owl activity was not recorded at Menlo Castle in 2018 and the site was deemed to be unoccupied during that nesting season. There was no evidence of Barn Owl observed during day time inspections in and around the castle and no activity recorded by nocturnal watches.

<u>Other raptors recorded during the 2014 and 2015 Barn owl surveys</u>

Other raptor species which were encountered during survey work in 2014 and 2015 were also recorded. A total of 21 raptor and owl sites (not including Barn owl) were confirmed in 2014 and 2015, which included nine Kestrel sites (four nests and five roosts), six Peregrine sites (four nests and two roosts), three Sparrowhawk sites (two nest sites and one displaying pair) and three Long-eared owl nests, see Figure 4.10 in **Appendix A.8.15**.

Peregrine falcon Survey

Peregrine falcon occupancy was recorded in three quarries in the survey area in May and June 2016, all of which held breeding pairs (see **Appendix A.8.16**). One breeding pair was successful (Roadstone Quarry at Twomileditch), with pairs in two quarries (Angliham and Lackagh Quarries) failing to raise young. All three quarry sites which held breeding pairs in 2016 were known sites where Peregrine have previously nested and are regarded as traditional nesting sites. The specific nesting location was recorded for the single successful pair (Roadstone Quarry at Twomileditch) in 2016, for the other two quarries that supported nest sites (Angliham and Lackagh) it was not possible to record a nest location in 2016, however the location of the eyries in previous years is documented. In 2017, Lackagh Quarry was monitored to determine breeding status and the nest site location, which confirmed a breeding pair and which identified the location of the traditional nest ledge. In 2018, a breeding pair of Peregrine falcon was again confirmed in Lacklagh Quarry and was successful in fledging young. The nest site was also confirmed in 2018 although it was at a different location to that recorded in previous years.

Red grouse

No sightings, or evidence, of Red grouse was recorded during the survey; or during the general breeding bird survey. During the course of other survey work in September 2014 (and over the course of the winter bird survey work from October 2014 to March 2015), evidence of Red grouse (droppings) was recorded adjacent to the scheme study area at Na Foraí Maola/Lough Inch (Arup, 2016).

8.3.9.2 Wintering birds

The winter bird surveys recorded a wide range of bird species at sites across the study area.

Table 8.23 below provides a summary of the findings of the winter bird surveys with respect to those species which are of highest conservation concern, and were recorded within winter bird survey sites:

- Special Conservation Interests (SCIs), for a wintering population, of nearby SPAs
- Species listed under Annex I of the Birds Directive (2008/144/EC)
- Red and Amber BoCCI species listed for their wintering populations

The full results of the winter bird surveys (for all surveyed sites within the wider scheme study area) are provided in **Appendix A.8.23**. Other record for wintering bird species from Galway City and environs are presented in the full results of the desktop review in **Appendix A.8.18**. Of note in that regard are the results of the bird surveys carried out in 2005/2006 as part of the N6 Galway City Outer Bypass project (RPS, 2006) which demonstrates the importance of the River Corrib corridor for bird species.

Table 8.23: Wintering Birds of Conservation Concern Recorded during the Winter Bird Survey

Common name / *Latin name*	**Conservation Importance**		
	BoCCI (wintering)	**Annex I**	**SCI**
Bar-tailed godwit *Limosa lapponica*	Amber	✓	Inner Galway Bay SPA
Black-headed gull *Larus ridibundus*	-	-	Lough Corrib SPA Inner Galway Bay SPA
Bittern *Botaurus stellaris*	-	✓	-
Common gull *Larus canus*	-	-	Lough Corrib SPA Inner Galway Bay SPA
Cormorant *Phalacrocorax carbo*	Amber	-	Inner Galway Bay SPA

Common name / *Latin name*	**Conservation Importance**		
	BoCCI (wintering)	**Annex I**	**SCI**
Coot *Fulica atra*	Amber	-	Lough Corrib SPA
Curlew *Numenius arquata*	Red	-	Inner Galway Bay SPA
Golden plover *Pluvialis apricaria*	Red	✓	Lough Corrib SPA Inner Galway Bay SPA
Great crested grebe *Podiceps cristatus*	Amber	-	-
Great northern diver *Gavia immer*	Amber	-	Inner Galway Bay SPA
Grey heron *Ardea cinerea*	-	-	Inner Galway Bay SPA
Hen harrier *Circus cyaneus*	Amber	✓	Lough Corrib SPA
Lapwing *Vanellus vanellus*	Red	-	Inner Galway Bay SPA
Light-bellied brent goose *Branta bernicla hrota*	Amber	-	Inner Galway Bay SPA
Little grebe *Tachybaptus ruficollis*	Amber	-	-
Merlin *Falco columbarius*	-	✓	-
Mute swan *Cygnus olor*	Amber	-	-
Oystercatcher *Haematopus ostralegus*	Amber	-	-
Peregrine falcon *Falco peregrinus*	-	✓	-
Redshank *Tringa totanus*	Red	-	Inner Galway Bay SPA
Shoveler *Anas clypeata*	Red	-	Lough Corrib SPA Inner Galway Bay SPA
Snipe *Gallinago gallinago*	Amber	-	-
Teal *Anas crecca*	Amber	-	Inner Galway Bay SPA
Tufted duck *Aythya fuligula*	Red	-	Lough Corrib SPA
Turnstone *Arenaria interpres*	Green	-	Inner Galway Bay SPA
Wigeon *Anas penelope*	Red	-	Inner Galway Bay SPA

Seven bird species which are listed as SCIs for Lough Corrib SPA were recorded during the survey: Black-headed gull, Common gull, Coot, Golden plover, Hen harrier, Shoveler and Tufted duck. Given the potential link for these birds to the SPA populations, they are valued as being of International Importance.

Fifteen bird species which are listed as SCIs for Inner Galway Bay SPA were recorded during the survey: Bar-tailed godwit, Light-bellied brent goose, Black-headed gull, Cormorant, Common gull, Curlew, Golden plover, Grey heron, Lapwing, Great-northern diver, Redshank, Shoveler, Teal, Turnstone and Wigeon. Given the potential link for these birds to the SPA populations, they are valued as being of International Importance.

Six species listed on Annex I of the Birds Directive (2008/144/EC) were also recorded during these surveys (some of which are also SCIs of the SPAs discussed and valued above): Bar-tailed godwit, Bittern, Golden plover, Hen harrier, Merlin and Peregrine falcon. The non-SCI Annex I bird species are valued as follows: Bittern, as a scarce visiting species not listed as being of conservation concern nationally, is valued as being of County Importance; Merlin, as a species of medium conservation concern which is likely to have a limited population at a county level, is valued as being of County Importance; Peregrine falcon, as a species of low conservation concern but which is likely to have a limited population at a county level, is valued as being of County Importance.

Of the bird species recorded during the winter bird surveys, seven are on the BoCCI Red List for their wintering populations: Curlew, Golden plover, Lapwing, Redshank, Shoveler, Tufted duck and Wigeon. All are SCI species for the nearby SPAs and are valued accordingly.

Of the bird species recorded during the winter bird surveys, 12 are on the BoCCI Amber List for their wintering populations: Bar-tailed godwit, Cormorant, Coot, Great crested grebe, Great northern diver, Hen harrier, Light-bellied brent goose, Little grebe, Mute swan, Oystercatcher, Snipe and Teal. Those species listed as SCIs for the nearby SPAs are valued as above. Great crested grebe and Little grebe are likely to have a limited population at a county level and are valued as being of County Importance. Mute swan, Oystercatcher and Snipe are relatively common wintering species at a county level but are likely to have a more limited population at a local level and are valued as being of Local Importance (higher value).

Species Accounts

Brief species accounts from the winter bird surveys are provided for these species below; the winter bird survey site reference numbers are given below in parenthesis. For the locations of the winter bird survey sites, refer to **Figure 8.9.1**.

<u>Bar-tailed godwit</u>

Nine Bar-tailed godwit were recorded at one winter bird survey site, Ballindooley Lough (WB02), on a single occasion in February 2015.

<u>Black-headed gull</u>

Black-headed gull were the most frequently recorded species and were distributed widely across the area, but mainly east of the River Corrib (recorded from 10 out of 17 winter bird sites within the ZoI of the proposed road development), and in numbers ranging from single individuals to a flock of 119 birds. Those sites within the ZoI which recorded larger flocks of over 40 individuals were the River Corrib corridor (WB12) and the NUIG Sporting Campus (WB45).

Bittern

A single Bittern was recorded at the Coolagh Lakes (WB04) in February 2015.

Common gull

Common gull were recorded widely across the study area (recorded from eight out of 17 winter bird sites within the ZoI of the proposed road development) and in numbers ranging in size from single individuals to a flock of 78 birds. The species was most frequently recorded on the River Corrib (WB12) and at the NUIG Sporting Campus (WB45) – on six and three occasions respectively. Common gull were recorded more infrequently at the other surveyed sites, and in low numbers; they were only recorded on one of the seven survey visits at five of the eight sites within the ZoI. The largest flocks were recorded 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.

Cormorant

Cormorant were recorded at five winter bird survey sites within the ZoI of the proposed road development: Ballindooley Lough (WB02), Coolagh Lakes (WB04), An Chloch Scoilte (WB07), west of Lough Inch (WB08) and the River Corrib (WB12). However, in all instances the numbers recorded were low; generally, one or two individuals with the exception of a record for four in February 2015 along the River Corrib (WB12).

Coot

Coot were recorded at three of the winter bird survey sites within the ZoI of the proposed road development: Ballindooley Lough (WB02), the Coolagh Lakes (WB04), and along the River Corrib corridor (WB12). Although Coot were regularly recorded at all of these sites, the numbers were relatively low with a maximum of 11 recorded at Ballindooley Lough in February/March 2015.

Curlew

Curlew were distributed widely across the scheme study area, and were recorded at eight of the 17 winter bird survey sites within the ZoI of the proposed road development. At the majority of survey sites and dates on which they were recorded, fewer than 10 birds were present. The largest flocks were recorded along the River Corrib corridor (WB12) south of Glenlo Abbey Hotel where a flock of 16 was recorded in October 2014 and at Galway Racecourse (WB23)—in the playing pitch to the west of the racecourse (grid reference (ITM) 533091 727407) — where a flock of 37 were recorded January 2015. The species was only regularly recorded at Ballindooley Lough (WB02), where it was present on six of the seven survey visits, with eight or fewer birds present on each occasion.

Golden plover

Golden plover were recorded at one winter bird survey site within the ZoI of the proposed road development, WB08 to the west of Lough Inch, during four out of the seven survey visits. The species were recorded in relatively small numbers (maximum of nine birds) on all but one occasion, when a flock of 73 were recorded in November 2014.

Great crested grebe

Great crested grebe (two birds) were recorded once on the River Corrib corridor (WB12) near Glenlo Abbey Hotel in October 2014.

Great northern diver

A single Great northern diver was recorded in Galway Bay at Ballyloughaun (WB30).

Grey heron

Grey heron were recorded at six of the 17 winter bird survey sites within the ZoI of the proposed road development: Ballindooley Lough (WB02), Cappagh (WB03), Coolagh Lakes (WB04), An Chloch Scoilte (WB07), west of Lough Inch WB08, and the River Corrib corridor WB12. The species was recorded in relatively small numbers, a maximum of three birds were recorded at WB08 in March 2015, with most records being of single birds.

Hen harrier

A single Hen harrier was recorded in the area east of Lough Inch (WB06) in January 2015.

Lapwing

Lapwing were recorded at two winter bird survey sites within the ZoI of the proposed road development: Ballindooley Lough (WB02) where a flock of 16 and a single individual were recorded on January and March 2015 respectively; and, west of Lough Inch (WB08), where 17 were recorded in October 2014.

Light-bellied brent goose

Light bellied brent geese were recorded at Galway Golf Course (WB19), Nimmo’s Pier/Claddagh area (WB38) and along the coastline of Galway Bay between Roscam Point and Oranmore (WB71). The largest numbers were recorded at WB38 in January and March 2015 (127 and 83 respectively).

Little grebe

Little grebe were recorded at four winter bird survey sites: Ballindooley Lough (WB02), Coolagh Lakes (WB04), west of Lough Inch (WB08) and the River Corrib corridor (WB12). The numbers recorded were generally low (< five birds). The species were recorded on all seven survey visits at Coolagh Lakes (WB04) and the River Corrib corridor (WB12). The species was recorded on five out of seven of the survey visits (November 2014 through to March 2015) at Ballindooley Lough

(WB02) and only on one occasion in December 2014 at the survey site to the west of Lough Inch (WB08).

Merlin

A single Merlin was recorded in the area west of Lough Inch (WB08) in December 2014.

Mute swan

Mute swans were recorded at five winter bird survey sites: Ballindooley Lough (WB02), Coolagh Lakes (WB04), west of Lough Inch (WB08), the River Corrib corridor (WB12) and the Terryland River Valley (WB14). The numbers recorded were generally low (< eight birds). The species were recorded on all seven survey visits on the River Corrib corridor (WB12), with 14 birds recorded near Glenlo Abbey Hotel in February 2015. The species was recorded on six out of seven of the survey visits to the survey site west of Lough Inch (WB08) (September 2014 and November 2014 through to March 2015) and at the Coolagh Lakes (WB04) (October 2014 through to March 2015). The species was recorded on five out of seven survey visits to Ballindooley Lough (WB02) (October 2014 through to January 2015 and March 2015), and on one occasion on the Terryland River (WB14) in February 2015.

Oystercatcher

Oystercatcher were distributed widely across the scheme study area and recorded from five out of 17 winter bird sites within the ZoI of the proposed road development. Numbers ranged from single individuals to a flock of 34 birds. The sites that recorded larger flocks of over 20 individuals were the NUIG Sporting Campus (WB45) where 34 birds were recorded in December 2014.

Peregrine

Peregrine were recorded at one winter bird survey site within the ZoI of the proposed road development, at the Roadstone Quarry (WN17). At the Roadstone Quarry a single bird was recorded on three occasions in December 2014, February 2015 and March 2015. Peregrine were also recorded at Angliham Quarry, c.1km north of the proposed road development.

Redshank

Redshank were recorded at two winter bird survey sites within the ZoI of the proposed road development; west of Lough Inch (WB08) and the River Corrib corridor (WB12). Only two birds were recorded at WB08 in March 2015 and only single birds were recorded at WB12, near Waterside, in November and December 2014.

Shoveler

Shoveler were recorded on, or flying into, only one of the winter bird survey sites in 2014/15: Ballindooley Lough (WB02). They were recorded on five out of the seven survey visits, in numbers ranging from 10 to 144 birds.

Snipe

Snipe were distributed widely across the study area (recorded from eight out of 17 winter bird sites within the ZoI of the proposed road development) and in numbers ranging from single individuals to a flock of 37 birds. The numbers recorded across the sites were generally low (<10). Ballindooley Lough (WB02) had the largest flock of 37 in March 2015, with a flock of 28 in December 2014 and in September and November 2014 one and two birds respectively. A flock of 15 birds was recorded in November 2014 at the Terryland River Valley (WB14), and a flock of 14 recorded at the survey site to the west of Lough Inch (WB08) in January 2015.

Teal

Teal were recorded at five winter bird survey sites within the ZoI of the proposed road development: Ballindooley Lough (WB02), Coolagh Lakes (WB04), west of Lough Inch (WB08), Ballagh (WB10) and the Terryland River Valley (WB14). The numbers recorded at WB04, WB08 and WB10 were generally low (<6 birds) and Teal were not present regularly throughout the winter period (recorded on two, four and one occasion, respectively). Teal were recorded on, or flying into, Ballindooley Lough (WB02) and the Terryland River (WB14) during all survey visits. At Ballindooley Lough numbers ranged from three in September 2014, to 146 in January 2015, and at the Terryland River numbers ranged from nine in October 2014 to 29 in January 2015.

Tufted duck

Tufted duck were recorded at only one site, Ballindooley Lough (WB02), where the species was recorded on four occasions over the winter (November 2014, January 2015, February 2015 and March 2015). The maximum number recorded was a count of 26 in January 2015.

Turnstone

Five Turnstone were recorded in Galway Bay at Ballyloughaun (WB30) in October 2014.

Wigeon

Wigeon were recorded at one winter bird sites Ballindooley Lough (WB02) on one occasion in February 2015, when 28 birds were present.

8.3.10 Amphibians

Two amphibian species were known to be present within the study area; the Common frog *Rana temporaria* and the Smooth newt *Triturus vulgaris*[47]. Both are legally protected under the Wildlife Acts (including their breeding and resting places). Common frog have been recorded throughout the study area, most often in the upland habitats west of the River Corrib and along the River Corrib corridor. Smooth newt have been recorded in the vicinity of Bearna Woods, Salthill,

[47] Records from the National Biodiversity Centre's online database. For full details of the desk review, refer to **Appendix A.8.18**.

Terryland Park and at Renmore. Local landowners have also reported the presence of Smooth newt on lands near Coolagh Lakes.

During the surveys carried out in 2014, Common frog (adults, juveniles and tadpoles) were recorded at 21 of the 52 surface water/drainage features surveyed across the study area. Smooth newts were recorded at nine of the 52 surface water/drainage features surveyed across the scheme study area; most which were located west of the River Corrib. A summary of the Smooth newt survey results are provided below in **Table 8.24**.

Two ad-hoc observations of Smooth newt and four ad-hoc observations of Common frog were recorded within the study area during the multidisciplinary surveys.

The results of the amphibian survey are shown on **Figures 8.10.1** to **8.10.8**.

Table 8.24: Summary of Smooth newt records from the amphibian surveys

Location	Feature	Note
East of the proposed road development within area of scrub and rough grassland, c.35 m east of Ch. 0+500	Well	3 females and 3 males
South-east of the proposed road development within area of scrub, c.10 m south-east of Ch. 5+175	Pond	1 female
West of the proposed road development/Ballymoneen Road at Ch. 0+100	Drainage ditch	4 unidentified
North of the proposed road development within area of scrub, between Ch. 5+700 to Ch. 5+800	Drainage ditch	1 unidentified and 2 females
South of the proposed road development within area of scrub, c.50m south of Ch. 5+800	Drainage ditch	4 gravid females and 1 male
Within the proposed road development, south-east of proposed Letteragh Road Junction at Ch. 1+600	Pond	2 gravid females
Area of scrub within the proposed road development, east of proposed N59 Letteragh Junction at Ch. 7+850	Pond	1 juvenile male
Gravel wash-out ponds in Lackagh Quarry	Pond	1 unidentified
Cattle trough at Lackagh Quarry c.40m north of the proposed road development at Ch. 11+775	Cattle trough	1 female
Within Development boundary in marsh scrub area between Ch. 13+000 and Ch. 13+050	Pond	2 males, 1 female and 1 unidentified gravid female.
Galway Racecourse, >280m from the proposed road development	Drainage Ditches	10 males, 5 females, 5 unidentified (>20 newts). Gravid females present.

The Common frog and Smooth newt populations are valued as being of Local Importance (higher value).

8.3.11 Reptiles

There were records for the Common Lizard *Zootoca (Lacerta) vivipara* from Menlough, Merlin Park Woods, and various locations around Galway City: the River Corrib corridor, Salthill and Cappagh[48]. The Common lizard is legally protected under the Wildlife Acts (including their breeding and resting places).

The Common lizard survey was conducted between the 24 September and 4 October 2015. Common lizard were recorded at five of the 10 survey sites (A, B, C, E, and F); all of which were west of the River Corrib (**Figures 8.10.1** to **8.10.8**). All of these sites were within the footprint of the proposed road development, or adjacent to the proposed development boundary in habitat mosaics of heath, scrub and wet or acid grassland. The lizard survey results are summarised below in **Table 8.25**.

Table 8.25: Summary of Common lizard survey results

Survey Site	Result
A	27 / 28 September 2015 – 1 adult 28 / 29 September 2015 – 1 adult
B	24 / 25 September 2015 – 1 juvenile 27 / 28 September 2015 – 1 juvenile
C	27 / 28 September 2015 – 1 juvenile
E	25 / 26 September 2015 – 1 adult 26 / 27 September 2015 – 1 adult 28 / 29 September 2015 – 1 adult
F	24 / 25 September 2015 – 1 juvenile 27 / 28 September 2015 – 1 juvenile

One ad-hoc observation of the species was recorded at Knocknafroska during the multidisciplinary survey in May 2015, near the N59 Link Road North.

The results of the reptile survey are shown on **Figures 8.10.1** to **8.10.8**.

The Common lizard population is valued as being of Local Importance (higher value).

8.3.12 Fish

The results of the various fisheries surveys carried out between the 22 and 30 September 2015, along with the findings of the desktop study, are summarised below. The locations of sampling points/areas are shown on **Figure 8.11.1**, with the full results (including the macro-invertebrate species lists) provided in **Appendix A.8.17**. Fish species are protected under the Fisheries Acts and by fishing by-laws.

---

[48] Records from the National Biodiversity Centre's online database. For full details of the desk review, refer to **Appendix 8.18**.

Atlantic salmon, Sea lamprey and the Brook lamprey are listed on Annex II of the EU Habitats Directive.

Sruthán na Líbeirtí

Sruthán na Líbeirtí was described during the fisheries habitat survey as a seasonal stream having moderate quality, semi-natural salmonid and European eel *Anguilla anguilla* habitat in the lower reaches; the electrofishing survey recorded small numbers of European eel in the lower reaches. Water quality in Sruthán na Líbeirtí was assessed as being moderately polluted (Q3[49]).

In terms of its fisheries value, Sruthán na Líbeirtí is valued as being of Local Importance (lower value).

Trusky Stream

The upper part of the Trusky Stream, where it is crossed by the proposed road development, was described during the fisheries habitat survey as a seasonal stream with some moderate semi-natural salmonid habitat; although the electrofishing survey did not record any fish species present. The lower reaches however, were described as having Brown trout *Salmo trutta* spawning habitat and good quality nursery habitat for European eel elver and juvenile Flounder *Platichthys flesus*. Fish species recorded during the electrofishing were Brown trout, European eel, Flounder and Three-spined stickleback *Gasterosteus aculeatus*. Water quality in the Trusky Stream was assessed as being moderately polluted (Q3).

In terms of its fisheries value, the upper reaches of the Trusky Stream is valued as being of Local Importance (lower value); the lower reaches, as Local Importance (higher value).

Bearna Stream

The Bearna Stream was considered excellent quality salmonid spawning and nursery habitat, and European eel habitat. The electrofishing survey recorded both Brown trout and European eel. Water quality in the Bearna Stream was assessed as being unpolluted (Q4).

The tributary of the Bearna Stream was described as a seasonal stream with some moderate semi-natural salmonid and eel habitat; although the electrofishing survey did not record any fish species present. Water quality in the Bearna Stream tributary was assessed as being moderately polluted (Q3).

In terms of its fisheries value, the Bearna Stream was valued as being of Local Importance (higher value). The seasonal unnamed tributary is valued as being of Local Importance (lower value).

Tonabrocky Stream

The upper reaches, in the vicinity of the proposed road development, had poor quality fisheries habitat being predominantly a dry drainage channel with localised pockets of water.

---

[49] After Toner *et al.*, 2005: Q5, Q4-5 and Q4 = Unpolluted, Class A; Q3-4 = Slightly polluted, Class B; Q3 or Q2/3 = Moderately polluted Class C; and, Q2, Q1/2 or Q1 = Seriously polluted Class D.

The lower reaches of the Tonabrocky Stream are considered excellent quality salmonid and eel habitat, including salmonid spawning habitat. The electrofishing survey recorded Brown trout. Electrofishing surveys carried out by Inland Fisheries Ireland (IFI) in 2008 recorded Atlantic salmon parr (*Salmo salar*), Brown trout, Sea trout smolts and European eel. IFI have also recorded Sea trout spawning in the lower reaches of the stream. Water quality in the Tonabrocky Stream was assessed as being unpolluted (Q4).

In terms of its fisheries value, the upper reaches of the Tonabrocky Stream is valued as being of Local Importance (lower value); the lower reaches, as Local Importance (higher value).

Knocknacarra Stream

The upper reaches of the Knocknacarra Stream were largely seasonal ditches with little or no fisheries value; large sections of the lower reaches are culverted. That tidal section of the stream, between the culvert and the estuary, are important as a transitional nursery habitat for estuarine fish and European eel, Grey mullet *Chelon labrosus*, Sand goby *Pomatoschistus minutes* and Flounder were recorded there during the electrofishing survey. Water quality in the Knocknacarra Stream was assessed as being moderately polluted (Q3).

In terms of its fisheries value, the upper reaches of the Knocknacarra Stream were valued as being of Local Importance (lower value); the lower reaches, at the estuary, as Local Importance (higher value).

River Corrib

The River Corrib is an important salmonid watercourse, supporting both Atlantic salmon and Brown trout, and is a designated salmonid watercourse under the European Communities (Quality of Salmonid Waters) Regulations, 1988. The River Corrib system is also designated under the Habitats Directive as a candidate Special Area of Conservation for Atlantic salmon, Sea lamprey *Petromyzon marinus* and Brook lamprey *Lampetra planeri*—Lough Corrib cSAC. The River Corrib is also an important catchment for the European eel *Anguilla anguilla*. Water quality in the lower reaches of the River Corrib is classified as unpolluted (Q4) by the EPA (sampled at the Salmon Weir - http://gis.epa.ie/Envision).

In terms of its fisheries value, the River Corrib was valued as being of International Importance.

Terryland River

The channel of the Terryland River is highly modified in parts, and showing signs of organic pollution, which limits its fisheries value. European eel were the only fish species recorded during the electrofishing surveys. Water quality in the Terryland River was assessed as being moderately polluted (Q2-3).

In terms of its fisheries value, the Terryland River was valued as being of Local Importance (lower value).

Coolagh Lakes

The Coolagh lakes were of some importance for coarse fish species. Fyke netting recorded Perch *Perca fluviatilis*, Roach *Rutilus rutilus* and European eel. The spring feed stream supplying the lakes was electrofished but no fish species were recorded. The Coolagh Lakes does not have a Water Framework Directive water quality status assigned to it.

In terms of their fisheries value, the Coolagh Lakes were valued as being of Local Importance (lower value).

Ballindooley Lough

Ballindooley Lough was considered to be an excellent coarse fishery with the fyke netting survey recording Pike *Esox lucius*, Perch, Rudd *Scardinius erythropthalmus* and Tench *Tinca tinca*. Ballindooley Lough does not have a Water Framework Directive water quality status assigned to it.

In terms of its fisheries value, Ballindooley Lough was valued as being of Local Importance (higher value).

Corrib Estuary and Galway Bay

The Corrib Estuary and Galway Bay are important transitional and marine fisheries habitat, supporting a range of fish species (The Central and Regional Fisheries Boards, 2009). The Corrib Estuary and Galway Bay are also designated under the Habitats Directive as a candidate Special Area of Conservation for Atlantic salmon — Galway Bay Complex cSAC. The transitional waters of the Corrib Estuary and the coastal waters of Galway Bay are classified by the EPA as unpolluted (http://gis.epa.ie/Envision).

In terms of its fisheries value, Galway Bay was valued as being of International Importance.

8.3.13 Local Biodiversity Areas

The local biodiversity areas include within the *Galway City Development Plan 2017–2023* and the most recent draft of the *Galway City Biodiversity Action Plan 2014-2024*, are derived from habitat mapping carried out in 2004. The results of the biodiversity surveys carried out since 2013, in the preparation of this assessment, have highlighted many other areas that would be considered to be locally important biodiversity areas. In many cases, these would encompass greater areas than that considered in the draft *Galway City Biodiversity Action Plan 2014-2024* given that the current survey areas extend beyond the city boundary. The locations of the biodiversity surveys and receptors across the local area are shown on **Figures 8.1 – 8.22** and described under the various sections above.

For the purposes of this assessment, the following biodiversity areas are considered; which include the local biodiversity areas from the draft *Galway City Biodiversity Action Plan 2014-2024*:

- The Coast Road (R336) to the N59 Moycullen Road (which includes the Cappagh – Ballymoneen and the Ballagh – Barnacranny Hill local biodiversity areas from the draft *Galway City Biodiversity Action Plan 2014-2024*)

  This local biodiversity area encompasses a mosaic of peatland habitats extending from near the coastline west of Bearna across to the N69 Moycullen Road – the peatland areas form part of a larger expanse of peatland habitat that extend off to the north-west, into the Connemara Bogs cSAC. In terms of habitats, it includes the Annex I habitats Wet heath, Dry heath, *Molinia* meadows and Blanket bog, amongst large areas of scrub, bracken, acid and wet grasslands, along with fens and upland/eroding streams. These habitats in turn support a diverse range of fauna species including: bats, Otter, Badger, the Marsh fritillary butterfly, breeding birds, wintering birds (including species listed as SCIs of the local SPA sites), amphibians, reptiles and fish species. Parts of this site lie within Moycullen Bogs NHA

- Rusheen Bay – Bearna Woods – Illaunafamona

  This local biodiversity area is described in the draft *Galway City Biodiversity Action Plan 2014*-2024 as follows "It incorporates several types of shoreline including glacial cliffs, gravel banks, rocky shore, sandy shore, muddy sand and saltmarsh. It also has several types of woodland in Barna Woods together with various semi-natural grassland types between Silver Strand and Gentian Hill. The coast is very indented with a number of sheltered feeding and roosting areas for significant numbers of wintering birds. The dynamic complex of shingle bars and saltmarsh at Illaunafamona is included in this area." This area lies within Galway Bay Complex cSAC and Inner Galway Bay SPA

- The River Corrib and the Coolagh lakes (which includes the River Corrib and adjoining wetlands local biodiversity areas from the draft *Galway City Biodiversity Action Plan 2014-2024*)

  This local biodiversity area supports a range of aquatic and wetland habitats ranging from rivers and lakes to reed swamp, wet woodland, marsh, wet grassland, fens and heath. These include a diverse range of Annex I habitats including Hard water lakes, Wet heath, *Molinia* meadow, *Cladium* fen, Hydrophilous tall herb habitat, Alkaline fen, Transition mire and Residual alluvial forests. Drier areas within this habitat complex support the Limestone pavement and Calcareous grassland Annex I habitat types. These habitats in turn support a diverse range of fauna species including: bats, Otter, Badger, breeding birds, wintering birds (including species listed as SCIs of the local SPA sites), molluscs, amphibians and fish species. This area includes part of Lough Corrib cSAC and part of Lough Corrib pNHA

- Menlough to Coolough Hill (including Lackagh Quarry)

  This local biodiversity area comprises a mosaic of semi-natural woodland, broadleaved woodland, exposed limestone rock, scrub and semi-natural grasslands, and a quarry site. This includes a range of Annex I habitat types, including: Limestone pavement, Calcareous grassland, Turloughs and Petrifying springs. These habitats in turn support a diverse range of fauna species including: bats (including a Lesser horseshoe bat maternity and hibernation roost), Otter, Badger and breeding birds (including a Barn owl nest site). This area includes part of Lough Corrib cSAC and part of Lough Corrib pNHA

- Ballindooley – Castlegar (which is linked to the River Corrib by the Terryland River valley)

  This local biodiversity area comprises a mosaic of wetland habitats associated with Ballindooley Lough (including reed swamp, wet grassland, fen and wet woodland) and areas of semi-natural woodland and exposed limestone rock. This includes a diverse range of Annex I habitat types including Hard water lakes, Alkaline fen, *Cladium* fen, Residual alluvial forests and Limestone pavement. These habitats in turn support a diverse range of fauna species including: bats, Badger, breeding birds, wintering birds (including species listed as SCIs of the local SPA sites), amphibians and fish species

- Galway Racecourse, Ballybrit

  Although primarily consisting of amenity grassland around the margins, the centre of the racecourse supports semi-natural grasslands, and the Marsh fritillary butterfly was recorded here in 2014

- Doughiska

  This biodiversity area comprises a mosaic of semi-natural grassland and exposed limestone rock, with some semi-natural woodland cover and scrub patches, amongst improved agricultural fields. In places the grassland habitats correspond with the Annex I Calcareous grassland habitat type, and the exposed or wooded limestone rock with Annex I Limestone pavement.

- Galway Bay (which includes the Mutton Island and Nearby Shoreline local biodiversity areas from the draft *Galway City Biodiversity Action Plan 2014-2024*).

  Galway Bay Complex cSAC and Inner Galway bay SPA lie within this biodiversity area. This biodiversity area includes a diverse range of shoreline, transitional, estuarine and marine habitats which in turn support a rich species assemblage. The Annex I habitats present include Large shallow inlets and bays, associated with which are Reefs, Tidal mudflats, Lagoons, Salicornia mud, Perennial vegetation of stony banks and Atlantic salt meadows. These habitats support the SCI bird species of Inner Galway bay SPA, providing nesting, foraging and roosting sites which include open water, intertidal and terrestrial habitats. The habitats within Galway Bay also support a diverse range of invertebrate and plant communities (marine and intertidal) and fish species, along with Otter, Harbour seal and cetaceans

8.3.14 Summary Ecological Valuation and Identification of Key Ecological Receptors

Table 8.26 below summarises the ecological evaluation of all receptors taking into consideration legal protection, conservation status and local abundance. Key Ecological Receptors (KERs) are identified in blue in the table. Species, habitats and features not qualifying as KERs are not subjected to impact assessment in line with current best practice of assessing the impacts on what are determined to be important ecological or biodiversity features: CIEEM and TII guidelines (CIEEM, 2016 and National Roads Authority, 2009).

All designated areas for nature conservation that lie within the ZoI of the proposed road development are considered to be KERs given that they are sites selected specifically for biodiversity conservation. Those designated areas for nature conservation that lie beyond the ZoI of the proposed road development are not considered to be at risk of impact and are therefore, not considered to be KERs.

In almost all cases, habitat and species valued as being of local importance (higher value), or higher, are considered to be KERs as they are important contributors to the local biodiversity resource and are of conservation concern, at least locally. However, some of the higher biodiversity value habitats and species included in **Table 8.26** below are not considered as KERs because, although they are present within the wider scheme study area, they lie beyond the ZoI of the proposed road development (as noted in the table below) and are therefore not at risk of being affected during construction or operational phases of the proposed road development.

Habitats valued as being of a local importance (lower value) are not considered to be KERs in this assessment. This is not to say that they are of no biodiversity value, but that impacts on these habitat types in their local context are not likely to result in a significant effect on biodiversity. It should be noted that this relates to the impact on the habitat itself as distinct from considering the role these habitat types play in supporting KER species – impacts of the proposed road development in that sense are captured and assessed under the relevant species' headings in **Section 8.5**.

These lower biodiversity value habitats include built or artificially created habitats, transient habitats as a result of disturbance, or those that have been highly anthropogenically modified (e.g. BC3, BL3, ED2, ED3, ED4, FL8, GA1, GA2, WS3, WS5). These habitat types tend to be associated with residential, commercial or industrial development, roads and highly managed amenity areas. It also includes grassland habitats that are relatively species poor and bracken, which is considered to be a problem species in terms of biodiversity for many habitat types.

In some cases, local importance (lower value) habitat can be associated with, or develop into, higher value habitats and where this is the case it is captured in valuing and considering whether a particular habitat type is a KER for this assessment. One example of this is the habitat Exposed calcareous rock (ER2). As a quarry wall feature it is considered a local importance (lower value) habitat type. In many cases it can be associated with the Annex I habitat Limestone pavement and is valued accordingly. Limestone quarry walls can also support calcareous springs (or the priority Annex I habitat Petrifying springs) and where this is the case the spring features are considered and valued separately in **Table 8.26** below.

Non-native invasive plant species are not considered as KERs, as they can result in negative effects on biodiversity and it is in that context they are included within the impact assessment.

The local biodiversity areas are, by definition, important locally. However, they support a range of habitats and species that are valued individually below; with the valuations ranging from local importance (e.g. spoil and bare ground) through to internationally important (e.g. priority Annex I habitats). Therefore, they are considered to be KERs but are not given an ecological valuation separate from the biodiversity receptors presented below and assessed in this chapter.

Table 8.26: Ecological Evaluation and Identification of KERs[50]

Ecological Receptor	Ecological Valuation	KER
Designated Areas for Nature Conservation		
Lough Corrib cSAC	International	Yes
Galway Bay Complex cSAC	International	Yes
Lough Corrib SPA	International	Yes
Inner Galway Bay SPA	International	Yes
Moycullen Bogs NHA	National	Yes
Lough Corrib pNHA	International[#]	Yes
Galway Bay Complex pNHA	International[†]	Yes
Other designated areas for nature conservation	International - National	No, as beyond the ZoI of the proposed road development (see NIS for more detailed discussion in relation to European sites – cSACs and SPAs)
Habitats (outside of designated areas for nature conservation)		
Flower beds and borders (BC4)	Local Importance (Lower Value)	No
Buildings and artificial surfaces (BL3)	Local Importance (Lower Value)	No
Spoil and bare ground (ED2)	Local Importance (Lower Value)	No
Recolonising bare ground (ED3)	Local Importance (Lower Value)	No
Active quarries and mines (ED4)	Local Importance (Lower Value)	No
Exposed siliceous rock (ER1)	Local Importance (Lower Value)	No
Exposed calcareous rock (ER2)		
Limestone pavement [*8240]	International Importance	Yes
Quarry walls	Local Importance (Lower Value)	No

[50] KERs are highlighted blue

Ecological Receptor	Ecological Valuation	KER
Limestone/marl lakes (FL3)		
Hard water lakes [3140]	National Importance	Yes
Mesotrophic lakes (FL4)		
Part of Ballindooley complex	County Importance[51]	Yes
Eutrophic lakes (FL5)		
Part of Ballindooley complex	County Importance[52]	Yes
Turloughs (FL6)		
Turloughs [*3180]	International Importance	Yes
Other artificial lakes and ponds (FL8)	Local Importance (Lower Value)	No
Calcareous springs (FP1) Priority		
Petrifying springs [*7220]	International Importance	Yes
Non-Annex I habitat type	Local Importance (Higher Value)	Yes
Reed and large sedge swamps (FS1)		
Cladium fen [*7210]	International Importance	Yes
Hydrophilous tall herb [6430]	National Importance	Yes
Non-Annex I habitat type	Local Importance (Higher Value)	Yes
Tall-herb swamps (FS2)		
Cladium fen [*7210]/Hydrophilous tall herb [6430]	International/National Importance	Yes
Non-Annex I habitat type	Local Importance (Higher Value)	Yes
Eroding/upland rivers (FW1)	Local Importance (Higher Value)	Yes
Depositing/lowland rivers (FW2)		
River Corrib	International Importance	Yes
Terryland River	Local Importance (Higher Value)	Yes
Drainage ditches (FW4)	Local Importance (Higher Value)	Yes
Improved agricultural grassland (GA1)	Local Importance (Lower Value)	No
Amenity grassland (improved) (GA2)	Local Importance (Lower Value)	No
Marsh (GM1)	Local Importance (Higher Value)	Yes
Dry calcareous and neutral grassland (GS1)		
Calcareous grassland [*6210/6210]	International/National Importance	Yes
Non-Annex I habitat type	Local Importance (Higher Value)	Yes
Non-Annex I habitat type	Local Importance (Lower Value)	No
Dry meadows and grassy verges (GS2)		
Lowland hay meadows [6510]	National Importance	No, as not within ZoI of the proposed road development
Non-Annex I habitat type	Local Importance (Higher Value)	Yes
Non-Annex I habitat type	Local Importance (Lower Value)	No

[51] On the basis that it forms part of the wetland complex at Ballindooley Lough
[52] On the basis that it forms part of the wetland complex at Ballindooley Lough

Ecological Receptor	Ecological Valuation	KER
Dry-humid acid grassland (GS3)		
Species rich *Nardus* upland grassland [*6230]	National Importance	No, as not within ZoI of the proposed road development
Non-Annex I habitat type	Local Importance (Higher Value)	Yes
Non-Annex I habitat type	Local Importance (Lower Value)	No
Wet grassland (GS4)		
Molinia meadow [6410]	National Importance	Yes
Non-Annex I habitat type	Local Importance (Higher Value)	Yes
Non-Annex I habitat type	Local Importance (Lower Value)	No
Dense bracken (HD1)	Local Importance (Lower Value)	No
Dry siliceous heath (HH1)		
Dry heath [4030]	National Importance	Yes
Dry calcareous heath (HH2)		
Dry heath [4030]	National Importance	No, as not within ZoI of the proposed road development
Wet heath (HH3)		
Wet heath [4010]	National Importance	Yes
Rich fen and flush (PF1)		
Alkaline fens [7230]/*Cladium* fen [*7210]	International Importance	Yes
Non-Annex I habitat type	County Importance	Yes
Non-Annex I habitat type	Local Importance (Higher Value)	Yes
Poor fen and flush (PF2)		
Non-Annex I habitat type	County Importance	No, as not within ZoI of the proposed road development
Non-Annex I habitat type	Local Importance (Higher Value)	Yes
Residential	Local Importance (Lower Value)	No
(Mixed) broadleaved woodland (WD1)	Local Importance (Higher Value)	Yes
Mixed broadleaved/conifer woodland (WD2)	Local Importance (Higher Value)	Yes
(Mixed) conifer woodland (WD3)	Local Importance (Higher Value)	Yes
Scattered trees and parkland (WD5)	Local Importance (Lower Value)	No, as not within ZoI of the proposed road development
Hedgerows (WL1)	Local Importance (Higher Value)	Yes
Treelines (WL2)	Local Importance (Higher Value)	Yes
Oak-ash-hazel woodland (WN2)		
Limestone pavement [*8240]	International Importance	Yes
Non-Annex I habitat type	Local Importance (Higher Value)	Yes
Wet willow-alder-ash woodland (WN6)	International Importance	Yes

Ecological Receptor	Ecological Valuation	KER
Residual alluvial forest [*91E0]		
Non-Annex I habitat type	Local Importance (Higher Value)	Yes
Scrub (WS1)		Yes
Limestone pavement [*8240]	International Importance	
Non-Annex I habitat type	Local Importance (Higher Value)	Yes
Immature woodland (WS2)	Local Importance (Higher Value)	No, as not within ZoI of the proposed road development
Ornamental/non-native shrub (WS3)	Local Importance (Lower Value)	No
Recently-felled woodland (WS5)	Local Importance (Lower Value)	No
Flora Species		
FPO listed species	n/a	No, as not within ZoI of the proposed road development
Non-native invasive plant species	n/a	No
Fauna Species		
Otter	International Importance	Yes
Bats		
Lesser horseshoe bat	National Importance	Yes
All other bat species	Local Importance (Higher Value)	Yes
Badger	Local Importance (Higher Value)	Yes
Other mammal species protected under the Wildlife Acts	Local Importance (Higher Value)	Yes
White-clawed crayfish	n/a	No, as not within ZoI of the proposed road development
Freshwater pearl mussel	International Importance[53]	Yes
Vertigo antivertigo	Local Importance (Higher Value)	Yes
Marsh fritillary butterfly	County Importance	Yes
SCI bird species	International	Yes
Barn owl	County Importance	Yes
Peregrine falcon	County Importance	Yes
All other Red listed bird species (non-SCI breeding populations)	Local Importance (Higher Value)	Yes
All other Amber listed bird species (non-SCI breeding populations)	Local Importance (Higher Value)	Yes
Any other Green listed bird species (non-SCI breeding populations)	Local Importance (Higher Value)	Yes

[53] Assessed in the NIS in the context of the qualifying interest population of Lough Corrib cSAC in the Owenriff River

Ecological Receptor	Ecological Valuation	KER
All other wintering bird species (non-SCI)	Local Importance (Higher Value)	Yes
Smooth newt	Local Importance (Higher Value)	Yes
Common frog	Local Importance (Higher Value)	Yes
Common lizard	Local Importance (Higher Value)	Yes
Atlantic salmon	International Importance	Yes
European eel	International	Yes
All other fish species recorded	Local Importance (Higher Value)	Yes
Local Biodiversity Areas		
Local biodiversity areas	The value of the biodiversity receptors recorded across the local biodiversity areas, in the vicinity of the proposed road development, range from Local Importance (Lower Value) to Internationally Important	Yes
The Coast Road (R336) to the N59 Moycullen Road	Local Importance (Lower Value) to Internationally Important includes Moycullen Bogs NHA	Yes
Rusheen Bay – Barna Woods – Illaunafamona	Local Importance (Lower Value) to Internationally Important includes Galway Bay Complex cSAC and Inner Galway Bay SPA	Yes
The River Corrib and the Coolagh Lakes	Local Importance (Lower Value) to Internationally Important includes Lough Corrib cSAC/SPA/pNHA	Yes
Menlough to Coolough Hill (including Lackagh Quarry)	Local Importance (Lower Value) to Internationally Important includes Lough Corrib cSAC	Yes
Ballindooley – Castlegar	Local Importance (Lower Value) to Internationally Important	Yes
Galway Racecourse, Ballybrit	Local Importance (Lower Value) to Internationally Important	Yes
Doughiska	Local Importance (Lower Value) to Internationally Important	Yes
Galway Bay	Local Importance (Lower Value) to Internationally Important includes Galway Bay Complex cSAC and Inner Galway Bay SPA	Yes

[#] Generally encompassed within Lough Corrib cSAC
[†] Generally encompassed within Galway Bay Complex cSAC

8.4 Characteristics of the Proposed Road Development

A detailed description of the proposed road development and construction activities are provided in **Chapter 5, Description of Proposed Road Development** and **Chapter 7, Construction Activities**.

The main characteristics of the proposed road development of relevance to the ecological assessment are outlined under construction and operation phases in the following.

8.4.1 Construction Phase

The main characteristics of the construction stage of the proposed road development that have potential for ecological impact are:

- Site preparation and clearance, including ground investigations, archaeological test trenching and fencing
- Removal of properties, boundaries, amenities
- Earthwork activity, including removal of topsoil, general earthworks and operation of construction traffic
- Construction of significant earthworks, including cuttings and rock cuttings (< 3m deep) and embankments (< 3m high)
- Construction of the new road, link roads and associated local road re-alignments, including provision of noise barriers, lighting, gantries signage, *etc*.
- Construction of new structures, including under and overbridges, culverts, a c.650m long bridge crossing of the River Corrib and its valley, a c.310m length of viaduct, and 2 separate sections of tunnel – one of c.270m length at Lackagh Quarry, and a second of c.240m length at Galway Racecourse.

8.4.2 Operational Phase

The main characteristics of the operation stage of the proposed road development that have potential for ecological impact are:

- The presence and operation (traffic) of the road
- The presence of additional roadside lighting

8.5 Evaluation of Impacts

8.5.1 Introduction

The following section presents the assessment of impacts on biodiversity within the Zone of Influence (ZoI) of the proposed road development. As outlined in **Section 8.2.5**, this is focussed on the Key Ecological Receptors (KERs) identified in **Section 8.3.14**. This includes consideration of the Do-Nothing impact – i.e. the existing trends with the potential to affect biodiversity in the absence of the proposed road development.

8.5.2 Do Nothing Impact

Existing trends

Across the study area, as evidenced from a review of historical orthophotos and the *Galway City Habitats Inventory* dataset (Natura, 2005), there have been changes to the biodiversity baseline in recent decades: the most significant change likely to have been habitat loss to development and habitat degradation impacts, primarily as a result of either agricultural intensification/reclamation or scrub encroachment through agricultural abandonment. The existing road network has limited drainage control or pollution control measures and, with increasing traffic numbers, may have had some effects on biodiversity in the receiving environment.

There have been habitat losses to development in the area between the Cappagh and Ballymoneen Roads, and along the network of local roads which extend north from the R336 coast road, e.g. Na Foraí Maola Road, Troscaigh Road, Bearna to Moycullen Road LL1321 and the Aille Road L5384. In some cases areas of peatland habitats have likely been affected. Where agricultural management has been reduced, or has been abandoned altogether, fields are becoming overgrown by gorse, bramble scrub and/or dense bracken cover. In places this is encroaching upon peatland habitat. This is most evident in the western part of the study area in those isolated peatland habitat blocks set between the network of local roads and the associated ribbon-type residential development. Sections of watercourses have been culverted as a consequence of development; the most extensive of which are associated with the Knocknacarra Stream. Coolough, Ardaun and Doughiska have seen losses of Limestone pavement [*8240] and most likely also areas of semi-natural grassland habitat [e.g. 6210] since 1994 as a result of road development, residential and industrial development, and agricultural land use change/improvement. Quarrying activities in the local area have resulted in the loss of limestone pavement and potentially also areas of calcareous grassland habitats since the year 2000. Scrub encroachment has also reduced the extent of exposed limestone pavement habitat area at Menlough, in the area between Bóthar Nua and Seanbóthar.

There is little historical baseline data to establish trends for fauna species locally although the habitat changes that have occurred may have had some effects, both positive and negative, on fauna biodiversity and distributions locally.

Likely Future Trends

As the full extent of the proposed road development passes through lands zoned under either the Galway City Council Development Plan 2017-2023, the Galway County Council Development Plan 2015-2021, the Bearna Local Area Plan 2007-2017, or the Ardaun Local Area Plan 2018-2024, the current land use zonings provide the best indication of what the future short to medium-term biodiversity trends might be, as they will influence and direct development in the surrounding area. It is also likely that traffic numbers will continue to increase on a road network with limited drainage control or pollution control measures, which may have effects on biodiversity receptors in the receiving environment.

The area around Sruthán na Líbeirtí is zoned for environmental management, as is the Trusky Stream corridor and the coastline – this zoning aims to protect areas of high biodiversity and promote sustainable development. An area east of Sruthán na Líbeirtí, and to the west of Bearna Woods, is zoned green wedge with the area in between zoned as rural fringe, these zonings limit the types of future development on those lands.

The area between Bearna Woods and the River Corrib is a mix of residential, amenity, agri-amenity and agriculture zonings. The lands between the proposed road development and the Cappagh Road are predominantly zoned residential, with some amenity and industrially zoned areas. Similarly, lands around NUIG and the N59 Moycullen Road are a mix of residential and amenity zonings. Sitting between both these areas is a large expanse of lands zoned for agriculture – which includes part of the Moycullen Bogs NHA at Tonabrocky. A second area at na hAille comprises both agricultural and agri-amenity land use zoning.

Between Menlough and the N83 Tuam Road, lands to the north of the proposed road development are largely zoned agricultural (in line with their current use) with a band of agri-amenity zoned lands extending from Menlough Village to Galway City along the east bank of the River Corrib. There is a small pocket of light-industrial and residential zoned lands along the N84 Headford Road, residential along the N83 Tuam Road and areas of light residential zoning at Menlough and adjacent to the southern end of Lackagh Quarry.

Aside from Galway Racecourse (which is zoned as an amenity area), lands between the N83 Tuam Road and the R339 are zoned for industrial, residential or commercial uses.

The majority of lands adjoining the proposed road development at Doughiska (east of the existing N6 and between the R446 and the R449) fall within what is the Ardaun Local Area Plan boundary. The *Ardaun Local Area Plan 2018-2026* includes large areas zoned for development. West of the existing N6 in this area is largely zoned for residential development.

Current biodiversity trends are likely to continue in areas zoned for environmental management, green wedge, rural fringe or agriculture with some limited development and land use change likely. Amenity or agri-amenity zoned areas are likely to come under some level of increased pressure from developing and constructing additional recreational infrastructure and through increased human presence and disturbance. Areas zoned for residential, commercial or industrial purposes are likely to have the greatest effects on local biodiversity through habitat loss and/or modifications (potentially affecting Annex I and other semi-natural habitats) and any associated effects on fauna species.

However, any effects on biodiversity are likely to be moderated by the environmental protective policies in both the *Galway City Council Development Plan 2017-2023*, *Galway County Development Plan 2015-2021*, the *Bearna Local Area Plan 2007-2017*, and the *Ardaun Local Area Plan 2018-2024*.

The interaction between the existing trends, future trends, and other plans or projects with the proposed road development are considered and assessed further in the cumulative impacts section (Section 8.9).

8.5.3 Designated Areas for Nature Conservation

This section describes and assesses the potential for the proposed road development to result in likely significant effects on designated areas for nature conservation at cSACs/SACs, SPAs, NHAs or pNHAs. In the context of European sites this is focussed on the habitats and species for which the sites are selected (QIs for cSACs and SCIs for SPAs) and the conservation objectives supporting their conservation status in each site. This assessment is directly related to the assessment methodology for European sites required under the Habitats Directive, which is presented in the Natura Impact Statement (NIS) for the proposed road development.

In the case of NHAs and pNHAs the assessment considers whether the integrity[54] of any such site would be affected by the proposed road development with reference to the ecological features for which the site is designated, or is proposed.

8.5.3.1 European Sites

In the context of assessing whether the proposed road development is likely to result in an impact on the integrity of any European sites, the tests and assessment presented in the NIS fulfil this role. The NIS considers whether the proposed road development will affect the conservation objectives supporting the favourable conservation condition of the European site's QIs/SCIs and as a result presents an assessment of whether the integrity of any European sites would be affected – i.e. if the proposed road development would adversely affect on the integrity of a European site, this would constitute a likely significant effect in the context of the EIA Directive.

The nature and scale of the proposed road development, the identified potential impacts and their relationship to European sites were considered in order to determine which European sites were within the ZoI of the proposed road development, in view of best scientific knowledge and in view of conservation objectives, and therefore potentially at risk of the proposed road development affecting their conservation objectives. The potential impacts associated with the proposed road development are discussed below in relation to those European sites within its ZoI (see also Section 6 of the NIS).

[54] Refer to **Section 8.2.5** for definition and impact assessment methodology

The Zone of Influence (ZoI) is a distance within which the proposed works could potentially affect the conservation condition of QI habitats or QI/SCI species of a European site.

The mechanism to define the ZoI is summarised as follows:

- Consider the nature, size and location of the proposed road development
- Consider the sensitivities of the ecological receptors
- Identify impact sources and pathways
- Determine the ZoI based on the extent of the impact

Considering the ZoI, in the absence of mitigation measures, the proposed road development was assessed as having the potential to adversely affect the integrity of the following four European sites (refer to Section 8 of the NIS):

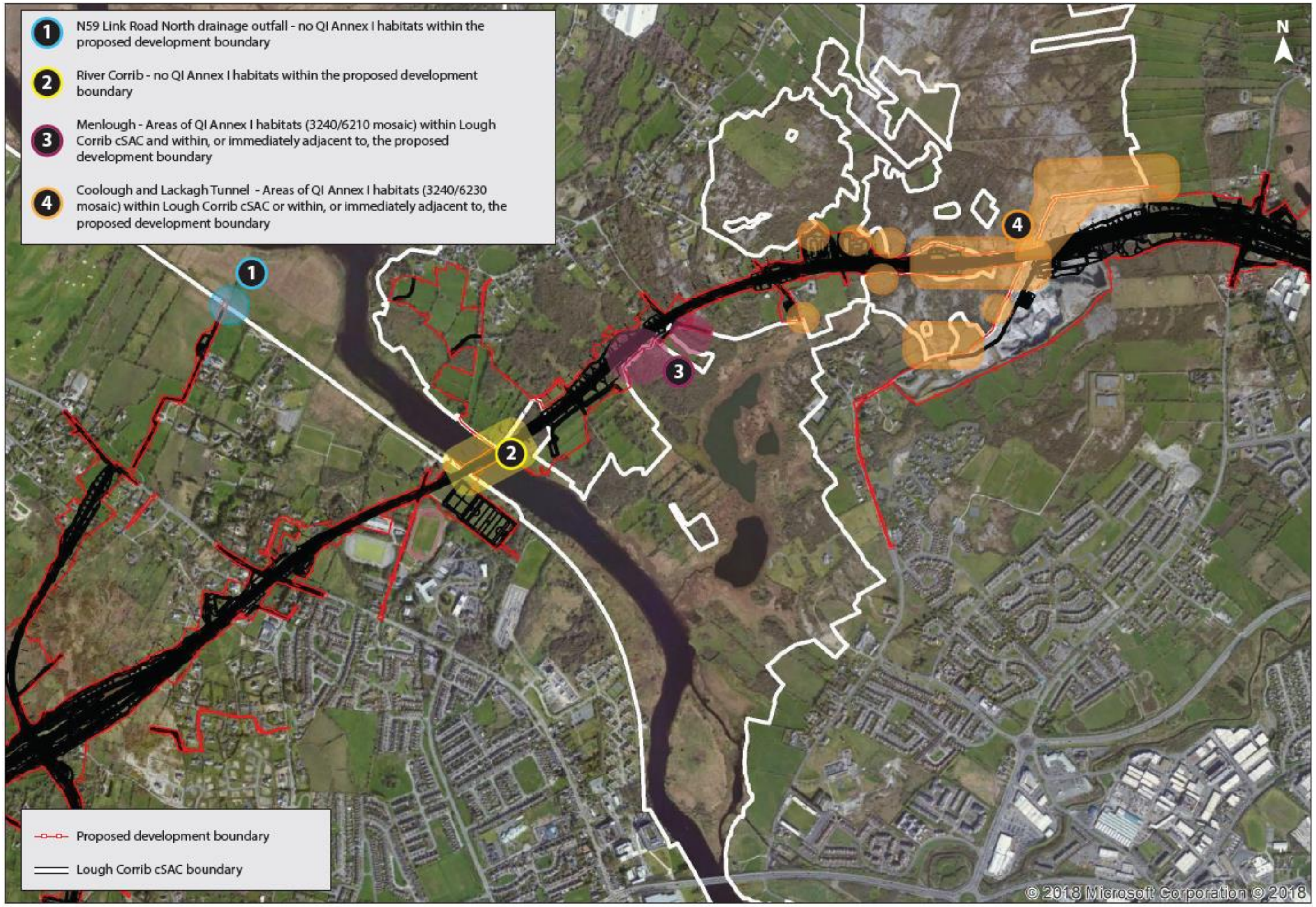
- Lough Corrib cSAC
- Lough Corrib SPA
- Galway Bay Complex cSAC
- Inner Galway Bay SPA

The locations of these European sites relative to the proposed road development, and the predicted ZoI, are shown on **Figure 8.12.1**.

Lough Corrib cSAC

The proposed road development and its boundary overlaps with, i.e. traverses through or adjacent to one Euroepean site, namely Lough Corrib cSAC at four locations: at the termination of the proposed drainage outfall from the N59 Link Road North at Kentfield; at the site of the proposed River Corrib Bridge between Dangan and Menlough; to the west of the Coolagh Lakes (Ch. 9+850 to Ch. 10+100); and, to the west and north of Lackagh Quarry where the proposed road development will consist of a tunnel (Lackagh Tunnel) and approach road infrastructure. Refer to **Plate 8.1** below. The proposed road development also traverses a number of groundwater bodies that support groundwater dependant wetland habitats within European sites and traverses a number of watercourses that lie within or drain to a Euorpean site.

Plate 8.1: Proposed Road Development overlap with European sites



The potential impacts to the Lough Corrib cSAC are discussed below under the following headings:

- Habitat loss
- Habitat degradation as a result of tunnelling/excavation associated with construction of the Lackagh Tunnel
- Habitat degradation as a result of hydrogeological impacts
- Habitat degradation as a result of hydrology impacts
- Habitat degradation as a result of air quality impacts
- Habitat degradation as a result of introducing/spreading non-native invasive plant species
- Mortality risk from construction works and road traffic

Habitat loss

There are no areas of QI Annex I habitats within Lough Corrib cSAC that lie beneath the footprint of the proposed road development or will be directly impacted. Neither will the proposed road development result in the direct loss of any habitats that support the QI habitats that are present in Lough Corrib cSAC. However, within Lough Corrib cSAC there are areas of the QI habitats Limestone pavement [*8240] and Calcareous grassland [6210] that lie within the proposed development boundary yet outside of the footprint of the proposed road developmnet which could be directly impacted, if not protected from construction works. With respect to these QI habitats and their conservation objectives, habitat loss could affect the habitat area of Calcareous grassland and Limestone pavement within Lough Corrib cSAC, and could also affect the distribution of these habitat types within the European site.

Habitat degradation as a result of tunnelling/excavations associated with construction of the Lackagh Tunnel

Construction of the Lackagh Tunnel could affect the structural integrity of the rock mass above, and result in damage to, or loss of, the QI Annex I habitats Limestone pavement and Calcareous grassland within Lough Corrib cSAC at the surfacce. With respect to these QI habitats and their conservation objectives, habitat loss could affect the habitat area of Calcareous grassland and Limestone pavement within Lough Corrib cSAC, and could also affect the distribution of these habitat types within the European site.

Habitat degradation as a result of hydrogeological impacts

The construction of the Lackagh Tunnel and the piers for Menlough Viaduct have the potential to affect the existing groundwater regime locally within the Lough Corrib Fen 1 (Menlough) GWB, the Lough Corrib Fen 1 (Lackagh) GWB and the Clare-Corrib GWB. This in turn could affect the groundwater supply to the Western and Eastern Coolagh Springs that contributes groundwater to the Coolagh Lakes and the associated QI wetland habitats in Lough Corrib cSAC[55]. With respect to the QI habitats and species and their conservation objectives, this impact could affect:

- The natural hydrological regime (e.g. water levels and flooding) and water chemistry
- The area, local distribution and condition of groundwater dependant wetland habitat
- The vegetation composition, diversity, structure and distribution, the abundance and distribution of typical and locally distinctive species associated with QI habitats

The drainage design of the proposed road development avoids any long-term impacts to the existing groundwater regime that could affect any of the groundwater dependant habitats in Lough Corrib cSAC. However, mitigation measures are required in the event that any groundwater conduits are encountered during construction and to ensure that karst features do not affect the functioning of the infiltration basins during operation.

<u>Habitat degradation as a result of hydrological impacts</u>

The proposed road development could affect surface water quality in the receiving environment which supports aquatic/wetland habitats within Lough Corrib cSAC. These habitats in turn support the QI aquatic species present: Otter, Atlantic salmon, Sea lamprey and Brook lamprey. With respect to the QI habitats and species and their conservation objectives, this impact could affect:

- Habitat area, distribution and condition/quality, along with vegetation composition, diversity, structure and distribution, and the abundance and distribution of typical and locally distinctive species
- Fish populations (including Atlantic salmon) through affecting fish numbers, population structure and habitat quality, which can also affect recruitment in the Freshwater pearl mussel populations upstream
- Otter abundance and distribution, prey abundance and the availability of holt and couch sites

<u>Habitat degradation as a result of air quality impacts</u>

Dust deposition arising from construction activities could locally affect the extent, diversity, and vegetation composition or structure of habitats within Lough Corrib cSAC that are present in the vicinity of the proposed road development.

---

[55] The Western Coolagh Spring is the main contributor to the Coolagh Lakes with a substantial groundwater supply through the underlying limestone bedrock. The Eastern Coolagh Spring only contributes a very small amount of surface water flow as any groundwater seepage to this spring is from the subsoil clays.

Habitat degradation as a result of introducing/spreading non-native invasive plant species

Introducing/spreading non-native invasive plant species could locally affect the extent, diversity, and vegetation composition or structure of habitats within Lough Corrib cSAC.

Mortality risk from construction works and road traffic

Constructing a bridge over the River Corrib poses a mortality risk to aquatic species beneath in the river; albeit a low level risk of having any long-term population level effects, given the temporary nature of the proposed works.

Operation of the proposed road development present a permanent risk of Otter mortality along the River Corrib corridor, and in the vicinity of the Coolagh Lakes, due to road traffic collisions and could have long-term effects on the Otter population of Lough Corrib cSAC.

Refer also to Table 9.16 and Table 9.17 in the NIS for how these impacts relate to the QI habitats and species and the specific conservation objectives of each QI potentially affected by the proposed road development.

Lough Corrib SPA

As the proposed road development does not traverse the SPA, none of the SCI species, or their supporting habitats within the SPA, are directly impacted by the proposed road development.

However, there are the following impacts by which the proposed road development could (in the absence of mitigation measures) affect the SCI bird species of Lough Corrib SPA and their supporting wetland habitats:

- Habitat degradation as a result of hydrogeological impacts
- Habitat degradation as a result of hydrological impacts
- Disturbance/displacement

Habitat degradation as a result of hydrogeological impacts

The proposed road development could affect the groundwater quality at potential ex-situ sites used by wintering bird species listed as SCIs for Lough Corrib SPA. This impact could affect the type, quality and extent of suitable habitat available to SCI bird species at ex-situ sites which lie within the hydrogeological ZoI. This impact could affect the type, quality and extent of suitable habitat available to SCI bird species locally and therefore, the number and range of areas available to the SPAs SCI bird populations and could have effects on their long-term population trends.

The design of the proposed road development avoids any long-term impacts to the existing groundwater regime that would affect any of the potential ex-situ sites used by SCI listed wintering birds. However, mitigation measures are required in the event that any groundwater conduits are encountered during construction and to ensure that karst features do not affect the functioning of the infiltration basins during operation.

Habitat degradation as a result of hydrological impacts

The proposed road development could affect the quality of surface water in the receiving environment which supports freshwater and wetland habitats at potential ex-situ sites used by SCI birds species of Lough Corrib SPA (Ballindooley Lough in particular). This impact could affect the type, quality and extent of suitable habitat available to SCI bird species locally and therefore, the number and range of areas available to the SPAs SCI bird populations and could have effects on their long-term population trends.

Disturbance/displacement

Long-term blasting in the vicinity of Ballindooley Lough could displace SCI listed bird species from this site for one or more winter seasons. Displacing SCI bird species from Ballindooley Lough, an important local site for some of the wintering bird species listed as SCIs for Lough Corrib SPA, could potentially negatively affect the long-term population trends of wintering SPA population.

The following, are the bird species listed as SCIs for Lough Corrib SPA which were recorded within the ZoI of the proposed road development and are therefore, at risk of significant effects: Shoveler, Tufted duck, Hen harrier, Coot, Golden plover, Black-headed gull, Common gull and Common tern. Wetlands are also listed as an SCI and could also be affected by the proposed road development. None of the other SCIs are at risk of impacts from the proposed road development as they are not present within the ZoI of the proposed road development.

Refer also to Table 9.30 and Table 9.31 in the NIS for how these impacts relate to the SCI species and the specific conservation objectives of each SCI potentially affected by the proposed road development.

Galway Bay Complex cSAC

As the proposed road development does not traverse Galway Bay Complex cSAC, none of the QI habitats or species will be directly impacted by the proposed road development and there is no risk of direct habitat loss or habitat fragmentation or direct mortality risk to QI species within the European site. Galway Bay Complex cSAC is also beyond the ZoI of any air quality or hydrogeological effects from the proposed road development. There is also no risk of disturbance associated with either construction or operation of the proposed road development affecting Otter or Harbour seal populations within Galway Bay Complex cSAC.

However, there are the following impacts by which the proposed road development could (in the absence of mitigation measures) affect the QI habitats and species of Galway Bay Complex cSAC:

- Habitat degradation as a result of hydrological impacts
- Habitat degradation as a result of introducing/spreading non-native invasive plant species
- Barrier effect
- Mortality risk

Habitat degradation as a result of hydrological impacts

The proposed road development could affect surface water quality in the receiving environment which supports freshwater, wetland and marine habitats, within Galway Bay Complex cSAC. These habitats in turn support Otter and the Harbour seal. With respect to the QI habitats and species and their conservation objectives, this impact could affect:

- The structure, extent and distribution of intertidal and marine communities associated with QI habitats
- The number and extent of typical plant and animal species associated with QI habitats
- Habitat area and distribution along with the vegetation structure and composition
- Otter prey abundance and the availability of holt and couch sites
- The condition of Harbour seal breeding and haul out sites

Habitat degradation as a result of introducing/spreading non-native invasive plant species

Introducing/spreading non-native invasive plant species could affect the extent, distribution, extent and diversity of Calcareous grassland habitats around Rusheen Bay and also affect the structure and composition of the vegetation.

Barrier effect

Introducing new culverts on watercourses within the Bearna Stream catchment may present a barrier to Otter movement throughout that catchment, potentially affecting the Otter population of Galway bay Complex cSAC.

Mortality risk

Introducing new road crossings on watercourses within the Bearna Stream catchment increases the risk of road traffic collisions with Otter, potentially affecting long-term population trends of the Otter population of Galway bay Complex cSAC.

Refer also to Table 9.23 and Table 9.24 in the NIS for how these impacts relate to the QI habitats and species and the specific conservation objectives of each QI potentially affected by the proposed road development.

Inner Galway Bay SPA

As the proposed road development does not cross the SPA, none of the SCI species, or their supporting habitats within the SPA, are directly impacted by the proposed road development. At its nearest point, the proposed road development is more than 1km from the SPA boundary and therefore, there is no risk of disturbance/displacement of SCI birds from habitats within the SPA.

However, there are the following impacts by which the proposed road development could (in the absence of mitigation measures) potentially affect the SCI bird species of Inner Galway Bay SPA and their supporting wetland habitats:

- Habitat degradation as a result of hydrogeological impacts
- Habitat degradation as a result of hydrological impacts
- Disturbance/displacement

Habitat degradation as a result of hydrogeological impacts

The proposed road development could affect the groundwater quality at potential ex-situ sites used by wintering bird species listed as SCIs for Inner Galway Bay SPA. This impact could affect the type, quality and extent of suitable habitat available to SCI bird species at ex-situ sites which lie within the hydrogeological ZoI. This impact could affect the type, quality and extent of suitable habitat available to SCI bird species locally and therefore, the number and range of areas available to the SPAs SCI bird populations and could have effects on their long-term population trends.

The design of the proposed road development avoids any long-term impacts to the existing groundwater regime that would affect any of the potential ex-situ sites used by SCI listed wintering birds. However, mitigation measures are required in the event that any groundwater conduits are encountered during construction and to ensure that karst features do not affect the functioning of the infiltration basins during operation.

Habitat degradation as a result of hydrological impacts

The proposed road development could affect the quality of surface water in the receiving environment which supports freshwater, wetland and marine habitats, within Inner Galway Bay SPA and at potential ex-situ sites used by SCI birds species (Ballindooley Lough in particular). This impact could affect the type, quality and extent of suitable habitat available to SCI bird species locally and therefore, the number and range of areas available to the SPAs SCI bird populations and could have effects on their long-term population trends.

Disturbance/displacement

Long-term blasting in the vicinity of Ballindooley Lough could displace SCI listed bird species from this site for one or more winter seasons. Displacing SCI bird species from Ballindooley Lough, an important local site for some of the wintering bird species listed as SCIs for Inner Galway Bay SPA, could potentially negatively affect the long-term population trends of wintering SPA population.

As Galway Bay lies downstream of the proposed road development, and lies within its ZoI, all bird species listed as SCIs for Inner Galway Bay SPA are at risk from impacts associated with the proposed road development: Great northern diver, Cormorant, Grey heron, Light-bellied brent goose, Wigeon, Teal, Shoveler, Red-breasted merganser, Ringed plover, Golden plover, Lapwing, Dunlin, Bar-tailed godwit, Curlew, Redshank, Turnstone, Black-headed gull, Common gull and Common tern. Wetlands are also listed as an SCI and could also be affected by the proposed road development.

Refer also to Table 9.37 and Table 9.38 in the NIS for how these impacts relate to the SCI species and the specific conservation objectives of each SCI potentially affected by the proposed road development.

8.5.3.2 Natural Heritage Areas and proposed Natural Heritage Areas

Considering the ZoI of the proposed road development, in the absence of mitigation measures the proposed road development has the potential to have a likely significant effect upon the following three NHAs/pNHAs:

- Lough Corrib pNHA
- Moycullen Bogs NHA
- Galway Bay Complex pNHA

The locations of these designated areas for nature conservation relative to the proposed road development, and the predicted ZoI, are shown on **Figure 8.13.1**.

8.5.3.2.1 Moycullen Bogs NHA

The proposed road development lies immediately adjacent to Moycullen Bogs NHA at Tonabrocky. This portion of the NHA consists of a mosaic of Lowland blanket bog (PB3) which included the Annex I habitats Blanket bog [*7130] and *Rhynchosporion* depressions [7150], Wet heath (HH3) which corresponded with the Annex I habitat Wet heath [4010], Transition mire (PF3) which corresponded with the Annex I habitat Transition mires [7140], Dry heath (HH1) which corresponded with the Annex I habitat Dry heath [4030] and Scrub (WS1).

Habitat Degradation – Air Quality

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, NO_s), volatile organic compounds (VOCs), particulate matter (PM), heavy metals (HM) and ammonia (NH_4) 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.

The current understanding of air quality impacts from roads and their interaction/effects on ecology are set out in the TII guidance document *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes* (National Roads Authority, 2011) and two UK reports: *The Ecological Effects of Diffuse Air Pollution from Road Transport* (Bignal et al., 2004) and *The Ecological Effects of Air Pollution from Road Transport: An Updated Review* (Natural England, 2016).

Although carbon monoxide (CO), carbon dioxide (CO_2) and sulphur dioxide (SO_2) are generated by vehicles they are not currently thought to be of importance in terms of contributing to air quality impacts to vegetation and are not discussed further (Bignal et al., 2004; Natural England, 2016).

Construction Impacts

Dust emissions associated with construction works could, in extreme circumstances, affect adjoining habitats, potentially burying sensitive habitats or plant species. Best practice construction methodologies (e.g. watering of the construction site/access roads and road cleaning) and mitigation measures (dust screens during construction – see **Section 8.6.3**) have been designed to minimise construction generated dust and to contain it within the proposed development boundary.

Operational Impacts

NOx, NOs and NH3

Air quality modelling of NO_x concentrations and deposition rates were calculated along the proposed road development at distances up to 200m from the proposed road development (refer to **Section 16.5.4** of **Chapter 16, Air Quality and Climate** for details). The Air Quality Standards Regulations (AQS) 2011 (S.I. No. 180 of 2011) have a limit value of 30µg/m^3 for the protection of vegetation.

In the majority of areas, the worst-case predicted annual average NO_x concentrations at various distances from the proposed road edge comply with the limit value of 30µg/m^3 for the Do-Something scenario, in 2024 and in 2039, including background concentrations. This includes the areas adjacent to the boundary of Moycullen Bogs NHA, where the road edge lies 40m from the NHA boundary. Predicted concentrations are in compliance with the Air Quality Standard for the protection of vegetation (limit value of 30µg/m^3). Therefore, even at 10m from the proposed road edge, harmful effects on vegetation from NO_x are not likely.

The contribution of the proposed road development to the NO_2 dry deposition rate along a 200m transect from the proposed road edge is well below the critical load for the lower boundary limit of inland and surface water habitats of 5-10 Kg(N)/ha/yr (National Road Authority, 2011) and therefore, harmful effects on vegetation within Moycullen Bogs NHA from NO_2 are not likely.

Ammonia (NH_3) is emitted in small amounts by vehicles but atmospheric concentrations are well below critical levels for this pollutant (Bignal et al., 2004 and Natural England, 2016) and therefore, effects on vegetation within Moycullen Bogs NHA from ammonia are not likely.

Volatile Organic Compounds (VOCs)

In terms of volatile organic compounds (VOCs), modelled benzene concentrations are well below the air quality standard of 5µg/m^3 for the protection of human health and the environment as a whole (refer to **Section 16.5.4** of **Chapter 16, Air Quality and Climate** for details). Comparisons of emission factors of VOCs (mg/vehicle/km) have been examined in order to estimate an appropriate ratio of ethylene to benzene. The highest ratio of ethylene to benzene determined was 3:1, for vehicles which were primarily diesel emissions. Increases in ethylene from the proposed road development have been predicted using this ratio and the predicted levels were low at 10m from the proposed road edge (refer to **Section 16.5.4** of **Chapter 16, Air Quality and Climate** for details). No background data is available for ethylene. There is little evidence of ecological damage by vehicle related VOCs and given the low concentrations predicted, no impacts on vegetation within Moycullen Bogs NHA are likely.

Partiulate Matter and Heavy Metals

Heavy metals from car emissions are associated with emissions of Particulate Matter, PM_{10} (particulate matter less than 10µm) and $PM_{2.5}$ (particulate matter less than 2.5µm). An assessment of emissions of PM_{10} and $PM_{2.5}$ was prepared in accordance with TII guidelines using the DMRB modelling spreadsheet. Predicted concentrations are compared to the air quality standard of 40µg/m3 and 25µg/m3 respectively for the protection of human health and the environment as a whole. The maximum predicted concentrations along the route of the proposed road development for the Do-Something scenario, including background concentrations, were well below these standards (refer to **Chapter 16, Air Quality and Climate** for details).

Particulate matter (PM) and heavy metals (HM) decay at an exponential rate with distance from a road and the highest concentrations are generally present within 20-30m. Given the 20-30m zone within which the majority of PM/HM would be deposited, that Moycullen Bogs NHA lies c.40m from the proposed road edge, the low concentrations predicted, and dispersion due to wind, impacts on vegetation within the NHA from PM or HM are not likely.

Conclusion

During operation, air quality impacts from the proposed road development on vegetation within Moycullen Bogs NHA are not likely to occur and will not result in a likely significant negative effect, at any geographic scale.

Habitat Degradation – Non-native Invasive Plant Species

Planting, dispersing, or allowing/causing the dispersal, spread or growth of certain non-native plant species is controlled under Article 49 of the European Communities (Birds and Natural Habitats) Regulations, 2011; and refers to plant or animal species listed on the Third Schedule of those regulations (see also **Section 8.3.6**).

As the proposed road development lies immediately adjacent to the boundary of Moycullen Bogs NHA, the accidental spread of such non-native invasive plant species as a result of construction works has the potential to have long-term impacts upon habitat areas within the NHA; potentially affecting plant species composition, diversity and abundance.

Introducing any of these non-native invasive plant species to Moycullen Bogs NHA has the potential to result in a likely significant negative effect, at a national geographic through affecting habitat area and quality within the NHA. Mitigation measures have been designed to avoid this impact (see **Section 8.6.6**).

Habitat Degradation – Hydrogeology

Moycullen Bogs NHA is beyond the hydrogeological ZoI of the proposed road development (**Figures 10.7.1** to **10.7.14**, **10.8.1** to **10.8.14**, **10.9.1** to **10.9.14** and **10.10.1** to **10.10.14**) both in terms of the potential for impacts on groundwater quantity and/or groundwater quality that support the habitats therein. Therefore, the proposed road development cannot impact on any habitats or species within Moycullen Bogs NHA as a consequence of any impacts on the existing hydrogeological regime and is not likely to have a significant effect on the NHA in that regard.

Habitat Degradation – Surface Water Quality

During construction, contaminated surface water runoff and/or an accidental spillage or pollution event has the potential to have a significant negative effect on habitats and species in the adjoining Moycullen Bogs NHA. The effects of frequent and/or prolonged pollution events in a peatland complex 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. Nevertheless, a precautionary approach is being taken in assuming a level of risk of water quality impacts. Consequently, detailed mitigation measures have been designed to further minimise the risk of the proposed road development having any perceptible effect on habitat quality in Moycullen Bogs NHA during construction (see **Section 8.6.4**).

Habitat degradation as a consequence of construction effects on surface water quality has the potential to affect the peatland habitat complex, and the species it supports in Moycullen Bogs NHA and therefore, has the potential to result in a significant negative effect.

Overall, in the absence of mitigation the proposed road development has the potential to affect the integrity of, and therefore have a significant negative effect on, Moycullen Bogs NHA as a result of air quality, non-native invasive plant species and surface water quality impacts during construction, potentially at the national geographic scale at which this receptor is valued.

8.5.3.2.2 Lough Corrib pNHA and Galway Bay Complex pNHA

In the case of Galway Bay Complex pNHA, which is remote from the proposed development boundary, the potential impact pathways connecting the proposed road development to Galway Bay are as presented and assessed in the NIS for Galway Bay Complex cSAC and Inner Galway Bay SPA (and summarised in **Section 8.5.3.1** above). As the proposed road development has the potential to adversely affect the integrity of Galway Bay Complex cSAC and Inner Galway Bay SPA, and hence the receiving marine environment in Galway Bay, it also has the potential to have a significant negative effect on Galway Bay Complex pNHA.

In relation to Lough Corrib pNHA, the potential impact pathways connecting the proposed road development to the pNHA site are also as per those presented above in **Section 8.5.3.1** and in the NIS for Lough Corrib cSAC and Lough Corrib SPA. However, the zone within which the proposed road development directly interacts with Lough Corrib pNHA is much smaller than that associated with Lough Corrib cSAC, and only includes the main river channel and banks. As the proposed road development has the potential, in the absence of mitigation measures, to adversely affect the integrity of Lough Corrib cSAC and Lough Corrib SPA, it also has the potential to affect the integrity of, and therefore have a significant negative effect on, Lough Corrib pNHA.

The proposed road development also has the potential to affect biodiversity in a broader sense than just the QIs/SCIs of those European sites. Where biodiversity receptors in Lough Corrib pNHA or Galway Bay Complex pNHA do not form part of the QIs/SCIs in the NIS assessment, they are considered under the other individual impact assessment headings for each KER below.

8.5.4 Habitats

This section assesses the potential impact of the proposed road development on habitats. Its focus is on habitat impacts outside designated areas for nature conservation which are discussed separately in **Section 8.5.3**, and detailed in the NIS.

In terms of quantifying the magnitude of effects for both Annex I and non-Annex I habitats, the estimated percentage of the local habitat resource being affected is based upon the total area of a given habitat type that was recorded within the scheme study area, regardless of whether it was within a designated area for nature conservation or not. This provides some local context as to the magnitude of the habitat loss and whether the impact is significant or not, and at what geographic scale.

8.5.4.1 Construction Phase Impacts

Habitat Loss & Fragmentation

The construction of the proposed road development will result in habitat loss across its length, totalling approximately 280ha. Some of the habitat types directly affected are considered to be of International/National importance, given their priority Annex I/Annex I status under the Habitats Directive. In the western part of the study area the Annex I habitats affected are Dry heaths [4030], Wet heath [4010], *Molinia* meadows [6410] and Blanket bog (active) [*7130]. East of the River Corrib the Annex I habitat types affected are Limestone pavement [*8240], Calcareous grassland [6210], Residual alluvial forests [*91E0], Turloughs [*3180], Petrifying springs [*7220] and *Molinia* meadows [6410]. These cover an area of approximately 8.8ha.

Other habitat types considered to be of a Local Importance (higher value) will also be lost as a result of the proposed road development. These include hedgerows (WL1), treelines (WL2), sections of stream/river channel (FW1), grasslands (GS1, GS2, GS3 and GS4), woodlands (WD1 and WN2) and scrub (WS1). These cover an area of approximately 75.5ha[56].

The remaining areas of habitat within the proposed development boundary (c.196ha) are made up of habitats of a Local Importance (lower value). This is

[56] Although some of the local importance habitats types (both higher and lower value) will be directly affected within Lough Corrib cSAC (e.g. WD1, WN2 and BL3) none of these habitat types are QIs, or support QI habitats or species, and losses of these habitat types within Lough Corrib cSAC will not affect the site's conservation objectives

primarily made up c.76ha of Improved agricultural grassland (GA1), c.32ha of Buildings and artificial surfaces (BL3), c.18ha of Spoil and bare ground (ED2), c.17ha of Dry calcareous and neutral grassland (GS1), c.14ha of Dense bracken (HD1), c.10ha of residential properties and c.9ha of Amenity grassland (improved) (GA2). Flower beds and borders (BC4), Recolonising bare ground (ED3), Other artificial lakes and ponds (FL8), Dry meadows and grassy verges (GS2), Dry-humid acid grassland (GS3), Wet grassland (GS4) and Ornamental/non-native shrub (WS3) make up the remainder.

The various KER habitat types affected, and the areas involved, are summarised below in **Table 8.27**. These calculations include all KER habitat areas within the proposed development boundary, as the possibility of areas within the proposed development boundary but outside of the footprint of the proposed road development itself being affected by construction activities cannot be ruled out.

Habitat loss may also lead to habitat fragmentation in many instances; creating new divisions of existing habitat blocks or contributing to an existing trend of fragmenting semi-natural habitat blocks — as has been happening to some areas of upland habitat in the western part of the study area, as a result of other development.

In the assessment below, where reference areas are used to calculate the percentage habitat loss of areas of Local Importance (higher value) these include areas that correspond with Annex I habitat types (where applicable).

The mitigation measures that have been designed to avoid or reduce the effects of direct impacts to habitats are in **Section 8.6.2**.

Table 8.27: KER habitat types within the proposed development boundary

Habitat type	Extent[57]
International Importance	
Turlough [*3180]	One (c.0.04ha of c.0.1ha is within fenceline)
Petrifying springs [*7220]	One feature
Residual alluvial forests [*91E0]	c.0.1ha
Limestone pavement [*8240]	c.2.3ha[58]
National Importance	
Wet heath [4010]	c.1.22ha
Wet heath/Dry heaths mosaic [4010/4030]	c.0.7ha
Dry heaths [4030]	c.1.96ha
Wet heath/Dry heath/*Molinia* meadow [4010/4030/6410]	c.0.43ha
Calcareous grassland [6210]	c.1.14ha
Molinia meadow [6410]	c.1.02ha

[57] This includes either a measure of habitat area (ha), linear length of habitat lost (m/km), or a total number of point features affected (e.g. spring/seepage sites), as appropriate.
[58] Some of the Limestone pavement habitat within the proposed development boundary lies within Lough Corrib cSAC – some of which also included areas of Calcareous grassland [6210] in a mosaic.

Habitat type	**Extent[57]**
Limestone pavement/Calcareous grassland mosaic [*8240/6210]	c.0.12ha
Local Importance (higher value)	
Calcareous springs (FP1)	Fifteen features
Reed and large sedge swamps (FS1)	c.0.14ha
Tall-herb swamp (FS2)	c.0.03ha
Eroding/upland rivers (FW1)	c.120m of Sruthán na Líbeirtí c.220m of the Trusky Stream c.140m of the Bearna Stream (and tributary) c.475m of the Tonabrocky Stream see **Section 8.5.4.3** for more details
Drainage ditches (FW4)	c.0.12ha
Marsh (GM1)	c.0.2ha
Dry calcareous and neutral grassland (GS1)	c.13.7ha
Dry calcareous and neutral grassland/Scrub mosaic (GS1/WS1)	c.1.55ha
Dry meadows and grassy verges (GS2)	c.8.2ha
Dry-humid acid grassland (GS3)	c.7.81ha
Wet grassland (GS4)	c.11.14ha
Poor fen and flush (PF2)	c.0.13ha
(Mixed) broadleaved woodland (WD1)	c.4.25ha
Mixed broadleaved/conifer woodland (WD2)	c.0.03ha
(Mixed) conifer woodland (WD3)	c.0.01ha
Oak-ash-hazel woodland (WN2)	c.4.18ha
Scrub (WS1)	c.21.12ha
Scrub/ Dry meadows and grassy verges (WS1/GS2)	c.1.47ha
Scrub/Oak-ash-hazel woodland/ Exposed calcareous rock (WS1/WN2/ER2)	c.1.3ha
Hedgerows (WL1)	c.7.8km
Treelines (WL2)	c.4km

Habitat Degradation – Surface 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 affect aquatic and wetland habitats in the receiving environment. 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 a worst-case scenario, estuarine and coastal habitats downstream could also be affected.

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. Nevertheless, a precautionary approach is being taken in assuming a level of risk of water quality impacts. Consequently, detailed mitigation measures are required to further minimise the risk of the proposed road development having any perceptible effect on water quality during construction.

Habitat degradation as a consequence of construction effects on surface water quality has the potential to affect the conservation status of aquatic, wetland or estuarine/marine habitats and therefore, has the potential to result in a significant negative impact.

The mitigation measures that have been designed to avoid or reduce the potential impacts of the proposed road development on surface water quality are presented in **Section 8.6.4**.

Habitat Degradation – Hydrological Regime

Construction works at the watercourse crossings along the proposed road alignment can have a temporary impact on the flow and flooding regime locally. None of these are predicted to have any long-term effects that would give rise to a likely significant negative effect on any aquatic habitats or species through effects on the hydrological regime (for more detail refer to **Section 11.5** of **Chapter 11, Hydrology**).

Habitat Degradation – Groundwater

Any effects on the existing hydrogeological baseline supporting lakes, turloughs, and wetland or peatland habitats has the potential to negatively impact upon habitat extent and distribution, and vegetation structure and composition. The potential effects of impacting upon the existing hydrogeological regime are not necessarily limited to habitats within the proposed development boundary but can be far-reaching, with significant negative long-term effects[59].

There will be no impacts to groundwater recharge rates during construction that will have any effect on biodiversity receptors. All groundwater intercepted by construction works will be managed and discharged within the same GWB and will remain within the surface water catchment that they would naturally have been received by. The groundwater recharge rate will not change in the Galway Granite Batholith aquifer (the area west of the N59 Moycullen Road) with only a temporary minor increase in the recharge rate (between 0.1m and 0.4m) in the Visean Undifferentiated Limestone aquifer (the area east of the N59 Moycullen Road). Although there will be some loss of aquifer volume in the Galway Granite Batholith aquifer and the Visean Undifferentiated Limestone aquifer, it will have an imperceptible impact on the groundwater resource (for more detail refer to **Section 10.5** of **Chapter 10, Hydrogeology**).

During construction, deep excavations or tunnelling are likely to interact with groundwater. As a consequence, construction works have the potential to affect groundwater levels from construction dewatering or drawdown associated with

[59] The potential hydrogeological ZoI of the proposed road development is shown on **Figures 10.7.1** to **10.7.14**, **10.8.1** to **10.8.14**, **10.9.1** to **10.9.14** and **10.10.1** to **10.10.14**.

excavations. There is also the potential that construction works could impact on groundwater flow paths or conduits, potentially affecting groundwater dependant or supported habitats and/or species. There is also a higher risk of impacts to groundwater quality through contaminated surface water runoff and/or an accidental spillage or pollution. As above in relation to surface water features, impacts on the groundwater could potentially have a significant negative effect on biodiversity.

Based on the findings of the hydrogeological impact assessment in **Chapter 10, Hydrogeology**, the proposed road development does not pose a risk to the groundwater supply to Ballindooley Lough. Nor does it pose a risk of affecting the turlough features at Menlough (c.320m north-west of Ch. 10+100), at Ballinfoyle c.190m south of Ch. 12+100, and at Ballindooley c.400m north of the N84 Headford Road Junction.

The proposed road development does however, have the potential to affect the groundwater supply to the Coolagh Lakes (which form part of the Lough Corrib cSAC) and the turlough located between Bóthar Nua and Seanbóthar (Ch. 10+320). Although the magnitude of the impact cannot be fully quantified, on a precautionary basis it is assessed as having the potential to affect water levels at these features and thereby, affect the supported aquatic and wetland habitats. The assessment of impacts relating to European sites are discussed separately in **Section 8.5.3.1**, and detailed in the NIS.

The proposed Menlough Viaduct will be constructed over the Turlough located between Bóthar Nua and Seanbóthar (Ch. 10+320). Although none of the supporting piers will be located within the Turlough, there is the potential for construction works to affect the supporting hydrogeological regime.

Habitat degradation as a consequence of construction effects on the existing groundwater resource and regime has the potential to affect the conservation status of groundwater dependant aquatic or wetland habitats and species and therefore, has the potential to result in a significant negative impact.

A more detailed description of how the proposed road development could affect the existing hydrogeological regime during construction is presented in **Chapter 10, Hydrogeology**.

The mitigation measures that have been designed to avoid or reduce the potential impacts of the proposed road development on groundwater are presented in **Section 8.6.5**.

Habitat Degradation – Air Quality

As discussed above in **Section 8.5.3.2**, the proposed road development has the potential to generate dust during construction works which could affect vegetation in habitat areas adjacent to the proposed development boundary. Mitigation measures have been designed to contain dust emissions during construction (see **Section 8.6.3**).

Habitat Degradation – Non-native Invasive Plant Species

Planting, dispersing, or allowing/causing the dispersal, spread or growth of certain non-native plant species is controlled under Article 49 of the European Communities (Birds and Natural Habitats) Regulations, 2011; and refers to plant or animal species listed on the Third Schedule of those regulations (see also **Section 8.3.6**).

The accidental spread of such non-native invasive plant species as a result of construction works has the potential to impact upon terrestrial habitats[60]; potentially affecting plant species composition, diversity and abundance over the long-term. This is not only confined to habitats within and immediately adjacent to the proposed development boundary but includes habitat areas along the network of proposed haul routes associated with the proposed road development (**Figure 7.101** to **7.118**).

The effects of introducing such non-native invasive plant species to highly sensitive and ecologically important habitat areas (e.g. designated area for nature conservation or areas of Annex I habitat) have the potential to result in a likely significant negative effect, at geographic scales ranging from local to international. Mitigation measures have been designed to avoid this potential impact (see **Section 8.6.6**).

Habitat Degradation – Tunnelling/Excavation

Tunnelling works or deep excavations have the potential to affect the structural integrity of the ground above a tunnel excavation, or that of the ground immediately adjacent to a deep cutting/excavation. This in turn can affect the habitats present.

This potential impact is only likely to arise in to the habitats present within Lough Corrib cSAC and either above the proposed Lackagh Tunnel or immediately adjacent to the cutting associated with the western approach to same. At this location, the overlying/adjoining habitats within Lough Corrib cSAC comprise a mosaic of wooded Limestone pavement [*8240], scrub covered Limestone pavement [*8240], exposed Limestone pavement [*8240], and Calcareous grassland [6210]. All of these habitat types are QI habitats of Lough Corrib cSAC. This assessment is discussed separately in **Section 8.5.3.1**, and detailed also in the NIS.

8.5.4.2 Operational Phase Impacts

Habitat Degradation – Surface Water Quality

During operation, there will be drainage outfalls to all river/stream catchments crossed by the proposed road development. Therefore, there is a risk that discharges from the road drainage network could affect water quality, potentially over the long-term, and consequently impact upon aquatic/wetland habitats. In a worst-case-scenario, this could result in long-term effects upon habitat extent and distribution, vegetation structure and composition.

---

[60] Non-native invasive aquatic plant species (or fauna species) were not recorded in the aquatic habitats which will be impacted by construction works.

The proposed drainage design consists of a petrol interceptor followed by attenuation and constructed wetland (where drainage will be discharged to the existing surface water/drainage network)—as described in detail in **Section 5.5.4.8** of **Chapter 5**, **Description of Proposed Road Development**. The drainage design, along with the design of any culverts associated with the proposed road development and any stream/river realignments, also ensures that during operation there will not be any perceptible impacts on the functioning of the existing hydrological regime (e.g. flood risk, flow rates or river morphology).

Habitat degradation as a consequence of operational effects on surface water is not predicted to affect the conservation status of any aquatic, wetland or estuarine/marine habitats and will therefore, not result in a likely significant effect, at any geographic scale.

Habitat Degradation – Groundwater

There will be no impacts to groundwater recharge rates during construction that will have any effect on biodiversity receptors as all groundwater intercepted by the road drainage will be discharged to the same GWB. The infiltration basins will lead to local increases in the groundwater table but overall there will be no net change to the groundwater resource.

There will be no active dewatering, of the bedrock aquifer, required during the operation phase but passive dewatering, of the bedrock aquifer, will occur at a number of cutting locations and the drainage associated with the proposed road development will cause the groundwater levels to adjust locally. This impact on the hydrogeological regime has the potential to affect the conservation status of groundwater dependant aquatic or wetland habitats and species and therefore, has the potential to result in a significant negative impact.

Impacts to groundwater quality could be caused by discharging contaminated road runoff to ground or where leachate/runoff from limestone fill could affect the pH of acidic groundwater along the western section of the proposed road development.

The proposed drainage design consists of a petrol interceptor followed by attenuation and infiltration ponds (where discharging to ground) — as described in detail in **Section 5.5.4.8** of **Chapter 5, Description of Proposed Road Development**. The functioning and effectiveness of the proposed road drainage network are discussed in more detail in **Chapter 11, Hydrology**. The drainage design, including the design of the infiltration basins, minimises the risk of a pollution event during operation affecting groundwater quality. Risk of spillage is low (<0.5%) and any impacts that do accidentally occur will be temporary. However, it is important that they are inspected to ensure that karst features do not affect the functioning of the infiltration basins during operation. If this is identified during routine inspections of the infiltration basins then mitigation is required to ensure any issues are addressed so that they continue to function as designed over the design life of the proposed road development

Local impacts to the local water chemistry, in terms of pH change, may apply where limestone derived alkaline material is placed over granite bedrock. Surface water run-off, interflow or groundwater movements through such material has the potential to impact local areas of peatland habitats by changing the pH of the recharge water particularly where this alkaline material is saturated (below the groundwater table). This potential impact will only apply to adjacent peatland habitats within hydrogeological Zone of influence of the proposed road development. The use of limestone based road material for the pavement and capping layers does not pose such a risk as these layers will be protected from direct surface water and groundwater infiltration and are located in the unsaturated zone above the groundwater table. This protection is provided by the road bitumen surface and the use of native topsoil capping along the grass verge and embankment sections of the proposed road development. Restriction on the use of limestone derived formation material will apply locally to road sections in the vicinity of peatland habitats within the granite bedrock area (west of the existing N59 Moycullen Road).

A more detailed description of how the proposed road development could affect the existing hydrogeological regime during construction is presented in **Chapter 10, Hydrogeology**.

The mitigation measures that have been designed to avoid or reduce the potential impacts of the proposed road development on groundwater are presented in **Section 8.6.5**.

Habitat Degradation – Shading

There are two elevated structures associated with the proposed road development which will have some level of shading effect on the habitats beneath during operation: the proposed River Corrib Bridge (Ch. 8+850 to Ch. 9+500) and the proposed Menlough Viaduct (Ch. 10+100 to Ch. 10+420). The retaining wall along the southern edge of the proposed road carriageway between Ch. 9+840 and Ch. 10+025 also has the potential to cause a shading effect on adjacent habitats. Shading effects include both a reduction in sunlight and a reduction in direct precipitation reaching plants beneath the bridge structure, affecting species communities, diversity and distribution. This potential impact will only arise in situations where habitats are being retained beneath the structure, as opposed to where habitats will be permanently lost as a result of construction works.

Habitat Degradation – Non-native Invasive Plant Species

Given the presence of non-native invasive plant species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations, 2011 in the immediate vicinity of the proposed road development, there is the potential that these species will recolonize vegetated areas within the proposed development boundary post-construction. As such, there is a risk that routine maintenance works may inadvertently spread contaminated vegetation cuttings.

The effects of introducing such non-native invasive plant species to highly sensitive and ecologically important habitat areas (e.g. designated areas for nature conservation or areas of Annex I habitat) have the potential to result in a significant negative effect, at geographic scales ranging from local to international. Mitigation measures have been designed to avoid this potential impact (see **Section 8.6.6**).

Habitat Degradation – Air Quality

<u>NO_x, NO_s and NH_3</u>

Air quality modelling of NO_x concentrations and deposition rates were calculated along the route of the proposed road development at distances up to 200m from the proposed road development (refer to **Chapter 16, Air Quality and Climate** for details). The Air Quality Standards Regulations (AQS) 2011 (S.I. No. 180 of 2011) have a limit value of 30µg/m^3 for the protection of vegetation.

In the majority of areas, the worst-case predicted annual average NO_x concentrations at various distances from the proposed road edge comply with the limit value of 30 µg/m^3 for the Do-Something scenario, in 2024 and in 2039, including background concentrations. All predicted concentrations are in compliance with the Air Quality Standard for the protection of vegetation (limit value of 30µg/m^3). Therefore, even at 10m from the proposed road edge in these locations, harmful effects on vegetation from NO_x are not likely.

The exception is the zone between the N84 Headford Road and the N83 Tuam Road where, due to the higher predicted traffic numbers, the limit value of 30µg/m^3 is exceeded marginally within 10m of the proposed road edge (predicted NO_x concentrations of 30.53µg/m^3). This reduces to below the limit value by 20m. In this area, there are no sensitive ecological receptors (e.g. Annex I habitats) within 20m of the proposed road edge and harmful effects on vegetation in ecologically sensitive areas nearby are not likely.

The contribution of the proposed road development to the NO_2 dry deposition rate along the 200m transect from the proposed road edge is well below the critical load for the lower boundary limit of inland and surface water habitats of 5-10 Kg(N)/ha/yr (National Road Authority, 2011) and therefore, harmful effects on vegetation from NO_2 are not likely.

Ammonia (NH_3) is emitted in small amounts by vehicles but atmospheric concentrations are well below critical levels for this pollutant (Bignal et al., 2004 and Natural England, 2016) and therefore, effects on vegetation are not likely.

<u>Volative Organic Compounds</u>

In terms of volatile organic compounds (VOCs), modelled benzene concentrations are well below the air quality standard of 5µg/m^3 for the protection of human health and the environment as a whole (refer to **Section 16.5.4** of **Chapter 16, Air Quality and Climate** for details). Comparisons of emission factors of VOCs (mg/vehicle/km) have been examined in order to estimate an appropriate ratio of ethylene to benzene. The highest ratio of ethylene to benzene determined was 3:1, for vehicles which were primarily diesel emissions. Increases in ethylene from the proposed road development have been predicted using this ratio and the predicted levels were low at 10m from the proposed road edge (refer to **Section 16.5.4** of **Chapter 16, Air Quality and Climate** for details). No background data is available for ethylene. There is little evidence of ecological damage by vehicle related VOCs and given the low concentrations predicted, no significant impacts on vegetation along the proposed road development are likely.

Particulate Matter and Heavy Metals

Heavy metals from car emissions are associated with emissions of Particulate Matter, PM_{10} (particulate matter less than 10µm) and $PM_{2.5}$ (particulate matter less than 2.5µm). An assessment of emissions of PM_{10} and $PM_{2.5}$ was prepared in accordance with TII guidelines using the DMRB modelling spreadsheet. Predicted concentrations are compared to the air quality standard of 40µg/m^3 and 25µg/m^3 respectively for the protection of human health and the environment as a whole. The maximum predicted concentrations along the proposed road development for the Do-Something scenario, including background concentrations, were well below these standards (refer to **Section 16.5.4** of **Chapter 16, Air Quality and Climate** for details).

Particulate matter (PM) and heavy metals (HM) decay at an exponential rate with distance from a road and the highest concentrations are generally present within 20-30m. Given the 20-30m zone within which the majority of PM/HM would be deposited, the low concentrations predicted, and dispersion due to wind, significant impacts on vegetation from PM or HM along the proposed road development are not likely.

8.5.4.3 Impact Assessment on Habitats

Turloughs [*3180]

Turloughs (FL6) which corresponds with this Annex I habitat type

The structure proposed for the Menlough Viaduct passes over the Turlough at Ch. 10+320 and avoids any direct impacts. This retention of the Turlough habitat in this area is captured in the mitigation strategy (**Section 8.6**) and shown on **Figure 8.23.7**. Construction and the long-term presence of the piers, whilst not located within the Turlough, they are situated immediately adjacent to it, pose a risk to the supporting hydrogeological regime and may affect both the functioning of the Turlough and the vegetation community present. Construction works also pose a pollution risk to groundwater and surface water quality.

The presence of groundwater conduits connecting the infiltration ponds at Ch. 10+650 to Ch. 10+800 to the Turlough, and also in relation to the infiltration ponds at Ballindooley Lough (Ch. 12+200) is unknown. If groundwater conduits do connect road drainage to the turlough there is the potential for impacts which could affect the vegetation composition and diversity.

Accidentally introducing non-native invasive plant species into turlough habitat could also increase the extent and magnitude of road effects, degrading the habitat quality; as could dust deposition during construction. Air quality effects on turlough habitat during operation are not likely to affect plant species composition, diversity or abundance.

There is therefore a risk that the proposed road development could result in the loss of turlough habitat, or have long-term effects on plant species composition. Such an impact would constitute a negative effect on conservation status[61] and result in a likely significant negative effect, at the international geographic scale.

Petrifying springs [*7220]

Calcareous springs (FP1) which corresponds with this Annex I habitat type

Six Calcareous springs corresponding with the Annex I habitat Petrifying springs [*7220] were recorded in Lackagh Quarry (see **Figure 8.15.8**).

One of these Petrifying springs (at the location of the proposed access road c.30m south of the mainline at Ch. 11+380) will be directly affected by the proposed road development and will be permanently lost.

The next Petrifying spring feature to the north, which lies c.25m to the north of the mainline at Ch. 11+400, lies within the area where rock stabilisation measures are required as part of the construction of the eastern entrance to the Lackagh Tunnel (see **Chapter 9, Soils and Geology**). Although no impacts are predicted as a result of any effects on the existing hydrogeological regime during construction or operation (refer to **Chapter 10, Hydrogeology**), the installation of rock stabilisation measures here could potentially directly impact on this Petrifying spring and result in the permanent loss of this feature.

None of the other four Petrifying spring features will be directly impacted by the proposed road development or affected in any way through impacts to the existing hydrogeological regime, during either construction or operation.

Loss of Petrifying spring features, as priority Annex I habitats, has the potential to result in a significant negative effect at the national or international geographic scales but only where habitat impacts would affect the habitat's conservation status at those levels. In order for habitat area loss to affect a habitat's favourable conservation status at a national level, it must affect the national favourable reference area (FRA), as this is the reference value against which the area parameter is measured in the context of assessing conservation status.

[61] The methodology for determining effects on the conservation status on Annex I habitats at a national level is assessed under the headings of range, area, structure & function, and future prospects (NPWS 2013a, 2013b, 2013c). Under the area criterion, any loss of habitat area with respect to the Favourable Reference Range (FRA) results in the habitat moving from Favourable conservation status (if that is the baseline condition) to either Inadequate or Bad. If the baseline condition is either Inadequate or Bad, then additional habitat loss is adding to an existing decline and potentially inhibiting efforts to maintain or restore Annex I habitats at favourable conservation status at a national level. The FRA for any of the Annex I habitat types affected by the proposed road development are either estimates based on partial data, or values much greater than the current area based upon a statistically robust estimate—generally to account for historic losses or impacts Since the Habitats Directive came into force in 1994. The FRA are also not spatially defined. In applying the precautionary principle, due to the absence of a clearly defined FRA, the loss of any area of Annex I habitat is considered to be affecting conservation status at the geographic scale at which the particular Annex I habitat has been valued.
The same assessment methodology also applies when assessing conservation condition at a site level.

The FRA for this habitat type is defined as 0.139km^2 in NPWS (2013b) and it notes therein that "There is no evidence of decline in extent since the Directive came into force and therefore the current area is set as the Favourable Reference Area". The current FRA is based upon the data presented in NPWS (2013b) and as the 10km grid square within which the Petrifying springs affected by the proposed road development are located (M32) is not within the current Favourable Reference Range (FRR) of this habitat type, they cannot form part of the national FRA. Therefore, their loss cannot affect the conservation status of this habitat type at either the national or international geographic scales.

There is little data available as to the current number of Petrifying spring sites at the county level. However, considering the restricted range of this habitat type in County Galway (based upon the data presented in NPWS, 2013b) it is likely that the number of sites is restricted and the loss of even a single Petrifying spring is likely to be a significant negative effect, at the county geographic scale.

Residual alluvial forests [*91E0]

Wet willow-alder-ash woodland (WN6) which corresponds with this Annex I habitat type

The proposed road development will result in the permanent loss of approximately 0.1ha of Residual alluvial forest habitat. This equates to approximately 0.73% of this Annex I habitat type mapped within the scheme study area. Although, given the expanse of unsurveyed wet woodland habitat present along the River Corrib and on the shores of Lough Corrib to the north of the scheme study area, this percentage figure is likely to be an overestimate of the loss of Residual alluvial forest habitat locally.

Habitat degradation as a result of effects on the existing hydrogeological regime during construction and operation have the potential to affect areas of Residual alluvial forest that form an element of the wetland habitats supported by the Coolagh Lakes.

Accidentally introducing non-native invasive plant species could also increase the extent and magnitude of potential impacts due to the proposed road development; as could an accidental pollution event affecting the River Corrib, the Coolagh Lakes or Ballindooley Lough. There are no areas of this habitat type within the ZoI of air quality impacts with the potential to affect plant species composition, diversity or abundance.

Despite the relatively small area of habitat loss, the loss of any area of this priority Annex I habitat constitutes a negative effect on conservation status. Therefore, the loss of Residual alluvial forest habitat associated with the proposed road development will result in a likely significant negative effect, at the international geographic scale.

Wet heath [4010] & Dry heaths [4030]

Dry siliceous heath (HH1) and Wet heath (HH3) which corresponds with this Annex I habitat type

Wet heath and Dry heaths are assessed together, as both habitat types generally form intricate mosaics with one another in areas affected by the proposed road development. From Bearna to Ballagh (Ch. 0+000 to Ch. 8+300) a total of c.5.15ha of heathland habitats will be permanently lost as a direct result of construction works or through indirect hydrogeological effects: approximately 1.96ha of Dry heaths, 2.06ha of Wet heath[62], 0.7ha of Dry heaths/Wet heaths mosaic, c.0.43ha of Wet heath/*Molinia* meadow/Dry heath mosaic between Ch. 2+920 and Ch. 3+040 (in the ratio of 82/15/3%, respectively) and c.0.01ha of Dry heath/Scrub mosaic along the access road at Na Foraí Maola Thiar.

In the context of the total area of these Annex I habitat types recorded within the scheme study area, the areas lost represent approximately 1.8%. However even the areas of heath habitat recorded within the scheme study area are only likely to represent a proportion of the actual local heathland habitat resource[63]. Therefore, the actual percentage of habitat loss is likely to be much smaller.

The proposed road development will also increase the fragmentation of heathland habitats; although the affected habitat blocks are already isolated from the larger more cohesive areas to the north at Na Foraí Maola, Lough Inch, Cappagh, Tonabrocky and Ballagh which will be unaffected.

Habitat degradation as a result of effects on the existing hydrogeological regime during construction and operation is also likely to affect the areas of Wet heath along the proposed road development. The construction hydrogeological ZoI will be temporary and is not predicted to have long-term effects on its own. However, the operational hydrogeological ZoI (in the context of groundwater drawdown effects) extends beyond the proposed development boundary to include additional areas of heathland habitat. This is not likely to have any long-term effects on areas of Dry heath, but Wet heath habitats is likely to dry out to some degree, with decreasing effect from the road edge. As it is not possible to quantify the effects of the predicted groundwater drawdown of Wet heath habitat condition, a precautionary approach is being taken in assuming any Wet heath habitat within the operational hydrogeological ZoI will be permanently lost. For the purposes of the impact assessment, it is also assumed that in a mosaic of Dry heath and Wet heath that all habitat affected in this way is Wet heath (a worst-case approach as Dry heath is not likely to be affected by the effects of operational groundwater drawdown). The area of potential Wet heath habitat within this zone is c.0.84ha. The likelihood is that the species composition will change to resemble more of a Dry heath habitat type. Peatland habitats within the hydrogeological ZoI could be affected by

[62] This c.2.06ha of Wet heath habitat includes an area of c.1.23ha that lies within the proposed development boundary and will be directly impacted, and an additional c.0.84ha that lies outside of the proposed development boundary but within the hydrogeological ZoI.

[63] Based upon a review of available orthophotography for the km grid square M22 (which covers the western part of the scheme study area), approximately 40km^2 of upland habitats are likely to be present but are not described or mapped. These are likely to be a mosaic of heath and bog habitats.

groundwater pH change and mitigation measures will be implemented to avoid this impact.

Accidentally introducing non-native invasive plant species into heath areas could also increase the extent and magnitude of road effects on these habitat types, degrading the habitat quality; as could an accidental pollution event or dust deposition during construction. Air quality effects on heathland habitats during operation are not likely to affect plant species composition, diversity or abundance.

Despite the relatively small area of habitat loss, and that the areas that will be lost are a multitude of small, isolated habitat patches, considering the likely effects and ongoing pressures on these habitat types locally, the loss of any area of these Annex I habitats constitutes a negative effect on conservation status. Therefore, the loss of Wet heath and Dry heath habitat associated with the proposed road development will result in a likely significant negative effect, at the national geographic scale.

Calcareous grassland [6210]

Dry calcareous and neutral grassland (GS1) which corresponds with this Annex I habitat type

The proposed road development will result in the permanent loss of approximately 1.14ha of Calcareous grassland habitat: c.0.09ha at Lackagh Quarry (Ch. 11+750), three small patches between Ch. 12+000 and Ch. 12+220 (totalling c.0.13ha), and c.0.92ha at Doughiska (between Ch. 16+220 and Ch. 16+320). In the context of the total area of Calcareous grassland habitat recorded within the scheme study area, the areas lost represent approximately 2.23%. The Calcareous grassland habitat affected is the non-priority variant [6210] and as such, is valued as being of national importance.

There is also some Calcareous grassland habitat present in a mosaic with Limestone pavement within the boundary of Lough Corrib cSAC and, as assessed in the NIS, it is not directly impacted by the proposed road development (this is captured in the mitigation strategy and shown on **Figure 8.23.8** as habitat areas to be retained).

All of the affected areas are small, isolated grassland patches and therefore, the proposed road development will not have any significant fragmentation impacts on Calcareous grassland habitat locally.

Accidentally introducing non-native invasive plant species into Calcareous grassland habitat could also increase the extent and magnitude of road effects, degrading the habitat quality; as could an accidental pollution event or dust deposition during construction. During operation, air quality effects on Calcareous grassland habitat in the vicinity of the proposed road development are not likely to affect plant species composition, diversity or abundance.

Despite the relatively small area of habitat loss, and that the areas that will be lost are a multitude of small, isolated habitat patches, considering the likely effects and ongoing pressures on Calcareous grassland habitat locally, the loss of any area of this Annex I habitat constitutes a negative effect on conservation status. Therefore, the loss of the non-priority Calcareous grassland habitat associated with the proposed road development will result in a likely significant negative effect, at the national geographic scale.

Molinia meadow [6410]

Wet grassland (GS4) which corresponds with this Annex I habitat type

The proposed road development will result in the permanent loss of approximately 0.94ha of *Molinia* meadow habitat: an area of c.0.08ha at Na Foraí Maola (Ch. 0+900) and c.0.93ha at the southern end on the Ballindooley Lough wetland complex (Ch. 12+250 to Ch. 12+400).

In the context of the total area of *Molinia* meadow habitat recorded within the scheme study area, the areas lost represent approximately 4%. Although as noted above for the heath habitats, given the local expanse of unsurveyed upland habitat present to the north of the scheme study area this percentage figure is likely to be an overestimate of the loss of *Molinia* meadow habitat locally.

The *Molinia* meadow at Na Foraí Maola is an isolated patch with no existing connectivity to other semi-natural habitat sites across the proposed road development, largely due to the existing local road network and residential development. Therefore, habitat fragmentation effects are not likely to arise. The *Molinia* meadow affected at Ballindooley is at the very southern end of the wetland complex which itself is an isolated wetland ecosystem. Therefore, habitat fragmentation is not likely to effect the habitat or the wetland complex overall.

Accidentally introducing non-native invasive plant species into *Molinia* meadow habitat could also increase the extent and magnitude of road effects, degrading the habitat quality; as could an accidental pollution event or dust deposition during construction. During operation, air quality effects on *Molinia* meadow habitat in the vicinity of the proposed road development are not likely to affect plant species composition, diversity or abundance.

Despite the relatively small areas of habitat loss, considering the likely effects and ongoing pressures on *Molinia* meadow habitat locally the loss of any area of this Annex I habitat constitutes a negative effect on conservation status. Therefore, the loss of *Molinia* meadow habitat associated with the proposed road development will result in a likely significant negative effect at the national geographic scale.

Limestone pavement [*8240]

Exposed calcareous rock (ER2), Oak-ash-hazel woodland (WN2) and Scrub (WS1) which corresponds with this Annex I habitat type

There is c.2.3ha of Limestone pavement habitat present within the proposed development boundary. This figure includes c.0.12ha of Limestone pavement/Calcareous grassland mosaic above the Lackagh Tunnel. Of this c2.3ha, c.1.85ha lies outside of the boundary of Lough Corrib cSAC. The remainder lies within the boundary of Lough Corrib cSAC and, as assessed in the NIS, is not directly or indirectly impacted by the proposed road development (this is captured in the mitigation strategy and shown on **Figures 8.23.7** to **8.23.8** as habitat areas to be retained).

Therefore, the proposed road development has the potential to affect approximately 1.85ha of Limestone pavement habitat which lies within the proposed development boundary, and outside of Lough Corrib cSAC. In the context of the total area of

Limestone pavement habitat recorded within the scheme study area (c.180ha), the areas lost represent approximately 1%. Other areas of Limestone pavement habitat, outside of the area covered by the habitat surveys, have been mapped locally to the north of Menlough Village near Coolanillaun and Angliham Quarry (Natura, 2005) which cover an area of c.22ha. Adding this marginally reduces the percentage loss to c.0.9%.

The design of the proposed road development includes for a culvert structure to span over c.0.04ha of exposed Limestone pavement (LPE) at Ch. 10+030. This will ensure that this area of Limestone pavement is not permanently removed, the natural clint and grike structure of the pavement area is retained, and does not affect its area, or range at any geographic scale. However, some level of vegetation removal is likely to be required to facilitate construction of the culvert, and the resulting shading effects of the structure (c.4.5m high and c.30m wide, over approximately 68% of this habitat patch) will likely affect the extent and species composition of the vegetation cover beneath the structure, reducing the quality of the Limestone pavement habitat remaining. However, in the context of the overall area of Limestone pavement habitat present locally (c.202ha, of which the area partially beneath the culvert represents <0.02%), affecting the quality of such a small area is preferable than loss of the area entirely and reduces the magnitude of the impact the proposed road development will have on this habitat type.

The Menlough Viaduct passes over c.0.7ha of Limestone pavement habitat between Ch. 10+100 and Ch. 10+425; the construction of which is likely to affect the habitats beneath through vegetation removal during site clearance, habitat loss, and shading from the viaduct structure during operation. The affected habitat areas include c.0.05ha of wooded Limestone pavement (LPW) west of Bóthar Nua (Ch. 10+100) and, between Bóthar Nua and Seanbóthar (Ch. 10+130 to Ch. 10+475), c.0.07ha of LPE and c.0.67ha of LPW. The construction methodology described in the constructability report in **Appendix A.7.2**, will ensure that construction impacts will only be temporary for the majority of this area due to the limestone pavement protection system that will be used. Use of this protection system will result in any vegetation beneath it being supressed for the duration of construction. Although some level of vegetation is likely to recolonise when the temporary protection system is removed, this will be inhibited by the shading effects of the viaduct structure and the existing species composition is not likely to fully re-establish itself. The area of Limestone pavement that will be permanently lost to the supporting piers is c.0.05ha. Although the viaduct will reduce the quality of Limestone pavement habitat remaining, as above, the area affected is relatively small in the context of the local habitat resource (c.0.03%) and retaining, rather than the permanent loss of, Limestone pavement habitat reduces the magnitude of the impact the proposed road development will have on this habitat type.

The other Limestone pavement areas within the proposed development boundary, but outside of Lough Corrib cSAC, is a total area of c.1.1ha. Construction works are likely to result in either the loss of, or significant damage to, these Limestone pavement habitat areas.

There is also c.0.44ha of Limestone pavement and Calcareous grassland within Lough Corrib cSAC which lie above the proposed Lackagh Tunnel. Although this habitat area will not be directly affected by the proposed road development, tunnelling beneath it poses a risk to the structural integrity of the rock mass that supports surface above and therefore, could affect these Annex I habitats. This is assessed further in the NIS.

In terms of habitat fragmentation, the only area of Limestone pavement outside of Lough Corrib cSAC that will be bisected by the proposed road development is that beneath the Menlough Viaduct. As this structure will be elevated on piers across its length (between Ch. 10+100 to Ch. 10+425), and substantial areas of this habitat type remain on either side, the proposed road development will not have any significant fragmentation impacts on Limestone pavement habitat locally.

Accidentally introducing non-native invasive plant species into Limestone pavement habitat areas could also increase the extent and magnitude of road effects on these habitat types, degrading the habitat quality; as could an accidental pollution event or dust deposition during construction. Air quality effects on exposed or wooded Limestone pavement habitats during operation are not likely to affect plant species composition, diversity or abundance.

Despite the relatively small area of habitat affected by the proposed road development in the context of the local resource, considering the likely effects and ongoing pressures on Limestone pavement habitat, the loss of any area of this Annex I habitat constitutes a negative effect on conservation status. Therefore, the loss of Limestone pavement habitat associated with the proposed road development will result in a likely significant negative effect at the international geographic scale.

Hard water lakes [3140]

Limestone/marl lakes (FL3) which corresponds with this Annex I habitat type

The complex of Hard water lakes at the Coolagh Lakes are within Lough Corrib cSAC and are assessed in the NIS. There are no direct impacts on this habitat type in Lough Corrib cSAC. The proposed road development has the potential to affect both the groundwater and surface water regimes supporting the Hard water lake habitat in Lough Corrib cSAC.

Although there are no direct impacts on Ballindooley Lough, run-off from the proposed road development during construction has the potential to affect surface water quality. Ballindooley Lough is upgradient from the proposed road development, in terms of groundwater flow, and there is therefore no potential for groundwater impacts to the lake itself.

As an Annex I habitat type, negatively affecting the water quality status of Ballindooley Lough has the potential to degrade the Hard water lake habitat and result in a likely significant residual effect, at the national geographic scale.

Alkaline fen [7230]

Rich fen and flush (PF1) which corresponds with this Annex I habitat type

The Alkaline fen along the River Corrib and associated with the Coolagh Lakes are within Lough Corrib cSAC and, as assessed in the NIS, there are no direct impacts on this habitat type in Lough Corrib cSAC. The proposed road development has the potential to affect both the existing groundwater regime and surface water quality (during construction in the absence of mitigation measures) supporting wetland habitats in Lough Corrib cSAC.

Although there are no direct impacts on Ballindooley Lough, run-off from the proposed road development during construction has the potential to affect surface water quality and the Alkaline fen habitat associated with the wetland complex there. Ballindooley Lough is upgradient from the proposed road development, in terms of groundwater flow, and there is therefore no potential for groundwater impacts to those areas of the wetland complex that support Alkaline fen habitat.

As an Annex I habitat type, negatively affecting surface water quality at the Ballindooley Lough wetland complex has the potential to degrade the Alkaline fen habitat and potentially result in a likely significant residual effect at the national geographic scale.

Hydrophilous tall herb [6430]

Reed and large sedge swamps (FS1), Tall-herb swamps (FS2) and Marsh (GM1) which corresponds with this Annex I habitat type

The Hydrophilous tall herb habitat along the River Corrib and associated with the Coolagh Lakes are within Lough Corrib cSAC and are assessed in the NIS. There are no direct impacts on this habitat type in Lough Corrib cSAC. The proposed road development has the potential to affect both groundwater and surface water quality supporting wetland habitats, including Hydrophilous tall herb habitat, in Lough Corrib cSAC.

Cladium fen [*7210]

Reed and large sedge swamps (FS1), Tall-herb swamps (FS2) and Rich fen and flush (PF1) which corresponds with this Annex I habitat type

The *Cladium* fen along the River Corrib and associated with the Coolagh Lakes are within Lough Corrib cSAC and are assessed in the NIS. There are no direct impacts on this habitat type in Lough Corrib cSAC. The proposed road development has the potential to affect both groundwater and surface water quality supporting wetland habitats in Lough Corrib cSAC.

Although there are no direct impacts on this habitat type at Ballindooley Lough, run-off from the proposed road development during construction has the potential to affect surface water quality and the *Cladium* fen habitat associated with the wetland complex there. Ballindooley Lough is upgradient from the proposed road development, in terms of groundwater flow, and there is therefore no potential for groundwater impacts to those areas of the wetland complex that support Alkaline fen habitat.

As a priority Annex I habitat type, negatively affecting surface water quality at the Ballindooley Lough wetland complex has the potential to degrade the *Cladium* fen habitat and potentially result in a likely significant residual effect, at the international geographic scale.

Mesotrophic lakes (FL4) and Eutrophic lakes (FL5)

These lakes form part of the larger wetland complex associated with Ballindooley Lough. Although direct impacts on the eutrophic lake that lies within the proposed road development are not likely to occur, run-off from the proposed development during construction has the potential to affect the quality of these lake habitats at Ballindooley. Similarly, the existing groundwater regime could be affected by works within that portion of the eutrophic lake that lies within the proposed road development and the hydrogeological ZoI.

Negatively affecting the habitat quality of these lakes has the potential to result in a significant residual effect at the county geographic scale.

Calcareous springs (FP1)

There were 21 Calcareous springs, not corresponding to the priority Annex I habitat Petrifying springs, recorded in Lackagh Quarry. Of these, 15 will be lost as a result of construction works: four in the vicinity of the eastern entrance to the Lackagh Tunnel, 9 along the northern wall of the quarry where material will be benched up against the cliff face as a stabilisation measure, and two south of the proposed mainline between Ch. 11+700 and Ch. 11+750. The loss of a large proportion of the springs within the quarry complex, particularly considering their scarcity locally, will result in a likely significant negative effect at the local geographic scale.

Reed and large sedge swamps (FS1)

The loss of a relatively small area (c.0.14ha) of what is a locally common habitat, supporting typical species of that habitat type (*Phragmites australis* reed swamp), is not likely to affect the long-term presence or viability of this habitat type locally. However, the proposed road development does have the potential to affect water quality at Ballindooley Lough which could affect a much larger area of this habitat type (c.3.6ha or 7.8% of the local habitat resource).

Therefore, the proposed road development has the potential to affect this habitat’s conservation status and result in a likely significant negative effect at the local geographic scale.

Tall-herb swamps (FS2)

An area (c.0.03ha) of Tall-herb swamp at Ch. 3+400 will be permanently lost to the proposed road development. The loss of such a small proportion of what is a locally common habitat (c.0.8% of the c.4.09ha recorded locally within the habitat survey areas), supporting typical species of that habitat type (*Apium nodiflorum*, *Iris pseudacorus* and *Epilobium hirsutum*), is not likely to affect the long-term presence or viability of this habitat type locally. The percentage loss calculated is also likely to be an overestimate of the actual magnitude of habitat loss given the extensive wetland complex present beyond, and upstream of, the scheme study area at Coolanillaun and Tonacurragh.

Therefore, the proposed road development is not likely to affect this habitat’s conservation status locally or result in a likely significant negative effect at the local geographic scale.

Eroding/upland rivers (FW1)

A full description of the hydrological baseline of each of the watercourses discussed below is provided in **Chapter 11, Hydrology**.

Sruthán na Líbeirtí

There is approximately 530m of Sruthán na Líbeirtí within, or along, the proposed development boundary. Of this, approximately 120m will be permanently lost to construction works, with the remaining length of stream channel located along the proposed development boundary and therefore, may be affected to some degree by construction works. The impact associated with the loss of instream habitat will be offset slightly by the creation of two new sections of stream channel, c.45m and c.40m in length. The impact associated with the loss of instream habitat will be further reduced by the creation of a new section of stream channel within the culvert structure, c.125m in length. As a seasonal stream in the upper reaches (where it is directly impacted by the proposed road development), with no fish species recorded during the fisheries surveys, the loss of natural stream channel habitat is not considered to be a likely significant negative effect at any geographic scale.

Impacts to water quality in Sruthán na Líbeirtí during construction however, have the potential to have a significant negative effect, at the local geographic scale.

Trusky Stream

The proposed road development will result in the loss of approximately 220m of the Trusky Stream channel during construction. The impact associated with the loss of instream habitat will be offset slightly by the creation of a new section of stream channel, c.65m in length. The impact associated with the loss of instream habitat will be further reduced by the creation of a new section of stream channel within the culvert structure, c.50m in length.

As a seasonal stream in the upper reaches (where it is directly impacted by the proposed road development), with no fish species recorded during the fisheries surveys, the loss of natural stream channel habitat is not considered to be a likely significant negative effect at any geographic scale.

Impacts to water quality in the Trusky Stream during construction however, have the potential to have a significant negative effect, at the local geographic scale.

Bearna Stream

There is approximately 345m of the Bearna Stream (and c.240m of its unnamed tributary) within, or along, the proposed development boundary. Of this, approximately 140m of the natural river channel will be permanently lost to construction works, with the remaining length of river channel located along the proposed development boundary and therefore, may be affected to some degree by construction works. The impact associated with the loss of instream habitat will be reduced by the creation of new sections of stream channel within the culvert structures, c.140m in length. As a seasonal stream in the upper reaches (where it is directly impacted by the proposed road development), with no fish species recorded during the fisheries surveys, the loss of natural stream channel habitat is not considered to be a likely significant negative effect at any geographic scale.

Impacts to water quality in the Bearna Stream during construction however, have the potential to have a significant negative effect, at the local geographic scale.

Tonabrocky Stream

Approximately 475m of the Tonabrocky Stream channel will be permanently lost to construction works. The impact associated with the loss of instream habitat will be offset slightly by the creation of a new section of stream channel, c.250m in length. The impact associated with the loss of instream habitat will be further reduced by the creation of a new section of stream channel within the culvert structure, c.80m in length.

As a seasonal stream in the upper reaches (where it is directly impacted by the proposed road development), with a low fisheries value, the loss of natural stream channel habitat is not considered to be a likely significant negative effect at any geographic scale.

Impacts to water quality in the Tonabrocky Stream during construction however, have the potential to have a significant negative effect, at the local geographic scale.

Knocknacarra Stream

The Knocknacarra Stream is of a low ecological value in its upper reaches, where it is directly affected by the proposed road development. It is seasonal with little water present in the upper reaches, heavily culverted along a significant proportion of its length (almost 50% - see **Section 11.3.5.4** of **Chapter 11, Hydrology**), and no fish were recorded here during the fisheries survey. Its fisheries value is limited to the tidal section at the estuary, after it emerges from an extensive culverted section.

Therefore, the loss of natural river channel habitat is not considered to be a likely significant negative effect, at any geographic scale.

Impacts to water quality in the Knocknacarra Stream during construction however, have the potential to have a significant negative effect, at the local geographic scale.

Depositing/lowland rivers (FW2)

A full description of the hydrological baseline of each of the watercourses discussed below is provided in **Section 11.3.5** of **Chapter 11, Hydrology**.

River Corrib

The potential for the proposed road development to impact upon the River Corrib is assessed in **Section 8.5.3.1** above and in the NIS.

Terryland River

The proposed road development will not have any direct impact on the Terryland River. As described in **Section 11.3.5.5** of **Chapter 11, Hydrology**, the proposed road development will not affect the flow regime of the Terryland River nor will it have any perceptible impact on water quality. The proposed N83 Flood Relief Measures will result in a slight increase in flood levels within the Terryland River channel, due to the discharge of flood waters into that catchment. However, the flood impact on the Terryland basin will only be slight given the extensive flood storage and flood area within this basin.

Considering the above, and that the Terryland River is heavily modified, with poor water quality and of a low fisheries value, the proposed road development will not result in a likely significant negative effect, at any geographic scale.

Drainage ditches (FW4)

The only notable network of drainage ditches in the eastern part of the study area are those associated with the wetland habitat complex at Ballindooley Lough. None of these features will be lost as a result of construction works although construction works in the vicinity pose a risk of affecting water quality and consequently the supported aquatic vegetation. In the western part of the study area, drainage ditches are a more common habitat; associated with the boundaries of wet grassland fields and the margins of the numerous heath and peatland habitat blocks. The design of the proposed road development includes for drainage pipes and structures that will maintain the functioning of drainage and surface water networks, where these are crossed by the proposed road development. Although the actual losses of drainage ditches cannot be fully quantified (for the most part due to their seasonal nature), given the likelihood of there being extensive drainage networks associated with the locally extensive heath, peatland and wetland habitat complexes, any losses associated with the proposed road development are not likely to affect the long-term presence or viability of this habitat type locally.

Therefore, the proposed road development is not likely to affect this habitat’s conservation status locally or result in a significant negative effect at the local geographic scale.

Marsh (GM1)

The proposed road development will result in the loss of a small number of marsh areas at Na Foraí Maola Thiar, An Chloch Scoilte and Castlegar: totalling c.0.2ha. This equates to approximately 2.9% of this habitat type mapped within the scheme study area, a percentage which is likely to be an overestimate of the actual magnitude of habitat loss given the extensive wetland complex present beyond, and upstream of, the scheme study area at Coolanillaun and Tonacurragh. None of the surrounding marsh areas fall with the ZoI of potential hydrological or hydrogeological effects.

The affected habitat patches are small, isolated and do not form an integral part of any larger semi-natural mosaics. They also did not support any atypical or notable plant communities or species. The larger marsh areas recorded during the habitat surveys are associated with the wetland complex at Coolanillaun and these are beyond the ZoI of the proposed road development. Therefore, impacts on those areas that will be lost is not likely to affect the long-term presence or viability of this habitat type locally.

Therefore, the proposed road development is not likely to affect this habitat’s conservation status locally or result in a significant negative effect at the local geographic scale.

Dry calcareous and neutral grassland (GS1)

The proposed road development will result in the permanent loss of c.13.7ha of Dry calcareous/neutral grassland, and c.1.55ha of a mosaic of Dry calcareous/neutral grassland and Scrub, valued as being of Local Importance (higher value). This equates to, at most, approximately 8.4% of the total area of Dry calcareous/neutral grassland habitat recorded within the scheme study area. However, based on a review or orthophotography of the surrounding local area (not covered within the extents of the habitat map) there is likely to be a much greater area of this habitat type present locally and the quoted 8.4% is likely to be an overestimate of the percentage habitat loss.

Therefore, the proposed road development is not likely to affect this habitat's conservation status locally or result in a significant negative effect at the local geographic scale.

Dry meadows and grassy verges (GS2)

The proposed road development will result in the permanent loss of c.8.2ha of dry meadows and grassy verges habitat valued as being of Local Importance (higher value). This equates to approximately 5.2% of the total area of acid grassland habitat recorded within the scheme study area. However, based on a review or orthophotography of the surrounding local area (not covered within the extents of the habitat map) there is likely to be a much greater area of this habitat type present locally and the quoted 5.2% is likely to be an overestimate of the percentage habitat loss.

Therefore, the proposed road development is not likely to affect this habitat's conservation status locally or result in a significant negative effect at the local geographic scale.

Dry-humid acid grassland (GS3)

The proposed road development will result in the permanent loss of c.7.81ha of Dry-humid acid grassland habitat valued as being of Local Importance (higher value).

The area of Dry-humid acid grassland habitat permanently affected is approximately 10.4% of the area of this habitat recorded locally. Additional areas of habitat would be expected to be present locally, associated with the margins of peatland habitat and low-intensity managed agricultural fields present to the north and west of the proposed road development in the western part of the study area. However, these areas are likely to be relatively small based upon its extent and distribution across the habitat mapped area and are not likely to significantly affect the relative percentage loss of this habitat type locally.

Accidentally introducing non-native invasive plant species into Dry-humid acid grassland habitat could also increase the extent and magnitude of road effects, degrading the habitat quality; as could an accidental pollution event or dust deposition during construction. During operation, air quality effects on Dry-humid acid grassland habitat in the vicinity of the proposed road development are not likely to affect plant species composition, diversity or abundance.

Therefore, the proposed road development is likely to affect this habitat's conservation status locally and result in a significant negative effect at the local geographic scale.

Wet grassland (GS4)

The proposed road development will result in the permanent loss of c.11.14ha of wet grassland habitat valued as being of Local Importance (higher value). This equates to approximately 4.7% of the total area of wet grassland habitat recorded within the scheme study area. However, based on a review or orthophotography of the surrounding local area (not covered within the extents of the habitat map) there is likely to be a much greater area of this habitat type present locally and the quoted 4.7% is likely to be an overestimate of the percentage habitat loss.

Therefore, the proposed road development is not likely to affect this habitat's conservation status locally or result in a significant negative effect at the local geographic scale.

Rich fen and flush (PF1)

The Rich fen and flush habitat along the River Corrib and associated with the Coolagh Lakes are within Lough Corrib cSAC and are assessed in the NIS, where relevant in relation to the QIs of the cSAC. There are no direct impacts on this habitat type in Lough Corrib cSAC. The proposed road development has the potential to affect both groundwater and surface water quality supporting wetland habitats in Lough Corrib cSAC.

Although there are no direct impacts on this habitat type at Ballindooley Lough, run-off from the proposed road development during construction has the potential to affect surface water quality and the rich fen and flush habitat associated with the wetland complex there. Ballindooley Lough is upgradient from the proposed road development, in terms of groundwater flow, and there is therefore no potential for groundwater impacts to those areas of the wetland complex that support rich fen and flush habitat.

As a priority Annex I habitat type, negatively affecting surface water quality at the Ballindooley Lough wetland complex has the potential to degrade the *Cladium* fen habitat and potentially result in a significant residual effect, at the international geographic scale.

Poor fen and flush (PF2)

The proposed road development will result in the direct, permanent loss of c.0.13ha of Poor fen and flush habitat. There will also be an additional indirect hydrogeology impact on the fen habit at Knocknafroska (Ch. 7+800 to Ch. 7+975) as a result of groundwater drawdown will result in an additional area of c.0.27ha being permanently affected.

The area of Poor fen and flush habitat permanently affected is approximately 18% of the area of this habitat recorded locally and has all been valued as being of a local importance (higher value). Additional areas of habitat would be expected to be present locally, associated with the expanses of peatland habitat present to the north and west of the proposed road development in the western part of the study area.

However, these areas are likely to be small based upon its extent and distribution across the habitat mapped area and are not likely to significantly affect the relative percentage loss of this habitat type locally.

Dust deposition during construction could also increase the extent and magnitude of road effects, degrading the habitat quality. During operation, air quality effects on Poor fen and flush habitat in the vicinity of the proposed road development are not likely to affect plant species composition, diversity or abundance.

Therefore, the proposed road development is likely to affect this habitat's conservation status locally and result in a significant negative effect, at the local geographic scale.

(Mixed) broadleaved woodland (WD1)

The proposed road development will result in the permanent loss of c.4.25ha of (Mixed) broadleaved woodland; equating to approximately 18.8% of the local resource of this habitat type. The most significant blocks of woodland affected are near the west bank of the River Corrib (Ch. 9+460 to Ch. 9+625) where one block of c.0.8ha and a second block of c.1.55ha of woodland will be lost (this second woodland block also lies within Lough Corrib cSAC). In terms of the potential Lough Corrib cSAC impact, this is discussed separately in **Section 8.5.3.1**, under the heading of Designated Areas for Nature Conservation, and in the NIS.

Accidentally introducing non-native invasive plant species into woodland habitat could also increase the extent and magnitude of road effects, degrading the habitat quality; as could an accidental pollution event or dust deposition during construction. During operation, air quality effects on woodland habitat in the vicinity of the proposed road development are not likely to affect plant species composition, diversity or abundance.

Even considering that much of the affected woodland blocks have been planted, many for amenity purposes, the loss (and fragmentation) of such a relatively large proportion of broadleaved woodland is likely to affect this habitat's conservation status locally and result in a significant negative effect at the local geographic scale.

Mixed broadleaved/conifer woodland (WD2)

The proposed road development will result in the permanent loss of c.0.03ha of Mixed broadleaved/conifer woodland at Ch. 1+580, next to the Troscaigh Road (L5387). This is part of a small woodland block (c.0.18ha) associated with the adjoining residential property. The habitat loss will not fragment the woodland nor is it likely to affect the long-term presence or viability of this habitat type locally, there are five other mixed broadleaved/conifer woodland blocks mapped within the scheme study area, totalling an area of c.2.75ha.

Therefore, the proposed road development is not likely to affect this habitat's conservation status locally or result in a significant negative effect at the local geographic scale.

(Mixed) conifer woodland (WD3)

The proposed road development will result in the permanent loss of <0.01ha of Mixed conifer woodland at Ch. 1+580, next to the Troscaigh Road (L5387). This is part of a small woodland block (c.0.05ha) associated with the adjoining residential property. The habitat loss will not fragment the woodland nor is it likely to affect the long-term presence or viability of this habitat type locally.

Therefore, the proposed road development is not likely to affect this habitat's conservation status locally or result in a significant negative effect at the local geographic scale.

Oak-ash-hazel woodland (WN2)

The proposed road development will result in the permanent loss of c.4.18ha of Oak-ash-hazel woodland; the majority of which is located near Menlough Village. This equates to approximately 1.8% of the total area of Oak-ash-hazel woodland mapped within the scheme study area.

Accidentally introducing non-native invasive plant species into woodland habitat could increase the extent and magnitude of road effects, degrading the habitat quality; as could an accidental pollution event or dust deposition during construction. During operation, air quality effects on woodland habitat in the vicinity of the proposed road development are not likely to affect plant species composition, diversity or abundance.

Although the area directly impacted is relatively small, the potential for indirect impacts could result in long-term impacts occurring and affecting a much greater area. Therefore, the proposed road development has the potential to affect this habitat's conservation status locally and result in a likely significant negative effect at the local geographic scale.

Scrub (WS1)

The proposed road development will result in the permanent loss of c.21.12ha of Scrub across the study area; the majority of which will occur between Bearna and Ballagh. This equates to approximately 5.3% of the total area of scrub habitat mapped within the scheme study area.

However, based on a review or orthophotography of the surrounding local area (not covered within the extents of the habitat map) there is likely to be a much greater area of this habitat type present locally and the quoted 5.3% is likely to be an overestimate of the percentage habitat loss. Dust deposition during construction could also increase the extent and magnitude of road effects, degrading the habitat quality. However, given the extent of this habitat type locally, this will not pose a risk to this habitats conservation status at a local level. During operation, air quality effects on scrub habitat in the vicinity of the proposed road development is not likely to affect plant species composition, diversity or abundance.

Therefore, the proposed road development is not likely to affect this habitat's conservation status or result in a significant negative effect at the local geographic scale.

Hedgerows (WL1)

The proposed road development will result in the permanent loss of c.7.8km of Hedgerow; the majority of which will occur in the eastern part of the study area.

Although there is not sufficient data to quantify the magnitude of hedgerow loss in a local context, it is likely that the extent and distribution of the habitat locally will be affected over the long-term. Particularly considering that Hedgerows are scarce or absent from much of the study area owing to the prevalence of stone walls as field boundaries and, in the western part of the scheme study area, extensive scrub encroachment.

Accidentally introducing non-native invasive plant species could increase the extent and magnitude of road effects, degrading the habitat quality; as could an accidental pollution event or dust deposition during construction. During operation, air quality effects on hedgerow habitat in the vicinity of the proposed road development are not likely to affect plant species composition, diversity or abundance.

Therefore, the proposed road development is likely to affect this habitat's conservation status locally and result in a significant negative effect, at the local geographic scale.

Treelines (WL2)

The proposed road development will result in the permanent loss of c.4km of Treelines along its length.

Although there is not sufficient data to quantify the magnitude of Treeline loss in a local context, it is likely that the extent and distribution of the habitat locally will be affected over the long-term; particularly considering the scarcity or absence of mature treelines within the study area.

Accidentally introducing non-native invasive plant species could increase the extent and magnitude of road effects, degrading the habitat quality; as could an accidental pollution event or dust deposition during construction. During operation, air quality effects on treeline habitat in the vicinity of the proposed road development are not likely to affect plant species composition, diversity or abundance.

Therefore, the proposed road development is likely to affect this habitat's conservation status locally and result in a significant negative effect, at the local geographic scale.

8.5.5 Rare and protected plant species

There are no rare or legally protected plant species present within the proposed development boundary. There are also no rare or legally protected plant species present in locations remote from the proposed road development that could be indirectly affected by impacts on the receiving hydrogeological or hydrological environments, through dust deposition, shading effects or through introducing/spreading non-native invasive plant species. Therefore, no impacts are predicted.

8.5.6 Mammals

8.5.6.1 Otter

8.5.6.1.1 Construction Phase Impacts

Although it cannot be predicted if Otter will establish new holt or couch sites within the ZoI of the proposed road development before construction works commence, it is a possibility and this scenario has been taken into account in the mitigation strategy (refer to **Section 8.6.7.1.1**).

Loss of breeding/resting sites

Based on the findings of the field surveys carried out, as there were no Otter breeding or resting places, holt or couch sites, present within the boundary of the proposed road development, there will not be any loss of holt or couch sites as a result of construction works.

Habitat Loss

In the context of rivers directly impacted by the proposed road development, Otter were recorded along the River Corrib and within the catchment of the Tonabrocky Stream.

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 terrestrial Otter habitat as a 10m zone of riparian habitat along the river banks. On all watercourses crossed by the proposed road development, bar the River Corrib, construction works will result in the permanent loss of some level of riparian vegetation; primarily within the construction footprint of the crossing structure (or temporary crossing structures) but also, in many cases, to construct the drainage outfalls to the surface water network. Instream habitat will also be lost, or be highly modified, as a result of construction works to install culverts. The level of permanent habitat loss will be greatest on watercourses where stream realignments are proposed as part of the design: Sruthán na Líbeirtí, the Trusky Stream and the Tonabrocky Stream.

On the River Corrib, the construction of the proposed bridge structure will not result in the loss of any instream habitat nor will it result in the permanent loss of Otter habitat on the west or east bank of the river within 5m of the river bank. Nevertheless, some vegetation cutting/removal would likely be required to facilitate the construction works and on an ongoing basis as part of the maintenance works associated with the proposed road development during operation. Some effects to any remaining vegetation underneath the bridge structure would also be expected as a result of shading effects. The construction of the drainage outfalls to the River Corrib will, however, result in the loss of approximately 3m of riparian habitat on each bank.

Habitat losses of such a comparatively small scale, in the context of the instream and riparian habitat resource in all surface water catchments crossed by the proposed road development which support Otter, would not constitute a significant decline in the extent of available Otter habitat and will not affect the local Otter population's ability to maintain itself, even in the short-term. Even in a case where it would be partially converted to hard surfaces, such as where a precast concrete culvert is installed, Otter routinely use highly modified habitat within culverts and beneath bridges.

Habitat loss associated with the construction of the proposed road development will not have a likely significant effect on the conservation status of Otter and will not have a likely significant negative effect, at any geographic scale.

Habitat degradation - 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. Nevertheless, a precautionary approach is being taken in assuming a level of risk of water quality impacts and detailed mitigation measures are required to further minimise the risk of the proposed road development having any perceptible effect on water quality during construction.

Habitat degradation as a result of effects on surface water quality during construction has the potential to affect the species' conservation status and result in a likely significant negative effect, at a local geographic scale. Mitigation measures have been designed to protect water quality during construction (see **Section 8.6.4**).

Habitat Severance/Barrier Effect

The physical disturbance to the stream/river channels and the associated riparian margins will result in the severance of river habitat, at least temporarily, during construction. This may also result in some level barrier effect during construction works, on all watercourses.

However, given that Otter are generally nocturnal in habitat and works will typically be carried out during normal daylight working hours, affected Otters would be expected to habituate to the altered landscape and any resulting barrier effect would be temporary in nature (see below on disturbance/displacement and the habituation of Otters to disturbance).

The severance/barrier effect of construction works on Otter is not likely to affect the local population, over even the short-term, and is not likely to affect the species conservation status and result in a significant negative effect, at any geographic scale.

Disturbance/displacement

There were no Otter breeding or resting places present within the ZoI of the proposed road development. Therefore, there will not be any disturbance or displacement effect on such sites associated with construction works.

Otter were recorded widely along the River Corrib corridor, and in the Tonabrocky Stream catchment, and therefore increased human presence and/or noise and vibration associated with construction works, has the potential to (at least temporarily) displace commuting or foraging Otter.

Otter are known to tolerate human disturbance, including road traffic, under certain circumstances (Bailey & Rochford, 2006, The Environment Agency, 2010, Irish Wildlife Trust, 2012). This is also evidenced by the presence of Otter signs along the River Corrib through the NUIG Campus (see **Figures 8.3.1** to **8.3.14**[64]), the presence of an active Otter couch site within 50m of the Quincentenary Bridge, and the presence of Otter (including holt sites) in the urban centre of Galway City.

As construction works will typically be undertaken during normal daylight working hours and Otter are generally nocturnal in habit, and that Otter can (in many circumstances) tolerate high levels of human presence and disturbance, displacement of Otter from their habitat is extremely unlikely to affect the local Otter population. Therefore, disturbance during construction is not likely to have a significant effect on the species' conservation status and will not result in a likely significant negative effect, at any geographic scale.

8.5.6.1.2 Operational Phase Impacts

Habitat Severance/Barrier Effect

The installation of new culverts or bridge structures has the potential to result in a permanent barrier to Otter movement along watercourses crossed by the proposed road development. Particularly during periods of spate flow or flooding, where increased water volumes and flow rates may render the structure impassable by Otter.

In the case of the proposed River Corrib Bridge, this impact will not arise as it is a clear span structure and will not affect the existing hydrological regime or functioning of the floodplain (see **Chapter 11, Hydrology**). Therefore, the Otter population associated with the River Corrib (and thus Lough Corrib cSAC) will not be affected in this regard. However, on all other watercourses (whether used by Otter at present, such as the Tonabrocky Stream, or not) the risk of the crossing structure resulting in a barrier effect is possible.

[64] There is a distinct difference in recorded levels of Otter signs/activity between the west and east banks of the River Corrib in the vicinity of the proposed River Corrib Bridge; with Otter clearly favouring the east bank of the River Corrib than that on the side of NUIG Sporting Campus. Although whether this is as a result of the west bank being more accessible to the public (and hence subject to higher levels of disturbance, particularly due to the presence of dogs), as a result of the open, and sparsely vegetated, nature of the riparian margin on the west bank, or some combination of the two, is unknown.

The habitat severance/barrier effect to Otter associated with the proposed road development has the potential to affect local Otter populations over the long-term, potentially affecting the species' conservation status, and result in a likely significant negative effect, at a local geographic scale. Mitigation measures to maintain mammal passage along watercourses used by Otter have been designed (see **Section 8.6.7.1.2**).

Disturbance/displacement

As discussed above in relation to construction impacts, Otter can be relatively tolerant of human and traffic disturbance. Any increased level of disturbance associated with the operation of the proposed road development is therefore, extremely unlikely to result in any perceptible disturbance/displacement of Otter from their habitat.

Nocturnal mammals, such as the Otter, would be likely to be disturbed by the introduction of artificial light into established breeding and foraging areas (Rich & Longcore, 2005).

Lighting will be provided for the proposed NUIG Sports Pitches. Whist there is planning permission to floodlight the existing pitches adjacent to the river, they are currently unlit. There is no holt located within or near the area of light spill from the proposed lighting for the proposed NUIG Pitches. The light spill will not impede Otter from using the River Corrib for feeding or commuting.

There will be no light spill to any other watercourses where Otter were recorded and there will not be any impacts in that regard.

Disturbance or displacement associated with the operation of the proposed road development is not likely to affect the conservation status of Otter and therefore, will not result in a likely significant negative effect, at any geographic scale.

Habitat degradation - water quality

There will be outfall points to surface water features from the road drainage network during operation. The proposed drainage design for the mainline of the proposed road development incorporates pollution control measures (this includes petrol interceptors, wetland and other measures, such as SuDS) followed by either infiltration ponds (where discharging to ground) or attenuation ponds (where drainage will be discharged to the existing surface water/storm sewer), as described in detail in **Chapter 5, Description of Proposed Road Development**.

Those sections of the road drainage that are to be discharged to ground, pose no risk to surface water quality. It is extremely unlikely that the normal operating water quality of the drainage outfalls discharging to the existing surface water/drainage network, even in the unlikely event of a pollution incident, would have any perceptible impact on water quality in receiving watercourses. The functioning and effectiveness of both elements of the road drainage network are discussed in more detail in **Chapter 11, Hydrology**.

Habitat degradation as a result of effects on surface water quality during operation is not likely to have any effect on the Otter population or its conservation status, and therefore will not result in a likely significant negative effect, at a local geographic scale.

Mortality Risk

The introduction of the proposed road development into a rural landscape, which includes new watercourse crossings, will permanently increase the risk of road traffic collisions with Otter; particularly where Otter have been recorded (see **Figures 8.3.1** to **8.3.14**). The exceptions to this are along the River Corrib, where the proposed road development is elevated above the river and floodplain such that it would not be accessible by Otter, and the Menlough Viaduct which is elevated above the turlough at Ch. 10+320.

Although it is not possible to quantify the magnitude of the effect, the increased collision risk has the potential to result in long-term effects on Otter populations locally, potentially affecting their local conservation status.

Collision risk to Otter associated with the proposed road development has the potential to result in a likely significant negative effect, at the local geographic scale. Mitigation measures have been designed to avoid this potential impact (see **Section 8.6.7.1.2**).

8.5.6.2 Bats

This section of the impact assessment deals with impacts on bats species. Firstly, it describes the different types of impacts that could potentially affect all bat species and then secondly deals with the potential impacts on each species individually.

8.5.6.2.1 Construction Phase Impacts

Roost Loss

Fifteen buildings supporting 20 bat roosts are within the proposed development boundary (6 Soprano pipistrelle roosts (PBR177, 179, 196, 205, 255, 267), 1 Common pipistrelle roost (PBR205), 1 unidentified Pipistrelle bat roost (PBR182), 7 Brown long-eared bats roosts (PBR 183, 178, 179, 196, 204, 256, 267), 3 Lesser horseshoe bat roosts (PBR178, 204, 210) and two unidentified species bat roosts (253, 270). Six of these are structures used by more than one bat species. **Figures 8.18.1** to **8.21.1** show the locations of these roosts.

Fourteen of these structures are proposed for demolition (see **Table 8.28** below), with one of the structures (PBR241) to be retained, protected from adverse impacts and bat roost features fitted to the structure. One structure (PBR183) will be demolished but an outbuilding will be retained for the purposes of compensation for loss of other roosts.

Table 8.28: Bat roosts to be removed as part of the proposed road development

Approx. Chainage	Roost reference	Roost type
Ch. 5+550	PBR267	Building. Roost for small numbers of Soprano pipistrelle and Brown long-eared bats (likely to be a transition/occasional roost)
Ch. 8+600	PBR256	Building. Brown long-eared maternity roost.
Ch. 8+650	PBR255	Building. Roost for small numbers of Soprano pipistrelle bats (likely to be a transition/occasional roost)
Ch. 8+650	PBR178	Building. Lesser horseshoe bat roost. Juvenile bats present late in the maternity season but not proven to be a maternity roost. Loss of maternity roost for Brown long-eared bats
Ch. 8+700	PBR177	Building. Roost for small numbers of Soprano pipistrelle bats (likely to be a transition/occasional roost)
Ch. 8+750	PBR210	Building. Lesser horseshoe bat night roost
Ch. 10+050	PBR179	Building. Roost for small numbers of Soprano pipistrelle and Brown long-eared bats (likely to be a transition/occasional roost)
Ch. 11+400	PBR253	Building. Roost for small numbers of unidentified bats (likely to be a transition/occasional roost)
Ch. 12+150	PBR204	Building. Lesser horseshoe bat and Brown long-eared bat day/night roost for small numbers of bats
Ch. 12+150	PBR182	Building. Roost for small numbers of unidentified Pipistrelle bats (likely to be a transition/occasional roost)
Ch. 12+150	PBR196	Building. Roost for small numbers of Soprano pipistrelle and Brown long-eared bats (likely to be a transition/occasional roost)
Ch. 12+960	PBR183	Building. Roost for small numbers of Brown long-eared bats (likely to be a transition/occasional roost)
Ch. 15+100	PBR205	Building. Roost for small numbers of Common and Soprano pipistrelle bats (likely to be a transition/occasional roost)
Ch. 15+250	PBR270	Building. Roost, possibly abandoned. Unidentified species

Two trees will be felled (PTR48, PTR43) that have been confirmed as supporting bats (Leisler's bat and Soprano pipistrelle bat respectively) and an additional 13 trees have high (category 1) potential to support bats and will also be felled. **Figures 8.16.1** to **8.16.15** show the locations of these trees.

The potential impacts of the permanent loss of these 14 roost structures, apart from the Lesser horseshoe bat roosts, and the two trees are deemed to be significant at a local level as they are valued as important at the local geographic level, almost all had a low number of bats using them and were recorded using other roost sites across the study area which will not be impacted by the proposed road development.

The impacts of the loss of the Lesser horseshoe bat roosts are potentially significant at a national level in the absence of mitigation measures. Evidence confirms that the roost at Aughnacurra (PBR178) is a satellite roost linked to Menlo Castle. Given that the physical structure of the Menlo Castle roost may be deteriorating, the Aughnacurra roost could be a relatively new addition to their network of roosts. The Aughnacurra satellite roost (PBR178) is within a sub-optimal building in terms of the preferred building type for this species and its occupation by bats may be a reflection of the lack of availability of better roost opportunities in the area.

Therefore, the loss of the satellite Lesser horseshoe bat roost at Aughnacurra (PBR178) and the loss of other Lesser horseshoe bat night roosts (PBR204, PBR210) within their foraging area could result in a likely significant effect on the Lesser horseshoe bat at a national geographic scale, in the absence of any measures to address this impact.

In the context of the potential impact on the Lough Corrib cSAC, of which Lesser horseshoe bats are a QI, although this species is present within the study area, the roost that forms the QI population for this European site (Eborhall House) is more than 30km away from the proposed road development, on the northern shore of Lough Corrib. This distance would be regarded to be beyond the normal core foraging range of the Eborhall 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 study area) undertaken for this project in 2014 and 2015 (*N6 Galway City Transport Project Route Selection Report*, Arup, 2016) did not suggest any evidence of movement between that population and the Eborhall House roost. Given the lack of any linkage between the study area and the roosts that are the reason for designation of this European site, likely significant effects on the Lough Corrib cSAC's Lesser horseshoe bat population have been ruled out.

Twelve other bat roosts were deemed to be in close proximity to the proposed road development (within 100m) of the proposed development boundary. Potential direct impacts are predicted on these roosts as a result of disturbance during the construction phase, although it is acknowledged that in some areas this impact may be of a lower magnitude than others as the boundary is set back from the actual construction footprint.

These roosts include night roosts for Lesser horseshoe bats, day roosts for Soprano and Common pipistrelle bats, Leisler's bats and a possible maternity roost for Brown long-eared bats. This is predicted to result in a likely significant effect at a local geographic scale for all of these species, in the absence of mitigation. **Table 8.29** describes these roosts.

Only PBR173 and PBR154 are suspected to be vulnerable to a significant level of construction impacts. PBR173 is a suspected maternity roost for Brown long-eared bats and PBR154 is a known night and occasional day roost for small numbers of Lesser horseshoe bats alongside the N84 Headford Road. All other roosts are set back from the proposed development boundary or are in locations where the construction works for the proposed road development are less likely to be as intrusive.

The species that is potentially incurring the greatest potential loss of roosting is the Soprano pipistrelle bat population, which also happens to be the most commonly occurring bat in the country and recorded at almost all recording locations in the study area.

The impact on population of Lesser horseshoe bats lost as a result of demolition comes from the loss of one property at Aughnacurra (PBR178), a satellite roost to Menlo Castle (PBR06) (which itself will not be affected by the demolition works).

Table 8.29: Bat roosts adjacent to the proposed road development or known to be used by bats that cross the proposed road development

Approx. Chainage	Roost reference	Roost type
Ch. 1+600	PBR225	Building. Possible maternity roost for Soprano pipistrelle bats, Brown long-eared bats also present
Ch. 4+500	PBR139	Building. Roost for small numbers of Leisler’s bats
Ch. 7+400	PBR49	Building. Roost for small numbers of Soprano pipistrelle and Brown long-eared bats (likely to be a transition/occasional roost)
Ch. 8+150	PBR173	Building. Possible maternity roost for Brown long-eared bats, small roost
Ch. 0+50 N59 Link Road North	PBR73	Church. Historical record of Natterer’s roost
Ch. 9+375	PBR06	Menlo Castle. Maternity roost for Lesser horseshoe bat. Also roost for Daubenton’s bats
Ch. 9+700	PBR156	Gateway arch. Night roost for Lesser horseshoe bats and Brown long-eared bats
Ch. 10+050	PBR219	Limestone feature. Night roost for Lesser horseshoe bats
Ch. 10+700	PBR129	Building. Lesser horseshoe bat night roost
Ch. 10+700	PBR85	Building. Lesser horseshoe bat night roost
Ch. 12+150	PBR154	Building. Lesser horseshoe bat night roost
Ch. 13+000	PBR145	Building. Possible maternity roost for Brown long-eared bats, small roost
Ch. 13+000	PBR153	Building. Lesser horseshoe bat day/night roost
Ch. 13+600	PBR192	Building. Roost for small numbers of Brown long-eared bats (likely to be a transition/occasional roost)
Ch. 13+900	PBR228	Building. Roost for small numbers of Common pipistrelle bats (likely to be a transition/occasional roost)

Approx. Chainage	Roost reference	Roost type
Ch. 14+450	PBR242	Building. Roost for small numbers of unidentified Pipistrelle bats (likely to be a transition/occasional roost)
Ch. 13+000	PBR54	Building. Day/night roost for small numbers of Lesser Horseshoe bats. This roost is linked to the Menlo Castle roost and Cooper's Cave
Ch. 13+100	PBR112	Cooper's Cave. Day/night roost for small numbers of Lesser Horseshoe bats. Mating, summer and hibernacula. This roost is linked to Menlo Castle and bats cross the proposed road development in several places when moving between the two roosts

The potential impacts on these roosts varies considerably as it depends on the degree of linkages between the roost and the proposed road alignment, the degree of severance of connecting features, potential effects of light spill etc. These impacts are therefore addressed in the relevant sections below. Mitigation to protect bats during the removal of roosts are detailed in **Section 8.6.7.2.1**.

Habitat Loss

Bats rely on suitable semi-natural habitats which support the insect prey upon which they feed. The proposed road development will result in the loss of such habitats used for feeding by all bat species recorded in the study area. The studies of several different species as part of the collection of baseline data has demonstrated that more open habitats including pastures, open heathland and suburban gardens are also used by bats. Therefore, there are actually very few areas within the corridor of the proposed road development that are considered unsuitable for bats. These would be restricted to locations where the proposed road development crosses main roads and connects to the existing dual carriageway near Oranmore. All other locations are potentially used by bats.

The direct loss of foraging habitats will have an adverse effect on the individual bats that have been using these areas as it represents a loss of feeding resources. Where these feeding resources are close to roosts it may lead to decline in use of the roosts as bats tend to feed close to roost especially prior to giving birth when they need to save energy. Scientific data has been collected so that the extent of the foraging habitat used by the Lesser Horseshoe bats roosting at Menlo Castle has been determined. However, for other confirmed roosts the extent of the foraging habitats can only be estimated. Scientific data on the mean size of foraging areas for each species was sourced from research literature and was used to identify likely core foraging areas for the other species of bats.

The UK Bat Conservation Trust (BCT) has published research results on the identification of Core Sustenance Zones (CSZs) for different bat species. A CSZ refers to the area surrounding a communal bat roost within which habitat availability and quality will have a significant influence on the "resilience and conservation status" of the colony using the roost. The 2016 guidance states that:

"*With reference to planning and development the core sustenance zone is:*

- *The area surrounding the roost within which development work can be assumed to impact the commuting and foraging habitat of bats using the roost, in the absence of information on local foraging behaviour. This will highlight the need for species-specific survey techniques where necessary.*
- *The area within which mitigation measures should ensure no net reduction in the quality and availability of foraging habitat for the colony, in addition to mitigation measures shown to be necessary following ecological survey work."*

The core sustenance zone for the Irish bat species are listed below in **Table 8.30** with an indication of the level of confidence attached to the zone size.

Table 8.30: Bat roosts adjacent to the proposed road development and CSZ

Species	CSZ radius (km)	Confidence in zone size
Lesser horseshoe bat	2-3	Good: The CSZ in the context of the roost at Menlo Castle and at Coopers Cave is regarded to be 3km (mean maximum foraging distance 2.93km in August 2014, 3.39km in August 2014, 2.86km in May 2015). This has been calculated using the same approaches as outlined in the BCT guidance. In the context of other day roosts the CSZ of 2km has been applied.
Brown long-eared bat	3	Poor. No data on mean-maximum distance between roost and foraging areas available from the literature. In addition, the calculated weighted average (based on the number of bats used to calculate the CSZ) (3.45km) lies just below the threshold where it was rounded down to give a CSZ size of 3km. The CSV of the Brown Long-eared bat that was studied during radio-tracking in 2014 is regarded to be approximately less than 4km radius (maximum foraging distance was 4.07km but data collection only took place over 2 days). Since only one bat was tracked, the BCT recommended CSZ distance of 3km has been used.
Daubenton's bat	4	Poor. No data on mean-maximum distance between roost and foraging areas available from the literature. In addition, the calculated weighted average (based on the number of bats used to calculate the CSZ) (3.5001km) lies just above the

Species	CSZ radius (km)	Confidence in zone size
		threshold where it was rounded up to give a CSZ size of 4km. The maximum foraging distances of the Daubenton's bats that were studied has shown a limited feeding area within the Corrib corridor up to 2.5km from the roost. Due to the low numbers of bats that were analysed the BCT recommended CSZ distance of 4km has been used.
Natterer's bat	4	Good. Calculation based on a reasonable sample size from multiple colonies and studies.
Whiskered bat	1	Poor. Data available from multiple colonies but only for a single study for M. mystacinus.
Common pipistrelle bat	2	Moderate. Data available from multiple colonies but only from a single study.
Soprano pipistrelle bat	2	Good. Calculation based on a reasonable sample size from multiple colonies and studies.
Nathusius' pipistrelle bat	3	Poor. Calculation based on small sample size.
Leisler's bat	4	Poor. Calculation based on small sample size.

Unidentified bats have been given a CSZ radius of 3km which represents the average of the above CSZ radii.

For all confirmed roosts that were identified during the field surveys, the proportion of the CSZ that will be lost as a result of the proposed road development was calculated (refer to **Appendix E** for details). Whilst the CSZ is a generic radial distance from the roost, in some cases not all of this habitat would be regarded to be suitable foraging habitat for bats as it included built land with little suitable habitat to provide foraging resources. Bats will therefore not use all of the CSZ; they will selectively feed in the most resource-rich areas. However, such potentially unsuitable areas within the footprint of the proposed road development were not deducted from the CSZs for each roost, thereby giving a worst-case scenario for the assessment of impacts. CSZs around night roosts have not been included in this analysis as theoretically these roosts occur within the CSZ of the associated day roost.

The level of significance of the loss of these habitats is described in terms of impacts on individual roosts and then on the patterns of bat foraging as suggested by the bat activity data.

It is important to note that the percentage loss of area within the CSZ does not account for any additional barrier effects provided by the road which could prevent bats reaching foraging areas on the other side of the proposed road development. Research by Berthinussen and Altringham (2012a, 2012b, 2015) has identified landscape-scale reductions in bat activity and diversity as a result of the construction of road developments in the UK. Whilst barrier effects and severance of flight paths has been clearly demonstrated, the causes of displacement of bats from the margins of the corridor of the proposed road development are less clear. (Also see Bontadina et al. (2002), Reiter et al., (2013), CALTRANS (July 2016): *Technical Guidance for the Assessment and Mitigation of the Effects of Traffic Noise and Road Construction Noise on Bats*, Luo et al., (2015)).

The scale of significance of habitat loss during construction was therefore influenced by:

- the nature of the roost (transition/occasional roost occasionally used by small numbers of bats compared to maternity roosts for larger numbers of bats)
- Records of bats within the CSZ indicating concentrations of feeding within the CSZ which could suggest some areas being more important than others
- Proportion of suitable habitat within the CSZ
- Potential for the proposed road development to form a barrier to reaching the remaining portions of the CSZ (i.e. whilst the loss of CSZ may be very small, bats may not be able to reach it and consequently a larger proportion of the CSZ may actually be unavailable)

Table 8.31 describes the scale of the loss of habitats within the theoretical CSZ for each bat roost within the proposed development boundary. **Table 8.32** describes the scale of habitat loss associated with bat roosts which will not be removed as a consequence of the proposed road development.

Table 8.31: Extent of direct habitat loss within the theoretical core sustenance zone relating to the roosts within the proposed development boundary (* takes into account that c.10ha of foraging habitat is being retained intact within the boundary of the proposed road development at Menlough)

Approx. Chainage	Roost reference	Species	Area of habitat loss within the CSZ	% of CSZ	Likely significance of Impact of habitat loss
Ch. 3+320	PBR241 (Building to be retained)	Soprano pipistrelle bats	37ha	2.95%	The CSZ includes Bearna Woods on the opposite side of the road though access may be severed by the proposed road development. This species has been recorded to the north west where there is good foraging habitat available. Habitat unlikely to be a limiting factor in the locality. Due to the small size of the roost, the availability of suitable foraging habitat and the lack of evidence for severance of key roost attributes this impact is likely to result in a significant negative effect at a local geographic scale only.
Ch. 5+550	PBR267	Soprano pipistrelle bats Brown Long-eared bats	46ha 79ha	3.66% 2.79%	The CSZ includes a large proportion (estimated at >30%) of built land which is unlikely to actually be part of the CSZ. Brown long-eared bats have been recorded at 3 other locations to the north and west where there is good foraging habitat available. Habitat unlikely to be a limiting factor in the locality. Due to the small size of the roost, the availability of suitable foraging habitat and the lack of evidence for severance of key roost attributes this impact is likely to result in a significant negative effect at a local geographic scale only.
Ch. 8+600	PBR256	Brown Long-eared bats (maternity)	100ha*	3.54%	The CSZ includes a mixture of suburban, dense urban and rural landscapes. A large proportion of the CSZ area is of low suitability and this is to the south (opposite side) of the proposed road development. Few records of this species are found south of the road so it is predicted that bats in this

Approx. Chainage	Roost reference	Species	Area of habitat loss within the CSZ	% of CSZ	Likely significance of Impact of habitat loss
					roost are likely to rely on the local wooded suburbs in Aughnacurra, Glenlo Abbey and Menlough Village and are likely to use the unlit River Corrib corridor to move across the local landscape. The N59 Moycullen Road is currently likely to present a degree of barrier effect to regular movements as it is illuminated by pole mounted lights. Bats will also be able to continue using the unlit Corrib river corridor during the construction phase. Overall, the impact of habitat loss during construction is likely to result in a significant negative effect at a local geographic scale since these bats will be able to utilise the majority of suitable habitat in the CSV that is currently available to them.
Ch. 8+620	PBR178	Lesser horseshoe bat Brown long-eared bats	64ha* 101ha*	5.1% 3.57%	Lesser horseshoe bats: The radio-tracking studies did not record any of the tagged bats using this roost so it cannot be stated with confidence these bats use the same foraging areas as the bats from Menlo Castle/Cooper's Cave. However, it would be reasonable to assume that they prefer similar habitats including woodland, scrub, suburban gardens and wetlands. The loss of the habitats for any remaining bats is likely to result in a significant negative effect at a local geographic scale, as the proportion of suitable habitat within the CSZ is predominantly to the north away from the proposed road development. Despite several studies in the NUIG Campus to the south of the road, the records of Lesser horseshoe bats there appears to be relatively few and perhaps limited by the open landscape and effects of public lighting nearby.

Approx. Chainage	Roost reference	Species	Area of habitat loss within the CSZ	% of CSZ	Likely significance of Impact of habitat loss
Ch. 8+650	PBR255	Soprano pipistrelle bats	64ha*	5.1%	The CSZ includes a mixture of suburban, dense urban and rural landscapes. A large proportion of the CSZ area is of low suitability and this is to the south (opposite side) of the proposed road development. Few records of this species are found south of the road so it is predicted that bats in this roost are likely to rely on the local wooded suburbs in Aughnacurra, Glenlo Abbey and Menlough Village and are likely to use the unlit River Corrib corridor to move across the local landscape. The N59 Moycullen Road is currently unlikely to present a degree of barrier effect to regular movements as this species is recorded on both sides. Bats will also be able to continue using the unlit River Corrib corridor during the construction phase. Overall, the impact of habitat loss during construction is likely to result in a significant negative effect at a local geographic scale since these bats will be able to utilise the majority of suitable habitat in the CSV that is currently available to them and are not reliant on having to cross the construction area to reach foraging areas.
Ch. 8+700	PBR177	Soprano pipistrelle bats	65ha*	5.18%	The CSZ includes a mixture of suburban, dense urban and rural landscapes all of which may be utilised by this species. A large proportion of the CSZ area is of lower suitability and this is to the south (opposite side) of the proposed road development. This species has been recorded widespread across its theoretical CSZ. The N59 Moycullen Road is currently unlikely to present a degree of barrier effect to regular movements as this species is recorded. Bats will also

Approx. Chainage	Roost reference	Species	Area of habitat loss within the CSZ	% of CSZ	Likely significance of Impact of habitat loss
					be able to continue using the unlit Corrib river corridor during the construction phase. Overall, the impact of habitat loss during construction is likely to result in a significant negative effect at a local geographic scale, since these bats will be able to utilise the majority of suitable habitat in the CSV that is currently available to them and are not reliant on having to cross the construction area to reach foraging areas.
Ch. 10+050	PBR179	Soprano pipistrelle bats Brown long-eared bats	75ha 116ha	5.97% 4.1%	The CSV for both species includes the River Corrib which appears to be an important feature for bats and will not be affected in terms of habitat loss or its function as a corridor to permit passage to other foraging areas. The loss of the foraging habitats near the roost is a small proportion of that located in the surrounding area and it is unlikely the loss will result in a significant negative effect any greater than at the local geographic scale. Foraging opportunities will still be available on both sides of the proposed road development immediately adjacent to the fenceline for both species so if there is a barrier effect caused during construction then this is unlikely to translate into a decline in foraging close to the road.
Ch. 11+400	PBR253	Unidentified bats	122ha (3km radius CSZ)	4.32%	The CSZ is centred over Lackagh Quarry which itself offers little suitable feeding habitat but clearly, as suggested by the radio-tracking and use of unattended detectors, was used by seven species of bats. Areas of open water and the shelter offered by the quarry walls may offer good conditions for feeding. The area of the proposed road development will use all of the quarry area during construction but the topography

Approx. Chainage	Roost reference	Species	Area of habitat loss within the CSZ	% of CSZ	Likely significance of Impact of habitat loss
					of the quarry lend itself to providing linear “guides” across the construction area. Given that the roost itself is unlikely to harbour large numbers of bats, it is likely that the roost does not rely on the immediate surrounding habitat. Therefore, the loss of the habitat is not likely to result in a significant negative effect any greater than at the local geographic scale.
Ch. 12+150	PBR204	Lesser horseshoe bats Brown long-eared bats	76ha (2km radius CSZ) 126ha	6.05% 4.46%	The immediate surroundings of the roost are the detached dwellings and other properties fronting the N84 Headford Road. The surrounding habitats are deemed to be of moderate suitability for both species but better to the north than toward the city to the south. The loss of the habitat is unlikely to manifest itself in a loss of foraging resources as habitats to the north will still be accessible. However, this section was identified as a location where Lesser horseshoe bats cross the width of the alignment and thereby the loss of the connecting habitats could restrict movements for some of the bats from the Menlo Castle/Cooper’s Cave roosts. This barrier effect caused by habitat loss could cause a potential impact predicted to be significant at a National geographic scale in the absence of mitigation due to the importance of this crossing point for Lesser horseshoe bats at this location. The impact on Brown long-eared bats is likely to result in a significant negative effect at a local geographic scale due to the more widespread occurrence of this species in the CSZ as suggested by the other survey results.

Approx. Chainage	Roost reference	Species	Area of habitat loss within the CSZ	% of CSZ	Likely significance of Impact of habitat loss
Ch. 12+150	PBR182	Unidentified pipistrelle bats	126ha	4.46%	This roost was not deemed to be a currently active roost and only two droppings were found so the effects of habitat loss of this roost is likely to, at most, result in a significant negative effect at a local geographic scale.
Ch. 12+150	PBR196	Soprano pipistrelle Brown long-eared bats	78ha 126ha	6.21% 4.46%	This roost hosts a single bat or small numbers of both species. Its theoretical CSZ includes stretches from the River Corrib in the west to the Galway Racecourse to the east and includes habitats of high suitability mostly in the northern half and around the Coolagh Lakes. In reality, the likely CSZ does not include the most built-up areas of developed lands to the south and probably includes Ballindooley Lough and its network of hedgerows. The loss of the roost and the habitats within the theoretical CSZ is unlikely to affect the local population of both species which will still have plenty of foraging habitat available. They are also less likely to be significantly affected by the barrier effects posed by the habitat loss due to the small numbers of bats involved.
Ch. 12+960	PBR183	Brown long-eared bats	118ha	4.17%	The habitats closest to this suspected transition/occasional or night roost for this species were relatively open and not regarded to be optimal feeding habitat for this species. The likely CSZ would be expected to exclude lands to the southwest toward Ballinfoyle which are more built up and be skewed toward the rural landscape to the north and west. Since there will be plenty of foraging habitats available to the local bat population for this species, the only impact that could potentially be significant could be caused by the barrier effect of removal of connecting landscape features. Bats of this species that were radio-tracked in 2014 (bat no.

Approx. Chainage	Roost reference	Species	Area of habitat loss within the CSZ	% of CSZ	Likely significance of Impact of habitat loss
					5) generally stayed to the south of the proposed road development footprint.
Ch. 15+100	PBR205	Common and Soprano pipistrelle bats	92ha	7.32%	Bats in this roost at the racecourse are likely to have their CSZ encompassing lands to the east and the west as suggested by the suitable habitats found there and bat detector records for both species in these areas. The CSZ is unlikely to stretch to the southwest due to lack of suitable habitats there so even if there is a barrier effect caused by habitat loss there is not likely to be a significant negative effect.
Ch. 8+750	PBR210	Lesser horseshoe bat	NA	NA	Night roost for Lesser horseshoe bats. Since this is within the range of a day roost (likely to be PBR178 or PBR06) the impact on the CSZ is covered by the commentary above.
Ch. 15+250	PBR270	Unidentified bat species	106	3.76	This roost may be abandoned as evidence was limited to small number of old droppings. Bats in this roost to the east of the racecourse are likely to have their CSZ encompassing lands to the east and the west as suggested by the suitable habitats found there. The CSZ is unlikely to stretch to the southwest due to lack of suitable habitats there so even if there is a barrier effect caused by habitat loss there is not likely to be a significant negative effect.

Table 8.32: Extent of direct habitat loss around confirmed bat roosts (day roosts close to the proposed development boundary, but not to be removed) (* takes into account that c.10ha of foraging habitat is being retained intact within the boundary of the proposed road development at Menlough)

Chainage	Roost reference	Species	Area of suitable habitat loss	% of likely core foraging area.	Likely significance of Impact of habitat loss
Ch. 1+600	PBR225	Soprano pipistrelle bats Brown long-eared bats	35ha 44ha	2.79% 1.56%	This roost is a possible maternity roost for Soprano pipistrelle bats and is located close to the footprint of the proposed road development. Whilst screened by a cluster of trees, the buildings will be close to earthworks and site clearance and be adversely affected by these. Surrounding habitats are mostly heath and peatland and whilst open in nature they do support feeding resources as suggested by detector records for this species along the minor roads. The impact of habitat loss is likely to result in a significant negative effect at a local geographic scale during construction due to the barrier effect likely to be posed by the proposed road at this location.
Ch. 4+500	PBR139	Leisler's bat.	100ha	1.99%	This property on the Cappagh Road was used by a tagged Leisler's bat. This species is known to move roost locations frequently and is also less affected by severance of landscape connectivity. It is predicted that there will be little material disturbance to the landscape close to the roost and that the habitat loss is unlikely to affect this small roost.
Ch. 7+400	PBR49	Soprano pipistrelle Brown long-eared bats	64ha 82ha*	5.1% 2.9%	This roost on the Letteragh Road is likely to be supported by the woodland immediately surrounding the buildings and also small clusters of woodland and hedgerows to the southwest at Mincloon. The removal of habitats will include some optimum habitat for both species and will also pose a considerable barrier effect to movements to the north east from the roost due to the proposed N59 Letteragh Junction. Overall the

Chainage	Roost reference	Species	Area of suitable habitat loss	% of likely core foraging area.	Likely significance of Impact of habitat loss
					potential impact is likely to result in a significant negative effect at a local geographic scale.
Ch. 8+150	PBR173	Brown long-eared bats	92ha*	3.25%	This potential maternity roost for this species is located close to the footprint of the proposed road development and it is likely that the removal of habitats will result in loss of foraging and connections to other foraging resources. However, habitats preferred by this species would be the taller dense hedgerows and gardens in The Heath to the south which will remain connected to the current roost location. However, the indirect effects of habitat loss may result in disturbance to the roost on the basis of proximity alone. Such an impact is likely to result in a significant negative effect, at a local geographic scale.
Ch. 0+50 N59 Link Road	PBR73	Natterer's bat	122ha*	2.43%	This roost at St James's Church was recorded by Members of Galway Bat Group. This is only one of three roosts for this species and bat detector records for Myotis species generally are thinly distributed across the study area. The location of the roost is close to a proposed link road in cut which could affect flight paths if bats are present. Significant impacts on this species are unlikely given the absence of any evidence that the roost is occupied. The N59 Moycullen Road is also illuminated at this location and may prevent bats flying eastwards. Suitable habitat for this species are also found to the south and landscape connectivity in this location will not be compromised by the proposed road development.
Ch. 9+375	PBR06	Lesser horseshoe bat	88ha* (based on merged	3.35%	Menlo Castle roost is located at the edge of the proposed development boundary for the proposed road development but is 140m from the likely working area. This distance is unlikely

Chainage	Roost reference	Species	Area of suitable habitat loss	% of likely core foraging area.	Likely significance of Impact of habitat loss
		Daubenton's bats.	radio tracked bats MCPs from 2014 and 2015) 11ha* (based on core foraging area recorded May 2015) 129ha*	8.8% 2.57%	to directly affect the roost during the construction as most Lesser horseshoe bats were noted to fly straight into the adjoining hedgerows and hugged the edge of the castle. The loss of habitats is likely to affect the foraging resources to the highest degree during the pre-partum period (May-June) when female bats tend to hunt close to the roost. Radio-tracking of bats in 2015 in this period notes that the CSZ is bisected by the road corridor with c.45ha left to the southeast and c 70ha to the northwest. There is suitable habitat within 2km of the roost that bats are known to use at other times of year and it is not unreasonable that bats may adapt their CSZ geometry to address changes in the landscape providing there are linkages to do so. Nevertheless, the potential loss of pre-parturition feeding habitat (11ha, of which 8ha is thought to be optimum feeding habitat) and the potential indirect loss of feeding habitats due to a barrier effect (45ha) is likely to result in a significant negative effect at a national geographic scale, as it could threaten the long-term viability of the roost. The potential impact on the Daubenton's roost during construction is not deemed to be significant as bats will be able to reach feeding ground in the river corridor unimpeded and there will be no loss of this habitat type from their CSZ. Other habitats types will be removed but are less likely to be utilised as suggested by radio-tracking data collected for this species.
Ch. 13+000	PBR145	Brown long-eared bats	120ha	4.24%	This roost was used by a post-lactating female which could be a small maternity roost for this species. It was captured at Cooper's Cave and is therefore known to fly in the area south of Castlegar. In the absence of any radio-tracking data to

Chainage	Roost reference	Species	Area of suitable habitat loss	% of likely core foraging area.	Likely significance of Impact of habitat loss
					confirm the location of the CSZ, it is predicted that the loss of habitat to the north of the roost may cause depreciation in the foraging resources available to the colony and lowering of fecundity. It is unlikely that the roost would be abandoned as there is still plenty of foraging habitat available to the south. Therefore, such an impact is likely to result in a significant negative effect at a local geographic scale.
Ch. 13+000	PBR153	Lesser horseshoe bat	100ha	3.54%	This shed/stable was used as a day/night roost by a single tagged bat (No. 12) in 2014. This bat foraged almost exclusively south of this roost between Castlegar and Cooper's Cave and particularly in the network of small fields south of Castlegar. Since there was little evidence of bats using this roost on a continuous basis and little evidence for flights across the proposed road development, the effects on this roost alone is not deemed to be significant. However, if the habitat loss prevents the passage of individuals between the Menlo Castle maternity roost and Cooper's Cave then it may isolate this roost from the core population in Menlough. The impact is likely to result in a significant negative effect at a local geographic scale.
Ch. 13+600	PBR192	Brown long-eared bats	133ha	4.7%	This roost is thought to support a small number of bats of this species as suggested by the droppings but no live bats were noted in 2015 or 2016. The property is close to the edge of the proposed construction area and any linear features connecting bats to the scrub and woodland to the north will be severed. Connectivity to the south toward Castlegar will be maintained and it is predicted that this habitat is sufficient to support this small roost. Nevertheless, the loss of the connectivity to the

Chainage	Roost reference	Species	Area of suitable habitat loss	% of likely core foraging area.	Likely significance of Impact of habitat loss
					north and the potential disturbance caused by habitat loss may cause abandonment of the roost which is likely to result in a significant negative effect at a local geographic scale.
Ch. 13+900	PBR228	Common pipistrelle bats	76ha	6.05%	This small roost of bats (3-4 no.) is predicted to have its CSZ primarily to the north and east, especially the scrub and the quarry close by. There are well distributed detector records for this species throughout the theoretical CSZ. Loss of habitat close to the roost may displace bats from feeding near the construction area but the availability and connectivity to habitat to the north and east will be maintained. The impact is likely to result in a significant negative effect at a local geographic scale if the roost is used less frequently or abandoned altogether, although the latter is not predicted since the building is well screened from the construction area by trees and scrub.
Ch. 14+450	PBR242	Unidentified pipistrelle bats	82ha	6.53%	The small numbers of bats thought to use this roost near the Galway Racecourse are likely to have their CSZ encompassing lands to the east and the west as suggested by the suitable habitats found there. The CSZ is unlikely to stretch to the southwest due to lack of suitable habitats. However, there may be a barrier effect caused by habitat loss preventing bats reaching lands to the north and east of the road during the construction phase although this will be temporary and likely to be reversed once the Galway Racecourse (ST14/02) tunnel is covered. The impact is likely to result in a significant negative effect at a local geographic scale for this roost.

Chainage	Roost reference	Species	Area of suitable habitat loss	% of likely core foraging area.	Likely significance of Impact of habitat loss
Ch. 13+100	PBR112	Lesser Horseshoe bats	124ha	4.39%	Cooper’s Cave. Passage between here and Menlo Castle is likely to be significantly affected by the barrier effects posed by the loss of connecting features during construction of the proposed road development. This potential impact is likely to result in a significant negative effect at a national geographic scale due the level of importance that the cave plays in the life cycle of the bat population in this area.

The proportion of habitat loss relating to each roost being lost is less than 7% of the CSZ in all cases except for PBR225 (stable block at Galway Racecourse) and less than 5% of the CSZ in the majority of cases. In the case of PBR225 the majority of the “real” CSZ is likely to extend to the quarry to the north west and agricultural land as foraging opportunities are more limited in the urban landscapes to the south. Much of the “real” CSZ is not affected by the proposed road development.

For Pipistrelle bat species which are adapted to feeding in a wide variety of landscape types[65], the impact of habitat loss during construction is not predicted to be significant since these bats will be able to utilise the majority of suitable habitat in their CSZ that is currently available to them and are not reliant on having to cross the construction area to reach foraging areas. This applies particularly to roosts to the north of the proposed road development as the majority of optimal feeding areas are outside of the urban city core which lies to the south.

For Lesser horseshoe bats which show a greater preference for following linear landscape features between roosts and foraging areas[66], the potential impact of habitat loss is compounded by the barrier effect which may prevent bats using suitable habitats on the other side of the proposed road development or moving between day and night roosts or between different roosts used at other times of year. Impacts are regarded to be potentially significant at a county level if the foraging range is affected (e.g. by not being able to reach night roosts) or national-scale where the fecundity or mortality rates are affected due to lack of feeding resources as a result of loss of feeding habitat and barrier effects. Significant efforts have been made to provide effective methods to getting bats across the construction areas and underneath or over the proposed road development so that they can avail of habitats on both sides of the proposed road development.

The magnitude of habitat loss for Lesser horseshoe bats has been measured in terms of the physical loss of the most important habitat as a result of the proposed road development. The area deemed to be of highest importance for Lesser horseshoe bats is regarded to be the core foraging area used by Menlo Castle (PBR06) radio-tracked bats in summer 2015. Prior to the birthing period in mid-June, female bats will utilise the best foraging habitats closest to the roost and research in at least one study (Bontadina et al, 2002[67]) has highlighted the importance of habitat within 600m of the roost. Whilst 11ha of habitat will be lost (which equates to nearly 9% of the core foraging area estimated after radio-tracking in 2015) only 7ha is regarded to be optimum feeding habitats for this species. This area of woodland, scrub, hedgerows and grassland will be lost in the area from the River Corrib to the Bothár Nua which spans the core foraging area for the Menlo Castle roost (PBR06).

---

[65] In the CEDR guidelines they are in Group C: Bats with medium manoeuvrability. They often hunt and commute along vegetation or structures at variable heights, but rarely close to or within the vegetation. May also hunt in open areas. Commuting over open stretches generally takes place at low to medium heights (typically 2 – 10m) with no clear tendency to lower flight.

[66] In the CEDR guidelines they are in Group A: Extremely manoeuvrable bats, which often fly within foliage, or close to vegetation, surfaces and structures at variable flight heights. When commuting, they often follow linear and longitudinal landscape elements. Low-flying (typically < 2m) when commuting over open gaps.

[67] Bontadina, F., Schofield H. and Naef-Daenzer B. (2002) *Radio-tracking reveals that Lesser horseshoe bats (Rhinolophus hipposideros) forage in woodland*. J. Zool., Lond. 258, 281-290.

The loss of this 7ha equates to 5.6% of the core foraging area (125ha) recorded in 2015 which is regarded to be the area of highest importance for the roost[68], although not all of the core foraging area is used equally by bats. The loss of habitat within the core foraging area for the Menlo Castle Lesser horseshoe roost (PBR06) is deemed to be a potentially significant factor threatening the viability of the roost there. If bats cannot feed close to the roost, especially close to the birthing period, then fecundity may be reduced. When compounded by other potential effects of the proposed road development (collision, barrier effects) this relatively small loss of habitat might have a significant effect on the population.

Other bat roosts in proximity along the proposed road development are unlikely to be associated with such optimum bat habitats. The loss of woodland in the Menlough area is unavoidable as the belt of woody vegetation on the northeast bank of the river stretches from the Quincentenary Bridge in the city all the way to Menlough Village and therefore the proposed road development will inevitably cross it at some location.

In order to prevent the loss of foraging habitats resulting in an adverse impact on bat species at either a local, county or national geographic scale, design measures have been incorporated into the design of the proposed road development.

The tables above (**Table 8.31** and **Table 8.32**), documents the impact predictions relating to each individual roost site that will either be removed as part of the construction phase or are close enough to the working footprint so as to warrant concern. There are other roosts further away from the proposed road development that have their CSZs that overlap with the proposed road development and could be adversely affected by the loss of foraging habitats. The impacts on a broader geographic scale are discussed below.

Fragmentation of foraging habitat and commuting routes and areas used by bats for other non-roosting activities[69]

Given that there is evidence of bats crossing the proposed road development in multiple locations, and that all parts of the proposed road development are within the theoretical or proven CSZ of at least one bat roost, there is the potential for the proposed road development to act as a barrier to flight paths for all species (except Leisler's bats which have been shown to fly at greater altitudes so as not to be affected by ground level features) and in all locations.

The barrier effect can manifest itself as soon as the site clearance phase commences and the barrier itself is in the form of the cleared lands. Removal of hedgerows, treelines, woodland and scrub will take place across the length of the proposed road development. Whilst it is not proposed to remove all the vegetation within the proposed development boundary, it has been assumed that intervention of some kind in the landscape may occur within the boundary to the extent that it could affect bat behaviour, thereby assessing the worst-case scenario.

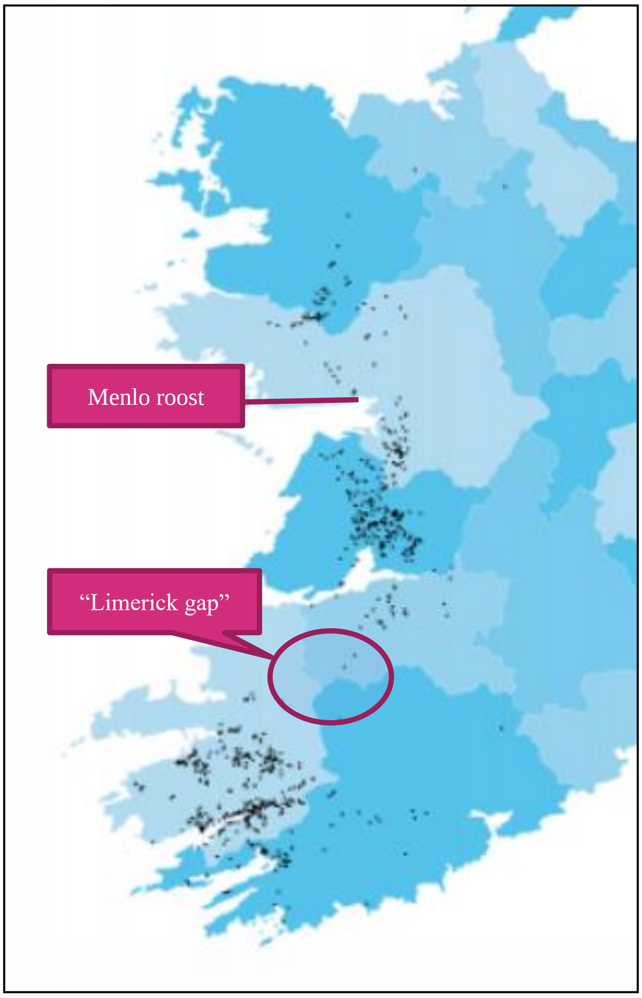
[68] This differs from the 98ha of land within the proposed development boundary which is within the 2925ha of CSZ for the roost at Menlo Castle, based on the MCPs for bats tracked in 2014 and 2015.
[69] As fragmentation of feeding habitat has the potential to disturb normal bat behavioural patterns, and thus adversely affect the ability of local bat populations to persist and reproduce, impacting on their local distribution and/or abundance and thereby conflicting with Regulation 51(b) of S.I. 477.

Interpretation of the patterns of bat activity records has indicated that potential barrier effects would be most significant at the following locations:

1. Bats flying to/from Bearna Woods – The woods were one of the few sites where Natterer's bats were recorded and also support a small/dispersed population of Lesser horseshoe bats. The relatively open, heathy landscape to the north of the woods would be regarded to offer less suitable opportunities for bat foraging so the woods are likely to be important for local populations of several bat species.
2. Aughnacurra (including Chestnut Lane and Upper Dangan) – the potential barrier effect posed by the proposed road development here is somewhat reduced by the proximity of the River Corrib which bats use as a flight corridor. The barrier effect would be likely to supress movements at a very localised scale.
3. Barrier effects in the area spanned by Menlough Castle-Coolagh-Castlegar are potentially the most significant as it is the known core foraging area/CSZ for the nationally-important Menlo Castle population of Lesser horseshoe bats as well as for roosts of other bat species close to the proposed development boundary. Severance of Lesser horseshoe flight paths between Menlo Castle and Cooper's Cave in particular could have significant effects on the ability of the breeding population to mate and hibernate in suitable roosts. Severance of flight paths between day and night roosts also could affect the ability of bats to reach suitable foraging areas further away by using the night roosts as stepping-stones.
4. The location of the Menlo Castle roost is regarded to be at a key location in the national distribution of Lesser horseshoe bats. The main strongholds for this species are in south Mayo, mid-Clare/south Galway, Kerry and West Cork but the species is present all along the west coast counties from Cork to Leitrim. Analysis of the genetic and echolocation differences has revealed that the Irish population is made up of differentiated north and south populations (Dool et al, 2016[70]). Factors such as habitat connectivity were identified as being one of the reasons why this species is subject to population fragmentation at a national scale. Dool et al (2016) describe the "Limerick gap" as an area where there has been a separation of lesser horseshoe bat populations, leading to genetic isolation in these areas. As can be seen in **Plate 8.2**, the Menlo Castle roost is in an area of similarly low densities of roost records and the loss of the population could create a new gap in in the natural range of the species in Ireland.

[70] Dool S.E., Puechmaille S.J., Kelleher C., McAney K., and Teeling E. (2016) *The effects of human-mediated habitat fragmentation on a sedentary woodland-associated species (Rhinolophus hipposideros) at its range margin.* Acta Chiropterologica, 18(2): 377–393, 2016.

Plate 8.2: Lesser horseshoe bat population distribution (taken from Bat Conservation Ireland distribution maps)



5. Based on the distribution of maternity roosts in the range of this species in Ireland, the Menlo Castle maternity roost and the local population it supports are of national importance, as defined in NRA (2009) “a smaller population may qualify as nationally-important where the population forms a critical part of a wider population or the species is at a critical phase of its life cycle”. However, the roost size falls well below the threshold for designation as a Special Area of Conservation (100 bats in maternity roost) and it has been confirmed by the NPWS as not being part of the Lough Corrib cSAC’s qualifying interest population.

6. There are only six known maternity roosts in and around Lough Corrib, with the majority of roosts concentrated on the northern shores near Cong. Only two roosts are located on the southern end: Ross Lake Gatehouse and Menlo Castle. These southern roosts may be stepping-stones for long-term movements and gene flow between bats at the northern shore of Lough Corrib, Lough Mask and Lough Carra and populations in South Galway and Clare. Recent counts from Ross Lake Gatehouse have shown that this roost has undergone significant deterioration resulting in decline in numbers from 150 bats in 1994 to five bats in 2011 (Rebecca Teesdale pers. Comm., 2014 and p44 in Roche et al, (2015)). A decline in the Ross Lake roost could potentially

increase the relative importance of the roost at Menlo Castle as a stepping stone roost, as it would be the only significant maternity colony at the southern end of Lough Corrib. Menlo Castle itself would not appear to be in a structurally-stable condition and the bat roost is vulnerable to rock fall, vandalism and blockage within the chimney flue. If bats were not able to reach the foraging areas and Cooper's Cave due to a barrier effect, then it would add another impact which might put the viability of this population at risk. Such impacts have the potential to result in a significant negative effect at the national geographic scale for the Lesser horseshoe bat. There is no evidence to suggest that Menlo Castle Lesser horseshoe bat population is connected to the Eborhall Lesser horseshoe bat population, which is the qualifying interest (QI) population for Lough Corrib cSAC. Any predicted impacts on Lesser horseshoe bats associated with the proposed road development will not affect the conservation objectives of the Lough Corrib cSACs QI Lesser horseshoe bat population, nor the QI Lesser horseshoe bat populations of any other European sites.

The numbers of Lesser horseshoe bats recorded using Cooper's Cave for hibernation has been relatively small (around 10% of the estimated roost size at Menlo Castle) but much of the cave is not accessible and there may be higher numbers present. The only other hibernation site known for this population is Menlo Castle and the roost site is not accessible for counting. A wildlife overpass has been included as part of the design of the proposed road development to allow bats to reach the cave for hibernation and to avoid them being forced to use less suitable locations. While Cooper's Cave is under ongoing pressures from fly tipping and disturbance, it is likely that bats will continue to use it unless the entrance is blocked altogether.

The western portion of the proposed road development (from Bearna to Upper Dangan) has a lower distribution density of bats and has less-suitable habitats for foraging but a barrier effect is still predicted in the absence of any effective mitigation. Such potential impacts are likely to result in a significant negative effect at a local geographic scale as the bat populations have been valued as being important at a local geographic scale, there are few roosts known in this area, and no important landscape features (such as major watercourses, areas of woodland or hedgerow networks) are predicted to be severed.

Mitigation to preserve flight paths across construction areas are detailed in **Section 8.6.7.2.1**.

Installation of temporary working and site compound lighting which may cause indirect disturbance of flight patterns

As construction works will typically be undertaken during normal daylight working hours, the requirement for lighting for construction works during night time will be limited.

Over the expected 36-month construction phase there will be up to a total of 10 weeks of night time working. Temporary night-time closure of existing local roads may be required where overbridges are to be constructed at locations such as the Rahoon Road, Letteragh Road, N59 Moycullen Road, Menlo Castle Bóithrín, Bóthar Nua, Seanbóthar, N84 Headford Road, N83 Tuam Road, Briarhill Business Park Road and R339 Monivea Road.

Night-time working requiring the use of floodlighting to permit safe working have the potential to displace bats from the illuminated area. This will be particularly sensitive at the following locations:

- N59 Moycullen Road near the Aughnacurra satellite roost (PBR178) and a proposed replacement roost structure
- Menlo Castle Bóithrín which is an important flight path for Lesser horseshoe bats and other bat species
- Bóthar Nua which is an important flight path for Lesser horseshoe bats and other bat species
- Seanbóthar which is an important flight path for Lesser horseshoe bats and other bat species
- N84 Headford Road which is an important crossing point for Lesser horseshoe bats and close to known night/occasional day roosts for this species and is also close to a proposed replacement roost structure

In all cases where lighting may cause disturbance, it will be temporary in nature but may last over several consecutive nights and this could result in temporarily lower bat diversity in these areas. Such displacement (which would be a matter of metres) could prevent bats from accessing foraging areas or roosts, or result in bats taking more circuitous routes to get to foraging areas and hence potentially depleting energy reserves. It cannot be predicted precisely when these works will take place during the year but it could be a significant disturbance if affecting bats pre-parturition (birth) or pre-hibernation when energy reserves are essential for survival. However, the potential impact only arises during months when bats are most active (April to September) and during these months the need for night lighting is likely to be limited as daylight hours are longer. Such potential impacts have the potential to result in a significant negative effect at a local geographic scale.

8.5.6.2.2 Operational Phase Impacts

Direct mortality through collisions

Research (Butchkowski and Hassinger, 2002; Dodd et al., 2004; Capo et al., 2006; Choquene, 2006; Glista and DeVault, 2008; Hein et al.,2009; Russell et al., 2009; Sparks and Choate, 2000; Whitaker and Mumford, 2009) has provided evidence that mortality of bats due to road collisions can reach an annual mortality of 5% of the bats in local roosts. Altringham (2008) arrived at a similar estimate, based on conservative calculations for a road in the UK crossed by lesser horseshoe bats from a large roost (data from Billington, 2001-2006).

Theoretical studies (e.g. Lande 1987, With and King 1999, Carr and Fahrig 2001) *"*show that populations of animal species with low reproductive rates and high intrinsic mobility, such as bats, are more susceptible to decline and ultimately extinction by the additional mortality caused by roads" (taken from Appendix A, WC1060 main report).

Lesiński (2007) recorded mortality highest where roads approached tree stands (up to 6.8 per km/year) or crossed a forest (2.7 per km/year) and lowest within densely built-up areas (0.3 ind./km/year). If the highest rates were applied to the Lesser horseshoe bat roost at Menlo Castle (PBR06) then this could equate to 34 deaths per year based on the maximum roost foraging area being bisected by c. 5km of the proposed road development (based on radio-tracking in 2014). The lower rate for mortality near forests would result in 13 deaths per year. Whilst the long-term population fluctuations are not known for this population, in a worst-case scenario such mortality rates could cause the entire roost to become extinct in less than two years assuming that all of the bats in the roost are exposed to the same level of mortality risk and that all of the bats killed per km were of this species. The loss of this roost would be regarded to be a significant potential effect at a national geographic scale, assuming a worst-case scenario and in the absence of any mitigation.

Similar mortality rates could be applied to similar low-flying gleaning species of bats such as Brown long-eared bats and some *Myotis* species such as Daubenton's bats. Since this would have significant negative effect on these species, a complex mitigation strategy has been developed and is presented in **Section 8.6.7.2.2**.

Barrier/Severance effects

The effects of the proposed road development on the movements of bats across the landscape after completion have been studied more frequently than the effects during the construction phase. Monitoring of bat activity around road schemes have shown the effects of traffic disturbance, lighting, loss of connecting landscape features and foraging habitats can result in depreciation in bat activity up to 1.6km from the road itself in certain landscapes (Berthinussen and Altringham (2012b, 2015), Elmeros et al (2016). The research is still in progress and the effects of different habitat types at the edge of the road carriageway is yet to be fully understood. In the absence of fully applicable research, it is predicted that potential significant impacts caused by the proposed road development acting as a barrier to landscape-scale movements may occur in the following location and on the following species:

- Movements of bats to Bearna Woods: As described in the context of impacts on PBR241, the proposed road development may impact on the movements of bats using north-south trajectory. Bearna Woods was noted as an area of relatively high bat diversity and abundance and is one of the few areas of continuous woodland in this part of the study area. A barrier effect may limit populations mixing outside of the Bearna Woods area and potentially lead to decline in reproductive rates. There are seven confirmed roosts south of the proposed road development near Bearna which could persist in the presence of the proposed road development but will have more limited access to foraging areas north of the proposed road development. The survey results have suggested widespread bat activity along the roads aligned north-south. Some of these may continue to be used by bats and cross the narrower parts of the mainline of the proposed road development but there are no junctions in this location that allow bats to pass under the proposed road development

- Movements of bats along banks of the River Corrib: Currently, bats move up and down the River Corrib corridor unhindered by lighting or physical obstacles. It is possible that existing lighting within the NUIG campus and at Quincentenary Bridge may be a deterrent to light-sensitive bats such as Lesser horseshoe bats. The proposed road development will introduce embankments for the bridge on both banks which could present a physical barrier to such movements. While bats will be able to fly around the toe of the abutments on each bank and under the elevated deck of the proposed River Corrib Bridge and have free movement over the river itself, such re-routing of flight paths could add to the energy requirements for individual bats. On the west bank, assuming that bats are commuting north-south in the area from the N59 Moycullen Road to the river (750m wide corridor), the proposed abutments would reduce the flight corridor to 420m and lead to an additional c. 500m of flight to get around the abutment in the Aughnacurra area. Assuming a flight speed of 3.5m/s (Lesser horseshoe bat) this would mean that a flight of 60m across the proposed road development that would normally take 17s will take 142s when the proposed River Corrib Bridge is in place. On the eastern bank, bats will be able to fly either around the western toe of the bridge abutment or under the road at the Menlo Castle Bóithrín with the barrier stretching between the two points for a distance of 210m
- Movement of bats in the area around Menlough-Coolough Road-Ballindooley-Castlegar area: this area is regarded to be important for Lesser Horseshoe bats, Brown long-eared and Pipistrelle bats. The movement of Lesser horseshoe bats has been confirmed by radio-tracking individuals in 2014 and 2015. This data suggests that the majority of flights across the proposed road development are in the section Ch. 9+500 – Ch. 10+150 between the River Corrib and the Coolough Road. The embankment section will either provide a barrier to bats or force them up and over the proposed road development bringing them across the flow of traffic and risking collision with vehicles. Similar potential barrier effects are predicted at the N84 Headford Road and further east at Ch. 12+200 – Ch. 12+450 and at locations north of Castlegar Village. Static detectors placed at Ch. 12+600 and Ch. 12+750 in 2015 recorded relatively high levels of activity for Lesser horseshoe bats, Common and Soprano pipistrelle bats and Leisler’s bats suggesting that they would be affected by a barrier to movement in this location (Leisler’s bats less so due to their tendency to fly at height).

Barrier effects in the absence of mitigation are likely to result in a significant negative effect at a local geographic scale for all chainages along the route of the proposed road development and at a national geographic scale for effects in the section Ch. 8+500 (N59 Moycullen Road) to Ch. 13+150 (School Road, Castlegar).

Mitigation to reduce barrier effects within the design and operation of the proposed road development are detailed in **Section 8.6.7.2.2**.

Indirect disturbance of flight patterns due to operational lighting

The barrier effect can be compounded by light spill associated with the illumination of the corridor of the proposed road development. Examination of light spill modelling has identified potential light spill impacts on bats (where light levels exceed 1 lux) at the following locations:

- Ch. 2+850: Lighting at the Bearna East Roundabout may impact on the movement of bats in the locality and prevent them using the proposed culvert CO2/01b. However, proposed landscape planting near the mouth of the culvert entrances will help in shading the flight paths approaching the culvert at this location to allow bats to fly through
- Ch. 4+300 - Ch. 4+550: Lighting at the Cappagh Road junction is close to PBR139 and PBR146 (both Leisler's bat roosts) and Soprano pipistrelle activity has been recorded nearby. Localised displacement may occur in this area although the presence of roadside scrub and garden shrubs and trees will provide shaded area which may be used by bats to avoid lit areas
- N59 Link Road North and South: This will be illuminated over a length of 2.4km across open agricultural and heath landscape. Light spill may cause a localised barrier to movements in an east-west direction although there are only two roosts (PBR49 and PBR237) which are parallel to this link road and neither are in the light spill of the proposed lighting design
- Ch. 9+150 – Ch. 9+250: Lighting will be provided as part of the proposed NUIG Sports Pitches. Whilst there is planning permission to floodlight the existing pitches adjacent to the river, they are currently unlit. There are a number of roosts in this general area (for Lesser horseshoe bat, Daubenton's bat, Soprano pipistrelle bat and Brown long-eared bats) however none of them are located within the area of light spill from the proposed lighting. The closest roost is Menlo Castle PRB06 which is approximately 375m from the proposed sports pitches at their closest point. No roosts will be directly impacted. The light spill will not impede bats from using the River Corrib for feeding or commuting. There may be a displacement effect locally from the sports pitches themselves and for an area around the sports pitches due to light spill, however the bat survey results did not record significant levels of usage of these fields by any species.
- Ch. 11+050 – Ch. 11+150: Lighting at western entrance to Lackagh Tunnel. This will be localised and will not affect roosts but is likely to have a displacement effect on bats over an area of circa 150m x 50m where light levels exceed 1 lux. Whilst there is little bat activity data collected for this location, it is likely to be used by several species of bats for feeding and commuting
- Ch. 11+380 – Ch. 11+500: Lighting at eastern entrance to Lackagh Tunnel. This will be localised and will not affect roosts but is likely to have a displacement effect on bats over an area of circa 150m x 50m where light levels exceed 1 lux. There is bat activity data collected for this location including feeding and resting Lesser horseshoe bats and it is likely to be used by several other species of bats for feeding and commuting

- Ch. 11+975 – Ch. 14+500: The N84 Headford Road at this location is currently unlit and the proposed new lighting will introduce approximately 8ha of illuminated area. This area is used by several species including Lesser horseshoe bats and will result in a displacement from this area. PBR154 (a Lesser horseshoe bat night roost and occasional day roost) will be impacted upon by light spill to the roost. However, the entry to the roost will still remain unlit and well shielded from the lighting as it faces to the east and is at a lower elevation than the N84 Headford Road and the proposed road development. Light spill from lighting columns in the area of Ballindooley-Castlegar (Ch. 12+600 to Ch. 13+600) will generally be contained within the immediate vicinity of the proposed road development which, at this location, is sunken below the level of the surrounding landscape. Light spill here will help to deter bats from crossing the road and reduce the risk of vehicle collision, whilst the Castlegar Wildlife Overpass will be in darkness and provide a safe crossing point.
- Lighting in the area around the N83 Tuam Road Junction, the City North Business Park Link and the Parkmore Link Road will alter and may have localised impacts on the flight paths of Pipistrelle species recorded nearby
- Ch. 14+850 – Ch. 15+000: Eastern end of Galway Racecourse Tunnel entrance. This will be localised and will not affect roosts but is likely to have a displacement effect on bats over an area of circa 150m x 50m where light levels exceed 1 lux. This may lead to localised impacts on the flight paths of Pipistrelle species recorded nearby
- Ch. 15+150 – Ch. 15+300: Western end of Galway Racecourse Tunnel entrance. This will be localised and will not affect roosts but is likely to have a displacement effect on bats over an area of circa 150m x 50m where light levels exceed 1 lux. This may lead to localised impacts on the flight paths of Pipistrelle species recorded nearby
- Ch. 15+500 – Ch. 17+483 (end of proposed road development): Scattered records of Pipistrelle species and Leisler’s bats in this location suggest that the widened illuminated corridor in this location will result in localised displacement. This impact is not regarded to be significant as most of the bat records suggest activity is focused to the north east away from the proposed road development

The potential impact of vehicle lighting has been assessed in the context of the potential illumination of Menlo Castle (PBR06). This would have particularly high sensitivity due to the absence of any notable lighting at present and the presence of both a maternity roost and hibernacula for Lesser horseshoe bats, a maternity roost for Daubenton’s bat and a former Brown long-eared roost; all species which would be susceptible to lighting impacts. In a worst case scenario, the cumulative impact of many vehicles on the River Corrib Bridge on Menlo Castle is less than 0.01 lux and this would only result on the top section of the castle. Given that the Lesser horseshoe bats generally flew at heights of 1-3m above the ground at and near the roost location this is not predicted to affect their flight paths. This level of illumination is also well within the tolerance range for this species.[71].

There are no roosts that will be directly illuminated by the proposed operational lighting to the extent that any likely significant effects are predicted.

8.5.6.3 Badger

8.5.6.3.1 Construction Phase Impacts

There were a total of 17 badger setts recorded across the study area. Three of these setts (S9, S11 and S14) were within the proposed development boundary. Two setts (S3 and S10) were within the ZoI of general construction activities (i.e. within 50m) based upon the impact distance bands described in the TII guidance (National Roads Authority, 2006c). A further seven setts (S2, S4, S8, S13, S15, S16 and S17) were within the ZoI of any potential pile driving or blasting works—i.e. within 150m. The remaining setts (S1, S5, S6, S7 and S12) are beyond the ZoI of any construction activities.

Although it cannot be predicted if Badger will establish new setts within the ZoI of the proposed road development before construction works commence, it is a possibility and this scenario has been taken into account in the mitigation strategy (refer to **Section 8.6.7.3**).

Based on interpretation of the survey results, the directly affected badger setts (S9, S11 and S14) were considered to be within the territories of two badger groups. S9 and S11 are considered to be part of one badger group to the east of Lackagh Quarry (hereafter, referred to as the Lackagh badger group). S14 is considered to be part of a separate badger group west of the N83 Tuam Road Junction at Cappanabornia (hereafter, referred to as the Cappanabornia badger group).

Loss of Foraging Habitat

Construction will result in the permanent loss of foraging habitat within the territories of up to ten badger groups across the study area[72]. The loss of habitat is likely to affect each of the badger groups to some degree, at least temporarily, as it will reduce the foraging area and feeding resource available within their existing territories. This is also likely to have a knock-on consequence of increased conflict with neighbouring Badger groups in competition for resources - although this territorial behaviour is a natural dynamic between neighbouring Badger groups in response to many other factors that affect population numbers, territorial behaviour, and dispersion of individuals.

---

[71] Average light levels recorded along preferred commuting routes of *Rhinolophus hipposideros* under natural unlit conditions were 0.04 lux across eight sites. Stone E.L. (2011) *Bats and development: with a particular focus on the impacts of artificial lighting.* (Ph.D. Thesis) University of Bristol, UK (2011).

[72] This territory number estimate is based upon an interpretation of the survey results – sett locations, sett types, and the distribution of signs such as tracks, foraging and latrine sites

There is an abundance of alternative suitable foraging habitat locally which is likely to be sufficient to maintain the local population in the long-term. Although the actual effect of foraging habitat loss cannot be quantified in terms of any threshold value that could be predicted, each of the affected Badger groups would be expected to adapt to the changed landscape. It is therefore predicted that, despite any temporary effects, the loss of foraging habitat associated with the proposed road development is unlikely to affect the conservation status of the local badger population and will not result in a likely significant negative effect, at any geographic scale.

Loss of breeding/resting sites

The proposed road development will result in the permanent loss of three badger setts, affecting two badger groups: the main sett (S9) and a subsidiary sett (S11) of the Lackagh Quarry badger group; and, a subsidiary sett (S14) of the Cappanabornia Badger group.

The significance of sett loss in relation to any badger group is based upon consideration of the type of sett, its importance to the badger group, and the availability of either alternative setts for affected badgers to relocate to or the availability of alternative suitable sett building habitat within the territory. Locally, given the underlying karst nature of the area, limestone is generally overlain by thin soils and frequently outcrops locally as limestone pavement; offering limited opportunities for sett building habitat. As a consequence, the significance of sett loss with respect to both badger groups is largely dependent on the presence of existing alternative setts within their territories. As discussed above in relation to loss of foraging habitat, sett loss may also lead to increased conflict with neighbouring Badger groups if alternatives, in the form of existing setts or suitable habitat to construct setts, are not available within the existing territory. There is also the potential for Badgers to be killed during site clearance works where setts are being removed.

The Lackagh Quarry badger group will lose two out of three setts (S9 and S11) recorded within their territory — including the main sett. The remaining subsidiary sett (S10) lies within the ZoI of what will likely be significant disturbance effects resulting from rock breaking and blasting associated with excavating the eastern approach to Lackagh Quarry, from the N59 Moycullen Road. Considering those factors and that there is little alternative suitable sett building habitat in the immediate vicinity, the proposed road development may have a long-term effect on this Badger group. On that basis, it is considered that the proposed road development has the potential to negatively affect the conservation status of this badger group and result in a likely significant negative effect, at a local geographic scale.

In relation to the Cappanabornia badger group, the proposed road development will result in the loss of a single subsidiary sett (S14) within its territory. There are two other Badger setts nearby, S13 and S15, both of which were also classified as subsidiary setts. Whilst it is not known whether all three setts are used by the same Badger group, based on their relative locations and distance from one another, it’s probable that at least one of those setts is and would therefore provide a suitable alternative to S14. Given there are alternative setts, and alternative suitable sett building habitat, available beyond the ZoI of general construction activities the loss of sett S14 is not likely to affect the species ability to maintain itself on a long-term basis locally, will not affect its conservation status locally, and will not result in a likely significant negative effect, at any geographic scale.

Given the legal protection afforded to Badgers under the Wildlife Acts, which prohibits their intentional killing or injury, or the wilful interference with their breeding or resting places, a mitigation strategy has been developed (see **Section 8.6.7.3.1**).

Disturbance/displacement

In conjunction with any displacement effects associated with habitat loss, increased human presence and/or noise and vibration associated with construction works, has the potential to displace badgers from both breeding/resting places and from foraging habitat. As construction works will typically be undertaken during normal daylight working hours and badgers are nocturnal in habit, displacement of badgers from foraging areas (outside of areas where foraging habitat will be lost as a result of the proposed road development) is extremely unlikely to affect the local badger population and will not result in a likely significant negative effect, at any geographic scale.

Two badger setts (S3 and S10) outside the proposed development boundary were within 50m of construction works and therefore, likely to be subject to temporary disturbance/displacement effects. Any disturbance/displacement impact is likely to be more significant during the badger breeding season (December to June inclusive) if the sett is in use at that time. A further seven setts were located within 150m of the proposed development boundary and therefore, likely to be subject to temporary disturbance/displacement construction effects associated with any rock breaking, blasting or pile driving works that may be required. If undertaken during the breeding season, this could result in the displacement of badgers from occupied setts, potentially affecting breeding success.

On a precautionary basis, disturbance/displacement effects during construction have the potential to negatively affect the conservation status of local badger groups/populations (at least in the short-term) and could result in a likely significant negative effect, at a local geographic scale.

Given the legal protection afforded to Badgers under the Wildlife Acts, which prohibits their intentional killing or injury, or the wilful interference with their breeding or resting places, a mitigation strategy has been developed (see **Section 8.6.7.3.1**).

Severance/barrier effect

It is considered near-certain that the physical disturbance to the existing landscape during site-clearance and construction will result in some initial temporary severance of Badger territories through which the proposed road development traverses; most notable where it severs the network of setts within a given territory (as is the case with the Cappanabornia Badger group), or setts from foraging areas (as in the case of the Lackagh Badger groups).

However, given that Badgers are nocturnal in habitat and works will be carried out during normal daylight working hours, affected Badger groups would be expected to habituate to the altered landscape. The severance/barrier effect of construction works will be temporary in nature and is not likely to affect the local population, over even the short-term, and will not result in a likely significant negative effect, at any geographic scale.

8.5.6.3.2 Operational Phase Impacts

Habitat Severance/Barrier Effect

The presence of a new road along the offline sections of the proposed road development, where it severs existing Badger territories, has the potential to act as a permanent barrier to Badger movements: either acting as a physical barrier or through traffic deterring Badgers from attempting to cross.

However, some sections of the proposed road development will be either elevated above ground level on piers or will pass through a subterranean tunnel (e.g. the proposed River Corrib Bridge, Menlough Viaduct and the proposed Lackagh Tunnel). In these locations, an accessible link will be maintained across the proposed road development either beneath viaduct/bridge structures or above tunnels, which will serve to maintain habitat connectivity within each affected Badger territory (Eldridge & Wynn, 2011).

Nevertheless, there will be extensive lengths of the proposed road development that may act as a barrier to Badger movements within the study area. This has the potential to have a long-term impact on local Badger population dynamics, affecting both local foraging behaviour and competition for resources and larger scale movements associated with dispersal and/or with breeding behaviour and genetic exchange between populations.

The habitat severance/barrier effect to Badgers associated with the proposed road development has the potential to affect local Badger populations over the long-term and result in a likely significant negative effect, at a local geographic scale. Mitigation measures have been designed to reduce the effects of this impact (**see Section 8.6.7.3.2**).

Mortality Risk

The introduction of the proposed road development into a rural landscape will permanently increase the risk of road traffic collisions with Badger, across the study area. The risk is likely to be higher in areas where the proposed road development is in close proximity to Badger setts, is severing Badger territories, or is passing through habitats where high levels of Badger activity were recorded (see **Figures 8.3.1** to **8.3.14**).

Although it is not possible to quantify the magnitude of the effect, the increased collision risk would likely result in a long-term suppression of the local Badger population in these areas and would negatively affect the conservation status of the local Badger population.

Collision risk to Badgers associated with the proposed road development is predicted to result in a likely significant negative effect, at a local geographic scale. Mitigation measures have been designed to avoid this potential impact (see **Section 8.6.7.3.2**).

Light Spill

Nocturnal mammals, such as the badger, are likely to be disturbed by the introduction of artificial light into established breeding and foraging areas (Rich & Longcore, 2005). Along the proposed road development lighting is proposed only at the Bearna West Roundabout, the Bearna East Roundabout, the Cappagh Road Junction, the Ballymoneen Road Junction, the N59 Link Road North and South, the western and eastern portals to the Lackagh Tunnel, the proposed NUIG Sports Pitches, the N84 Headford Road Junction to the N83 Tuam Road Junction including the junctions at the Galway Racecourse Tunnel and the Coolagh Junction. The majority of the proposed road development will remain unlit, minimising the potential for light spill to affect fauna species. The lighting design of the proposed road development controls light emissions such that along the majority of the alignment light spill does not extend beyond the proposed development boundary and where it does, this is at tie-ins with the existing road network or at residential properties (**Figures 5.4.01** to **5.4.14**). There are no badger setts, or areas of high badger activity, beyond the proposed development boundary that are located within the modelled light spill zone for the proposed road development.

Therefore, lighting associated with the proposed road development will not disturb or displace Badgers from habitat areas beyond the proposed development boundary, will not affect the species conservation status in that regard and will not result in a likely significant negative effect, at any geographic scale.

8.5.6.4 Other Mammal Species

8.5.6.4.1 Construction Phase Impacts

Habitat Loss

Road construction will result in the permanent loss of mammal habitat within the boundary of the proposed road development. Given the relatively low numbers of individuals of each species that are likely to be affected (Pine marten, Wood mouse, Red squirrel, Irish stoat, Hedgehog, Pygmy shrew, Fox, Rabbit, Mink and Bank vole), and the abundance of alternative suitable habitat available locally, the effects of habitat loss associated with construction works are unlikely to affect the long-term viability of their local populations. Therefore, habitat loss is unlikely to affect the species’ conservation status or result in a significant negative effect, at any geographic scale.

Mortality Risk

Site clearance works have the potential to result in the mortality of mammal species. The potential for impact would be expected to be greater during the breeding season when juveniles would be present in nests, or in the case of Hedgehog impacts may be greater during their hibernation period. Given the relatively low numbers of individuals of each species that are likely to be affected, and that they are highly mobile species, site clearance is unlikely to result in a level of mortality that would affect the species' conservation status, and result in a significant negative effect, even at a local geographic scale.

Habitat Severance/Barrier Effect

As discussed above in relation to Badgers, the presence of a new road along the offline sections of the proposed road development has the potential to act as a permanent barrier to many other terrestrial mammal species. Either acting as a physical barrier or through traffic deterring mammals from attempting to cross.

Sections of the proposed road development elevated on piers and above tunnels will serve to maintain habitat connectivity. Nevertheless, there will be extensive lengths of the proposed road development that may act as a barrier to the movements of other terrestrial mammal species within the study area. This has the potential to have a long-term impact on local mammal population dynamics, affecting both local foraging behaviour and competition for resources and larger scale movements associated with dispersal and/or with breeding behaviour and genetic exchange between populations.

The habitat severance/barrier effect to these other terrestrial mammal species associated with the proposed road development has the potential to affect local mammal populations over the long-term and result in a significant negative effect, at a local geographic scale. Mitigation measures have been designed to minimise the long-tern effects of any barrier effect posed by the proposed road development (see **Section 8.6.7.4.1**).

Disturbance/displacement

In conjunction with any displacement effects associated with habitat loss, increased human presence and/or noise and vibration associated with construction works, has the potential to displace mammal species from both breeding/resting places and from foraging habitat.

However, as disturbance will be intermittent and temporary (in the majority of locations) it is extremely unlikely to result in any long-term effects on the local mammal population or their conservation status. Therefore, disturbance / displacement during construction is unlikely to result in a significant negative effect, at any geographic scale.

Habitat degradation - 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 Galway Bay and consequently an impact upon marine mammals; either directly (e.g. acute or sub-lethal toxicity from pollutants) or indirectly (e.g. affecting their food supply or supporting habitats).

However, it is considered unlikely that a pollution event of such a magnitude would occur during construction that would have any perceptible effect on water quality in the marine environment, 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 and detailed mitigation measures have been designed to further minimise the risk of the proposed road development having any perceptible effect on water quality during construction or affecting the conservation status of the marine mammal species in Galway Bay (see **Section 8.6.4**).

8.5.6.4.2 Operational Phase Impacts

Habitat Severance/Barrier Effect

The presence of a new road along the offline sections of the proposed road development, would be certain to act as a permanent barrier to mammal movements locally, either through acting as a physical barrier or as a consequence of road traffic acting as a crossing deterrent.

As discussed above for Badger, elevated sections of the proposed road development (e.g. the proposed River Corrib Bridge and the Menlough Viaduct structures) will serve to maintain a degree of habitat connectivity within each affected Badger territory (Eldridge & Wynn, 2011).

Nevertheless, there will be extensive lengths of the proposed road development that will act as a barrier to species movements within the study area. This has the potential to have a long-term impact on population dynamics, affecting both local foraging behaviour and competition for resources and larger scale movements associated with dispersal and/or with breeding behaviour and genetic exchange between populations.

The habitat severance/barrier effect associated with the proposed road development has the potential to affect local mammal populations over the long-term and result in a significant negative effect, at a local geographic scale. Mitigation measures have been designed to minimise the long-tern effects of any barrier effect posed by the proposed road development (see **Section 8.6.7.4.2**).

Disturbance/displacement

The operation of the proposed road development is likely to have some level of long-term effects on mammal usage of habitat in the vicinity of the proposed road development (Benítez-López et al. 2010). However, this is not likely to affect the species' conservation status nor result in a likely significant negative effect, at any geographic scale.

Habitat degradation - water quality

There will be outfall points to surface water features from the proposed road drainage network during operation and therefore, a potential impact pathway to affect water quality in Galway Bay. This in turn could affect the marine mammal species therein. The proposed drainage design for the mainline of the proposed road development incorporates pollution control measures (this includes petrol interceptors, wetland and other measures, such as SuDS) followed by either infiltration ponds (where discharging to ground) or attenuation ponds (where drainage will be discharged to the existing surface water/storm sewer), as described in detail in **Chapter 5, Description of Proposed Road Development**.

Those sections of the proposed road drainage that are to be discharged to ground, pose no risk to surface water quality. It is extremely unlikely that the normal operating water quality of the drainage outfalls discharging to the existing surface water/drainage network, even in the unlikely event of a pollution incident, would have any perceptible impact on water quality in receiving watercourses. The functioning and effectiveness of both elements of the road drainage network are discussed in more detail in **Chapter 11, Hydrology**.

Habitat degradation as a result of effects on water quality in Galway Bay during operation is not likely to have any effect on the marine mammal populations or their conservation status, and therefore will not result in a likely significant negative effect, at any geographic scale.

Mortality Risk

The proposed road development will permanently increase the risk of road traffic collisions with mammal species[73]. For some species, such as rodents, the risk may be higher as many such species forage in rough grassland and scrub habitats and may be attracted to foraging along the road margins. However, the hard surfaces of the road infrastructure offer little in the way of potential foraging habitat for mammal species, other than opportunistic scavenging by larger mammal species. The rates of mammal fatality recorded by Haigh (2012) were low (1.2 per 100km) although the presence of dedicated mammal passage facilities were present on sections of the studied roads which is likely to have positively influenced this figure. In the absence of being able to fully quantify the impact on an unmitigated road scheme, a precautionary approach is to conclude that the proposed road development does have the potential to affect the local mammal populations in the long-term, if even only in a local context. Therefore, the proposed road development has the potential to affect the local conservation status of many mammal species, and result in a significant negative effect, at the local geographic scale. Mitigation measures have been designed to reduce this potential impact (see **Section 8.6.7.4.2**).

8.5.7 Invertebrates

8.5.7.1 White-clawed crayfish

As the White-clawed crayfish is not present within the ZoI of the proposed road development, no impacts are predicted.

8.5.7.2 Freshwater pearl mussel

As the Freshwater pearl mussel is not present within the ZoI of the proposed road development, no impacts are predicted.

[73] Haigh (2012) recorded the following mammal road kill species in a study undertaken along the road network between Bandon in County Cork and Caherlistraine in Co. Galway: Rabbit, Hedgehog, Badger, Fox, rodents, Mink, Hare, Otter, Pine marten and Stoat. However, in terms of the protected mammal species discussed in this section, all bar Hedgehog and rodents were infrequently recorded.

Although no freshwater pearl mussel were present with the ZoI of the proposed road development, impacts to salmonid fish species could indirectly affect the Freshwater pearl mussel population in Lough Corrib cSAC; the QI population is in the Owenriff River, c.23km to the north – see **Section 8.5.11** below for impacts on fish species.

8.5.7.3 Marsh whorl snail

8.5.7.3.1 Construction Phase Impacts

Habitat Degradation – Surface Water Quality

An accidental spillage or pollution event affecting the River Corrib, the Coolagh Lakes and surrounding drainage features and springs, and Ballindooley Lough has the potential to negatively impact upon water quality and consequently on the fringing wetland habitat that supports the Marsh whorl snail.

The magnitude and significance of such an impact would be entirely dependent on the nature, scale and duration of the pollution event. Although unlikely, in a worst case scenario this could potentially result in extensive degradation of fringing aquatic habitat in receiving watercourses/waterbodies such that it could, at least in the short-term, no longer support the species. There is the potential for such impacts to have long-term effects on the local Marsh whorl snail population, potentially resulting in localised extinctions. Habitat degradation therefore, has the potential to affect the species' conservation status and result in a significant negative effect, at the local geographic scale. Mitigation measures have been designed to protect water quality during construction (see **Section 8.6.4**).

Habitat Degradation – Groundwater

Any effects on the existing hydrogeological regimes at the Coolagh Lakes and Ballindooley Lough have the potential to negatively impact upon the fringing wetland vegetation that supports the Marsh whorl snail.

Based on the findings of the hydrogeological impact assessment in **Chapter 10, Hydrogeology**, the proposed road development does not pose a risk to the groundwater supply to Ballindooley Lough. The proposed road development does however, have the potential to affect the quantity and quality of groundwater supplying the Coolagh Lakes. Although the magnitude of the impact cannot be fully quantified, on a precautionary basis it is assessed as having has the potential to affect the species' conservation status and result in a likely significant negative effect, at the local geographic scale. Mitigation measures have been designed to protect the existing hydrogeological regime during construction (see **Section 8.6.5**).

Habitat Loss & Mortality Risk

Two wetland habitat areas that will be directly impacted by the proposed road development supported the Marsh whorl snail: at Ballindooley Lough (Ch. 12+350) and a marsh area at Castlegar (Ch. 13+000).

Overall, the Marsh whorl snail was relatively common locally: recorded at 33 sampling sites out of a total of 120. The relatively minor loss of habitat at

Ballindooley Lough and at the Castlegar marsh will not reduce the local wetland habitat resource for the species such that it would be likely to affect its ability to maintain the local population on a long-term basis. Similarly, although there is likely to be some level of mortality associated with construction works at these locations, the species’ conservation status locally is not likely to be affected.

Habitat loss and mortality risk during construction are not likely to affect the species’ conservation status and will not result in a likely significant negative effect at any geographic scale.

8.5.7.3.2 Operational Phase Impacts

Habitat Degradation – Surface Water & Groundwater

There will be drainage outfall points to two surface water features supporting the Marsh whorl snail: the River Corrib and Ballindooley Lough. Therefore, there is a risk that discharges from the proposed road drainage network could affect water quality and consequently impact upon the Marsh whorl snail or its supporting habitat.

The proposed drainage design consists of a petrol interceptor followed by either attenuation and infiltration ponds (where discharging to ground) or attenuation and constructed wetland (where drainage will be discharged to the existing surface water/drainage network) — as described in detail in **Chapter 11, Hydrology**.

Those sections of the proposed road drainage that are to be discharged to ground, pose no risk to surface water quality. It is extremely unlikely that the normal operating water quality of the drainage outfalls discharging to the existing surface water/drainage network, even in the unlikely event of a pollution incident, would have any perceptible long-term effect on water quality in receiving watercourses. The functioning and effectiveness of both elements of the proposed road drainage network are discussed in more detail in **Chapter 11, Hydrology**.

Although the drainage design will ensure that groundwater quality will be maintained during operation, it is important that infiltration basins are inspected to ensure that karst features do not affect the functioning of them during operation. If this is identified during routine inspections of the infiltration basins then mitigation is required to ensure any issues are addressed so that they continue to function as designed for the operational lifespan of the proposed road development.

Habitat degradation as a result of effects on surface water quality during operation is not predicted to affect the conservation status of the Marsh whorl snail and will therefore, not result in a likely significant negative effect, at any geographic scale.

Habitat degradation as a result of effects on groundwater during operation has the potential to affect the conservation status of the Marsh whorl snail locally and therefore, has the potential to result in a significant negative effect, at the local geographic scale.

8.5.7.4 Marsh fritillary butterfly

The Marsh fritillary butterfly exists in a metapopulation structure — i.e. individual colonies, or populations, that are spatially separated yet interact with one another on some level. Survival and persistence of the metapopulation relies on there being a sufficient network and density of interconnected suitable habitat areas, such that the individual colonies can readily interact and recolonise new habitat patches in response to (what can be) frequent local extinctions. These local extinction events occur in response to factors such as changes in habitat management and condition, weather, resources and intraspecific competition, and/or parasite infestations. In assessing the impacts on the Marsh fritillary butterfly, given the species' population structure, areas of suitable habitat are equally as important to consider as areas where larval webs were recorded.

The natural fluctuations and variations in Marsh fritillary populations are reflected in the larval web records across the four survey years. Comparing the results of the 2013 and 2014 surveys (as both years covered the larger scheme study area): in 2013, only a single habitat patch supported larval webs yet in 2014, 111 larval webs were recorded across the network of suitable habitat patches[74]. This pattern suggests that there was a core population (either in an area within the scheme study area that was not surveyed, or beyond it) which, despite the apparent population crash in 2013, was robust enough to recolonise the locality in 2014. Even comparing the 2015 and 2016 surveys, which both covered a smaller, more targeted survey area focussed on the proposed road development and lands in the immediate vicinity, the number of larval webs recorded increased from 12 in 2015, to 56 in 2016. The same area in 2014 held 39 webs.

The area of suitable habitat mapped for the species across the scheme study area in 2014 totalled approximately 110ha, spread over 139 distinct habitat patches—the densest clusters of which were concentrated around the bog/heath/scrub/wet grassland habitat mosaics at Na Foraí Maola, Lough Inch, An Chloch Scoilte, Ballard, Na hAille, Cappagh and Tonabrocky. Of the suitable habitat patches in these areas, larval webs were recorded in 39 (in total covering an area of c.60ha).

8.5.7.4.1 Construction Phase Impacts

Habitat Loss

The proposed road development will result in the permanent loss of suitable Marsh fritillary habitat, including habitat patches supporting larval webs. The resulting impact will increase habitat fragmentation, not only within individual suitable habitat patches, but also amongst the local network of suitable habitat areas supporting the local Marsh fritillary metapopulation.

In terms of habitat loss in areas where suitable habitat was recorded, and larval webs were present (during any of the surveys carried out between 2013 and 2016), the proposed road development will affect the Marsh fritillary butterfly in the western

74 The majority of the two core areas at Cappagh and Tonabrocky which supported significant numbers of larval webs in 2014 were not surveyed in 2013.

part of the study area; between Bearna and the River Corrib. The area of Marsh fritillary habitat directly affected is approximately 5.2ha.

It is noted in the literature (Bulman 2001; Fowles & Smith 2006) that within 16km^2 sample areas, it was estimated that a minimum area greater than 71ha (and probably 100ha) of suitable habitat was required to give a high degree of probability that a metapopulation would persist long-term. The total coverage of suitable habitat, across the western part of the scheme study area, approximates an area of 16km^2. Therefore, even with the loss of c.5.2ha, the remaining 104.8ha [75] present within the scheme study area is more than the quoted threshold and will probably be sufficient to maintain the local metapopulation in the long-term.

This is evident in the findings of the surveys which demonstrate that even despite localised “crashes” in the local population year on year, there is a sufficient habitat network, and a persisting core colony or population within recolonization range, to allow the metapopulation to recover. Also of note in that regard is that the larger and consistently more densely populated habitat complexes at Lough Inch, Cappagh, and Tonabrocky will remain unaffected by the proposed road development.

Therefore, habitat loss associated with the proposed road development is not likely to affect the species conservation status or result in a likely significant negative effect, at any geographic scale.

Habitat Fragmentation/Severance

Key to Marsh fritillary being able to recolonise or relocate to alternative habitat areas is the spatial relationship between areas of suitable habitat in a network of suitable habitat sites; and principally, their proximity to one another. Therefore, the loss of suitable habitat patches, regardless of their size or whether the species has been recorded there previously, has the potential to result in fragmentation, or habitat isolation, that could potentially affect the long-term viability of the local Marsh fritillary metapopulation.

The Marsh fritillary butterfly is generally a sedentary species. Many studies have reported that the maximum distances over which the species will readily colonise/disperse between habitat areas is 1-2km (Betzholtz et al. 2007; Fowles and Smith 2006); although longer distance movements have been recorded, they are likely to be more infrequent (Warren 1994; Hula et al. 2004; Zimmermann et al. 2011). In applying the more conservative 1km threshold to considering how habitat loss could affect the future prospects of the affected Marsh fritillary metapopulation to colonise suitable habitat areas, the resulting fragmentation would not result in

75 The total area of suitable Marsh fritillary habitat recorded within the scheme study area is likely to only represent a proportion of the actual coverage of suitable habitat available to support the local metapopulation. Although no surveys were undertaken for this project beyond the scheme study area, based on a review of recent orthophotography it would appear that a similar habitat mosaic to that within the scheme study area, extends to the west and north. This, along with the rapid recolonization of the scheme study area between the “crash” year of 2013 and 2014, suggests that a core colony persisted in suitable habitat, within close proximity. Therefore, the quoted area of available habitat, post-construction, is probably a very conservative underestimate.

any of the unaffected suitable habitat areas being permanently isolated by this distance, or greater.

The fragmentation of an individual suitable habitat patch by the proposed road development may also render the remaining fragments unsuitable for the species, due to their small size or due to increased edge effects. Bulman (2001) found that Marsh fritillary did not breed in habitat patches less than 0.1ha in area and this minimum area is considered to be the threshold below which isolated habitat patches would become unusable by the species. This is reflected in the findings of the surveys where all, bar two, of the 39 suitable habitat patches where larval webs had been recorded were greater than 0.1ha in area. Therefore, any remaining suitable habitat fragments below this threshold have been included in the habitat loss calculation. Small, isolated habitat patches are likely to be more susceptible to edge effects and scrub encroachment/succession which could, over the longer-term, result in them becoming unsuitable to support the species. However, even if all such areas were to ultimately become unavailable to the local Marsh fritillary butterfly as a consequence of the habitat fragmentation impact, the areas involved only total c.2ha. In the context of the area of suitable habitat that will be available post-construction (104.8ha) and the additional areas of suitable habitat likely to be present beyond the scheme study area, given the mosaic of heath, bog and wet grassland evident from the orthophotography, this loss is extremely unlikely to affect the long-term viability of the local population or metapopulation.

Therefore, habitat fragmentation/severance is not likely to affect the species conservation status or result in a likely significant negative effect, at any geographic scale.

Mortality Risk

Site clearance works have the potential to result in the mortality of Marsh fritillary butterflies and/or disturb their breeding/resting places; either adults, eggs or larvae, depending on the time of year works are undertaken. The magnitude of the potential impact would be dependent on the species' distribution and abundance across the area in any given year.

Given the distribution of breeding sites across the study area over the survey period, and the resilient nature of the species' natural response to frequent local extinction events, any mortality or disturbance that may result from construction works will most likely be confined to the season within which site clearance works are undertaken and is likely to only affect the local population[76]. Although unlikely, it is possible that the suitable habitat patches affected by the proposed road development could support a significant proportion of the local metapopulation in a given year. If this were to occur, it could potentially affect the species' conservation status locally and result in a significant negative effect, at the local geographic scale. Given the current distribution of the Marsh fritillary butterfly at the county scale (c.46 10km squares), and considering the scale and short-term nature of the predicted impact and the resilient nature of the species' natural response to frequent local extinction events, it would not be likely to affect the

[76] The current distribution for the species within, or adjacent to, the County Galway border covers c.46 10km squares (NPWS, 2013c)

species' conservation status at the county geographic scale, at which the local Marsh fritillary population has been valued.

Mitigation measures to avoid this impact are detailed in **Section 8.6.8.2.1**.

8.5.7.4.2 Operational Phase Impacts

Barrier Effect

From the available literature, there is no definitive evidence to conclude whether the construction or operation of the proposed road development will create a permanent barrier to Marsh fritillary movements. Along the length of the proposed alignment, there are two locations where the proposed road development will sever areas of Marsh fritillary habitat: in the western part of the study area, between Ch. 0+750 and Ch. 8+000; and at the Galway Racecourse where the proposed road development surrounds it on three sides.

The Marsh fritillary butterfly is a species capable of long-distance dispersal movements (Warren 1994; Hula et al. 2004; Zimmermann et al. 2011). It has also evidently crossed the existing road network in the past to colonise habitat at the Galway Racecourse. Considering the above and also that (at least in the western part of the study area) the proposed road development consists of a relatively narrow single carriageway (c.20m), the proposed road development would not be expected to pose a physical barrier to Marsh fritillary movements between the existing network of suitable habitat patches such that it would affect the long-term prospects for either the local populations or the greater metapopulation. Even taking a very precautionary approach, and assuming that the full area of suitable habitat south of the proposed road development would become unavailable, the loss of 7.6ha is not likely to reduce the area of suitable habitat that the local metapopulation is likely to require to ensure it persists over the long-term (see discussion on habitat area requirements above, under the heading of construction phase impacts).

Therefore, any barrier effect associated with the proposed road development is not likely to affect the species' conservation status or result in a significant negative effect, at any geographic scale.

Mortality Risk

It is likely that during operation the proposed road development will result in some level of mortality risk to Marsh fritillary butterfly crossing the proposed road carriageway; although from the available published literature, it is not possible to quantify what that level of risk might be. Of the c.105ha of suitable Marsh fritillary habitat that will remain post-construction, only 7.6ha lies to the south of the proposed road carriageway. The majority (c.97.4ha), which includes the core areas at Cappagh and Tonabrocky, lies to the north. This limits the potential, or need, for Marsh fritillary butterflies to cross the proposed road carriageway and it is not likely that there would be frequent movement of Marsh fritillary butterflies across the proposed road development.

Therefore, it is not likely that any population level effects would arise as a consequence of road mortality that would affect the species' conservation status or result in a significant negative effect, at any geographic scale.

8.5.8 Birds

8.5.8.1 Breeding Birds

The assessment carried out in the NIS for the proposed road development considered the potential for the proposed road development to affect the bird species listed as SCIs of Lough Corrib SPA and Inner Galway Bay SPA for their breeding populations: Black-headed gull, Cormorant and Common tern. That assessment concluded that the proposed road development would not affect their breeding colonies or have any long-term effects on the local breeding populations—which for the purposes of that assessment took a precautionary approach in assuming that all SCI bird species recorded within the scheme study area formed part, or were linked to, the SPA populations. Therefore, for these species, the proposed road development will not affect the conservation status of the breeding populations and will not result in a likely significant negative effect at any geographic scale.

8.5.8.1.1 Construction Phase Impacts

Habitat Loss & Loss of Breeding/Resting Sites

The proposed road development will result in the loss of breeding bird nesting and foraging habitat across the study area. The areas of habitat loss along route of the proposed road development are given in **Section 8.5.4.3** and tabulated in **Table 8.27** for KER habitat types[77]. In the western part of the study area, this is predominantly habitat blocks comprised of mosaics of bracken, scrub, heath and wet grassland. There are sections where the proposed road development crosses more intensively managed agricultural lands, with little vegetation cover for nesting breeding birds, and habitat loss in these areas will have a much lower effect on local bird populations than the more semi-natural habitat mosaics. From the N59 Moycullen Road through to Lackagh Quarry, the habitats affected are amenity grassland and small agricultural fields and a mix of amenity planted woodland (at NUIG) and semi-natural Ash and Hazel woodland (east of the River Corrib). East of Lackagh Quarry a small area of scrub and wet grassland will be lost at Ballindooley Lough. At Castlegar a small area of scrub surrounding a marsh will be affected, near the N83 Tuam Road a small area of Ash/Hazel woodland, and some scrub around the existing N6 Junction. Aside from these areas, the majority of the proposed road development, east of Lackagh Quarry, will largely result in the loss of improved agricultural grassland fields or artificial surfaces associated with the existing road network, business parks and Galway Racecourse.

The primary consequence of habitat loss will be increased competition for resources (e.g. nesting habitat or prey/food source) both between and amongst breeding bird species. The magnitude of this effect will be largely defined by many unquantifiable factors such future land use changes and whether the local habitat resource has currently reached its carrying capacity or not in terms of breeding bird species. For

[77] The loss of these KER habitat types are those most likely to directly affect breeding birds – comprising more than 80ha of scrub, woodland, semi-natural grasslands, wetland habitats (e.g. fens, marsh and reed swamp) and heath habitats, along with almost 12km of hedgerows and treelines.

species with larger home ranges during the breeding season (such as Peregrine falcon, which hunt within 2km of the nest site) habitat loss at the scale of the proposed road development is not likely to have any perceptible effects on breeding success or population dynamics. Another example is Barn owl, which generally hunt within a kilometre of the nest site (Hardy et al., 2009). Within this distance of Menlo Castle, most of the habitats affected are woodland or residential development and not the favoured permanent rough grassland foraging habitat.

The habitat areas that will be lost as a result of the proposed road development form a relatively small part of what are much larger expanses of similar habitat types and mosaics nearby. In that regard, none of the habitat areas that will be lost are unique in the sense that they are not the only areas of that habitat type locally and, either individually or collectively, are not likely to support a significant proportion, or the only population, of any given breeding bird species locally. Although a decline in overall breeding bird abundance could potentially occur at a local level, this is unlikely to affect the local range of the breeding bird species present nor is it likely to affect the ability of these breeding bird populations to maintain their local populations in the long-term. Mitigation measures will be implemented to reduce the effects of habitat loss on breeding birds species locally (see **Section 8.6.9.1.1**).

Mortality Risk

If site clearance works were to be undertaken during the bird breeding season (March to August, inclusive) it is likely that nest sites holding eggs or chicks will be destroyed and birds killed.

Mortality of birds at the scale of the proposed road development, over what is likely to be a single breeding bird season in terms of completing site clearance works, will probably have a short-term effect on local breeding bird population abundance. However, in the longer-term this would be unlikely to affect the ranges of the breeding bird species recorded in the study area nor would it be likely to affect the long-term viability of the local populations.

Mortality of birds during site clearance works is not predicted to affect the conservation status of any of the breeding bird species present within the study area.

Disturbance/displacement

The noise, vibration, increased human presence and the visual deterrent of construction traffic associated with site clearance and construction will disturb breeding bird species and is likely to displace breeding birds from habitat areas adjacent to the proposed development boundary. The magnitude of the impact will be dependent on the type of construction works and their duration; general construction activities will have a less pronounced affect than blasting, in terms of its ZoI, but will be on-going from periods of several months to several years and breeding seasons. Although it is not possible to quantify the magnitude of this potential impact (or the potential effect zone) it could potentially extend for several hundred metres from the proposed road development.

In terms of nesting sites, the most sensitive in terms of disturbance effects (given their low numbers locally, conservation status and proximity of nest sites to the construction works) are Barn owl and Peregrine falcon.

The Barn owl nest site at Menlo Castle is c.140m from the main construction works with landscape planting and installation of a boundary fence proposed adjacent to the castle. The main construction works are likely to be sufficiently removed from Menlo Castle that the resident Barn owl pair will not abandon the nest site and as a consequence no long-term effects on the local population are likely in this regard.

The Peregrine falcon nest site at Lackagh Quarry is immediately adjacent to the proposed road development and construction activities here include rock breaking and rock blasting, and the installation of rock bolts on the exposed cliff faces (for more detail refer to **Chapter 7, Construction Activities**). There is therefore a high risk that the resident pair of Peregrine falcons will abandon the quarry, if works commence part way through the breeding season. As works will be ongoing in the vicinity for a period of c.3 years, this has the potential to have long-term effects on recruitment within the local Peregrine falcon population if the pair repeatedly fail to breed.

Given the temporary to short-term nature of the construction works, disturbance or displacement effects will also be over the short-term and are therefore not likely to affect the conservation status of the majority of affected breeding bird species and will not result in a likely significant negative effect, at any geographic scale.

However, there is the potential for long-term effects on the local Peregrine falcon population and significant negative effects at a county geographic scale. Mitigation measures will be implemented to reduce the effects of construction related disturbance on nesting Peregrine falcon (see **Section 8.6.9.1.1**).

8.5.8.1.2 Operation Phase Impacts

Mortality Risk & Disturbance/Displacement

Road traffic, has been shown to negatively influence local bird populations (Reijnen & Foppen, 2006; Summers et al., 2011): new roads increase mortality risk, road traffic acts as a visual deterrent, and noise associated with road traffic has a negative impact upon bird abundance and occurrence. The magnitude of the potential impact is related to the interaction between a multitude of factors such as species and traffic density (which influences noise levels and mortality risk) and is also influenced by habitat type. Roadside habitat can have a positive effect on bird abundance (e.g. the provision of scrub, either through planting or as a result of edge effects, wetland habitat, or rank grassland habitat). Although any benefits associated with this type of habitat creation are generally on quiet, low-traffic roads and the impacts associated with high density traffic on bird densities generally outweigh any potential benefits.

It is likely that the abundance of breeding bird species will permanently decline near to the proposed road development as a consequence of increased disturbance and mortality from road traffic; the effects of which will reduce to a neutral impact with increasing distance from the proposed road development. Although it is not possible to quantify the magnitude of the potential impact (or the potential road effect zone) based upon the available literature for most breeding bird species, in general it could potentially extend for several hundred metres from the proposed road development. However, where the proposed road development crosses a landscape which is already highly disturbed (i.e. where it will be constructed alongside the existing road network) or of low habitat quality for breeding birds (e.g. the business parks at Ballybrit and Parkmore), the road effect zone will be minimal.

The road effect zone may also act as a population sink during good breeding bird years; where fecundity and juvenile survival rates are high. Less experienced juveniles may be attracted in to the poorer quality habitat affected by road traffic disturbance and with a relatively higher associated mortality risk due to the proximity of the proposed road development. This in turn is likely to affect their breeding success and survival. Another likely consequence of the displacement of breeding birds from the road effect zone is increased competition for resources (e.g. nesting habitat or prey/food sources) both between and amongst breeding bird species.

One exception to this predicted road effect zone is the Barn owl which is likely to be affected at a much greater distance and is discussed separately below. Another, is the Peregrine falcon; a species which is relatively tolerant of human disturbance and road traffic.

Although the proposed road development is predicted to have a long-term effect on local breeding bird populations, even at a local level this is not predicted to affect the ability of almost all local breeding bird species to persist within their current ranges or to maintain their populations long-term — the exception being the Barn owl.

Therefore, the proposed road development is not likely to affect the conservation status of breeding bird species generally (excluding Barn owl and Peregrine falcon, which are discussed separately below) and will not result in a likely significant negative effect, at any geographic scale.

Barn owl

Available published material relating to the potential impacts of road development on Barn owl concludes that the presence of major roads within 2.5km of an active nest site is likely to result in a severe depletion of the local population (Ramsden, 2003). The risk of such effects is likely to be extremely high in the case of the Menlo Castle nest site as it lies c.150m from the proposed road carriageway. Although only a single nest site is within the predicted road effect zone, it is not likely that there will be large numbers of nest sites at a county scale and a long-term decline of the population level at a county scale is likely.

It is unlikely that operational noise levels will result in any disturbance to nesting Barn owl at Menlo Castle (L_{den} 50-60dB). Barn owl are a nocturnal species and therefore, disturbance from road traffic at night (particularly from headlights) and from artificial lighting along the proposed road development is likely to result in some level of displacement of Barn owl from foraging habitat near the proposed road development. However, given the relatively small impact zone of the lighting when compared with the home range of the species (up to 5,000ha in the winter and up to 350ha in the summer (Hardy et al., 2009)), disturbance during operation is not likely to result in any decline in the local Barn owl population or affect its ability to maintain itself over the long-term.

Overall, mortality risk associated with the proposed road development is likely to affect the conservation status of Barn owl and result in a significant negative effect at the county geographic scale. Mitigation measures will be implemented to reduce the mortality risk to Barn owl posed by the proposed road development (see **Section 8.6.9.1.2**).

Peregrine falcon

Although the nest site at Lackagh Quarry used between 2015 and 2017 will not be lost, the nest site used by the breeding pair of Peregrine falcon in 2018 will likely be directly impacted, Despite the retention of the 'traditional' nesting ledge, the presence of a new road at such close proximity and elevated above the existing ground levels, has the potential to permanently displace nesting Peregrine falcon from that nest site. The absence of any alternative suitable nesting sites within the quarry may result in the permanent loss of the quarry as local Peregrine falcon nest site. There are two other quarry sites present locally which are currently not occupied by a Peregrine falcon pair. However, it cannot be predicted with any degree of certainty that Peregrine displaced from Lackagh Quarry would take up residence at these other sites, even with interventions such as creating suitable nesting ledges. The potential loss of one out of three local Peregrine falcon nest sites has the potential to have long-term effects on the local population, affecting the species conservation status locally.

The potential loss of this nesting site is also significant at the county geographic scale. The actual number of nest sites known across counties Galway and Clare is not known[78] but current estimates are on the region of 60-70 nest sites. The loss of one site, that has been regularly in use for many years, is significant in that context.

The potential loss of the nest site at Lackagh Quarry has the potential to result in a likely significant negative effect, at the county geographic scale.

Habitat Degradation – Water Quality

There will be drainage outfalls to all river/stream catchments crossed by the proposed road development. Therefore, there is a risk that discharges from the proposed road drainage network could affect water quality, potentially over the long-term, and consequently impact upon aquatic habitats and bird species, and their prey. In a worst-case-scenario, this could result in a long-term decline in aquatic/wetland bird species abundance and distribution on affected rivers or streams.

The proposed drainage design for the mainline of the proposed road development incorporates pollution control measures (this includes petrol interceptors, wetland and other measures, such as SuDS) followed by either infiltration ponds (where discharging to ground) or attenuation ponds (where drainage will be discharged to the existing surface water/storm sewer), as described in detail in **Chapter 5, Description of Proposed Road Development**.

Those sections of the proposed road drainage that are to be discharged to ground, pose no risk to surface water quality. It is extremely unlikely that the normal

[78] At the time of writing, a national Peregrine falcon census is underway but the results are not yet known.

operating water quality of the proposed drainage outfalls discharging to the existing surface water/drainage network, even in the unlikely event of a pollution incident, would have any perceptible long-term effect on water quality in receiving watercourses. The functioning and effectiveness of both elements of the proposed road drainage network are discussed in more detail in **Chapter 11, Hydrology**).

Habitat degradation is not predicted to affect the conservation status of aquatic or wetland bird species because of effects on surface water or groundwater during operation and will therefore, not result in a likely significant negative effect, at any geographic scale.

8.5.8.2 Wintering Birds

This section of the impact assessment deals with wintering bird species — i.e. those bird species which are SCIs of SPAs for their wintering populations, or are listed on either the BoCCI Red or Amber lists for their wintering populations.

Local bird population figures are based on the sum of the mean populations from I-WeBS summary data for Lough Corrib and Inner Galway Bay (accessed December 2015). However, local bird population figures are likely to be an underestimate of the actual local population due to patchy/incomplete I-WeBS counts and that only two wetland areas are covered in the local area (Inner Galway Bay and Lough Corrib).

8.5.8.2.1 Construction Phase Impacts

Habitat Loss

The proposed road development will result in the loss of suitable wintering bird habitat area from nine of the wintering bird sites surveyed over the winter of 2014/15.

The proposed road development will result in the loss of a mosaic of wet grassland/heathland/scrub habitat at An Chloch Scoilte WB07 (c.2.2ha), Cappagh WB03 (c.4.2ha) and Ballagh WB10 (c.2.8ha). In all cases the habitat loss is along the southern margins of those habitat blocks and will therefore, not result in any fragmentation. Although these sites supported Curlew (on the BoCCI Red List for its wintering population) the numbers were low across all three sites in any of the positive survey months—eight in September 2014, seven in October 2014 and 2 in November 2014. These sites also supported wintering bird species on the BoCCI Amber List. Single Cormorant and Common gull were recorded on only one occasion at survey sites WB07 and WB10, respectively. A single Teal was also only recorded once at WB10. Snipe were recorded frequently across all three survey sites but in relatively low numbers (between one and nine individuals, with almost half being one or two birds). Given that the majority of each habitat block will be unaffected by habitat loss, or fragmentation, and the numbers of wintering birds were low and/or infrequently recorded across the affected wintering bird sites, long-term effects on local wintering bird populations of conservation concern are not likely. There is a small overlap with survey site WB08 at Na Foraí Maola Thoir (c.0.04ha) but this part of the site has been built on and is not of importance for wintering bird species.

At the NUIG Sporting Campus, (WB45) c.3.7ha of the amenity grassland habitat used by wintering birds will be affected by construction phase (for c.18 months). Of this, c.2.8ha will be permanently lost to the proposed Sports Pitches. Considering the availability of alternative amenity grassland habitat on the complex, and elsewhere in Galway City, long-term effects on local wintering bird populations at this site are not likely as a consequence of the habitat loss.

The proposed road development will potentially result in the permanent loss of c.0.9ha of wet grassland habitat from the southern end of the Ballindooley Lough survey site (WB02). This represents approximately 0.7% of the lake and wetland complex. As this portion of habitat was not recorded as being used by wintering birds during the surveys, and the loss of habitat will not fragment the wetland complex, the habitat loss associated with the proposed road development at Ballindooley Lough is not likely to affect the local wintering bird populations using the site.

At Galway Racecourse (WB23), c.0.5ha (or c.1%) of the habitat area within that survey site will be lost. No wintering bird species were recorded using the affected habitat area and as it is on the western edge, the proposed road development will not fragment the site. In terms of wintering birds of conservation concern, the Galway Racecourse site infrequently supported small numbers of Black-headed gull (three, on a single occasion), Common gull (also three on a single occasion), Oystercatcher (one individual on one occasion). More notable is that Curlew were recorded on three occasions (three in October 2014, two in November 2014, and 37 in January 2015) but always in the south-western corner of the survey site, where the proposed road development will not result in any habitat loss.

In WB01, which includes the lands around Ardaun and Doughiska, only small numbers of Black-headed gull were recorded on two occasions. Given the infrequent and low numbers recorded, and that there is an abundance of alternative agricultural grassland habitat locally that will remain unaffected by the proposed road development, the loss of habitat at this survey site is not likely to affect the local Black-headed gull wintering population.

At Lackagh Quarry(WB16), Kestrel were the only wintering bird of conservation concern recordedover the winter of 2014/15 — three were recorded overflying the site in February 2015. Although not confirmed, it is likely that the Menlough/Coolough area is a winter home range for a local pair recorded nesting at Angliham Quarry in 2014, 2015 and 2016. Lackagh Quarry has not been recorded as a roosting site for the species and offers little in the way of foraging habitat for the species. Considering this, and given the availability of alternative foraging habitat within the local area (e.g. open wet grassland and peatland habitats at Coolanillaun), the loss of habitat to the proposed road development is not likely to have any perceptible effect on local wintering Kestrel.

Peregrine falcon nest/roost at Lackagh Quarry during the breeding season and, although not recorded during the winter bird surveys, are also likely to be resident during the winter. With a large hunting range (2-6km from nest site – Hardy *et al.* 2009), and given the availability of alternative foraging habitat within the local area for such an adaptable species in terms of habitat preference, the loss of habitat to the proposed road development is not likely to have any perceptible effect on local wintering Peregrine falcon.

Overall, and considering the cumulative effect of habitat loss across all affected winter bird survey sites, habitat loss is not likely to affect the conservation status of wintering bird species and will not result in a likely significant negative effect, at any geographic scale.

Disturbance/displacement

As the majority of works will be carried out during normal working daylight hours, the potential for construction to disturb wintering birds at night, either foraging or roosting, will not arise. Therefore, the discussion below is focussed on daytime disturbance.

For the purposes of impact assessment and defining disturbance effect distances, construction related disturbance is considered in relation to general construction activities (e.g. visual impact of construction workers and machinery and the associated vibration and more constant/continuous noise levels) and impulse noise disturbance from infrequent noise sources with a high noise level, such as blasting.

General Construction Activity Disturbance

In a report prepared for Humber INCA, Cutts *et al.* (2009) investigated the effects of disturbance on foraging and roosting waterbirds. Based on the findings of that study, in terms of a response to third party disturbance (e.g. human presence), minimal effects would be expected beyond 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 would 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 within this range. Noise levels above 70dB would likely result in 8.31 birds moving out of the affected zone, or leave the site altogether. This is supported by the findings of Wright et al. (2010) which found that average noise levels above 60dB resulted in behavioural responses, with birds abandoning the site in response to noise levels above 70dB.

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. 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.

Calculations of indicative noise levels for typical noise sources associated with road construction works at set distances from the construction activity were calculated 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 levels are presented in **Table 8.33** 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. and therefore represent a "worst case" scenario.

Table 8.33: Indicative Noise Levels Associated with Construction Works

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

Piling Works	Calculated $L_{Aeq, T}$ at distance from works (m)							
	50m	100m	150m	200m	250m	300m	350m	400m
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 disturbance effect on waterbirds at distances beyond 150m. At 300m, noise levels are below 60dB or, in most cases, are approaching the 50dB threshold. Low, or no, effects would be expected for those noise levels. Any landscape features, vegetation cover or buildings between the construction site and winter bird sites would contribute to further reducing the ambient noise at any given distance. Therefore, 300m is considered to be a precautionary buffer in defining the ZoI of disturbance effects.

Impulse Noise Disturbance

In terms of noise levels associated with blasting, behavioural response thresholds would be expected to be similar to those described above for general construction related disturbance — i.e. greater than 60dB. However, calculating a distance whereby blasting would attenuate to below 60dB is less certain given the large number of variables that would influence that calculation (e.g. size of charge used).

Rees et al. (2005) found that impulsive noise disturbance (e.g. airport bird scaring) alerted Whooper swans at distances of up to c.800m. As a precautionary approach, this distance is the zone within which some level of disturbance would be expected from rock blasting. However, it is worth noting that in that study less than a third of birds were alerted and disturbance events were also temporary, with birds resuming undisturbed behaviour within minutes. Therefore, the magnitude of any disturbance effects is likely to be greatest where blasting is occurring regularly, over a prolonged period, and probably at distances less than 800m. The only location along the proposed road development where regular, prolonged blasting is likely to occur in the vicinity of an important wintering bird site (i.e. with high numbers of birds, frequently present) is in the zone between the western approach to Lackagh Tunnel and the proposed N83 Tuam Road Junction. Therefore, Ballindooley Lough is the only winter bird site where blasting may have a significant negative effect on wintering bird species and this is reflected in the discussions below, under the individual species headings.

Impacts on Winter Bird Species of Conservation Concern

In terms of effects on each of the wintering bird species recorded within the ZoI of the proposed road development, the NIS for the proposed road development presents a detailed assessment of those species listed as SCIs of either Lough Corrib SPA or Inner Galway Bay SPA. Based on the abundance and frequency of these bird species recorded at each affected winter bird site, and the assessment methodology relating to disturbance outlined above, it was concluded that there would not be any population level effects. Therefore, for these species disturbance/displacement from construction works will not affect the species' conservation status or result in a likely significant negative effect, at any geographic scale.

The non-SCI wintering bird species of conservation concern present within the ZoI of the proposed road development were: Bittern, Great crested grebe, Little grebe, Merlin, Mute swan, Oystercatcher, Peregrine falcon and Snipe. The potential impact of the proposed road development on the wintering populations of each of these species are discussed below.

Bittern

A single Bittern was recorded at the Coolagh Lakes (WB04) in February 2015, initially in flight and landing in reed beds on the eastern side of the larger northern lake. Bittern is a scarce winter visitor to Ireland and is not included within the BoCCI lists. Ad hoc observations of Bittern in County Galway suggest it was last recorded near Lough Corrib in December 2011[79]; with only two records in the county in the 5 years up to winter 2015. It is likely that construction works will take place over the winter period within 300m of the Coolagh Lakes and therefore, there is the potential for disturbance and displacement of wintering birds, including Bittern. However, only the very northern end of the wetlands at the Coolagh Lakes falls within the ZoI of general construction related disturbance. Blasting may be required during construction within 800m of the Coolagh Lakes, but the requirements are likely to be minimal: i.e. likely to be carried out over periods of days, or a few weeks, with infrequent blasting events at any given location. Thus, displacement from any blasting is unlikely to cause any more than a brief effect at any instance. Given the extensive woodland cover that lies between the wetland/lake habitats and the proposed road development the disturbance effects during construction are likely to be significantly reduced from the 300m and 800m distances related to the construction effects described. Even if Bittern were temporarily displaced from the area, there is an abundance of alternative suitable habitat available to accommodate the species, both surrounding the Coolagh Lakes and to the north of Menlo Castle. Therefore, disturbance from construction works

[79] According to www.irishbirding.com 'Sightings' records Accessed 18th December 2015

is not likely to affect the species' conservation status and will not result in a likely significant negative effect, at any geographic scale.

Great crested grebe

Two Great crested grebe were recorded on a single occasion during the winter bird surveys on the River Corrib corridor (WB12), near the Glenlo Abbey Hotel's boat landing stage. This is estimated at approximately 3.4% of the local population. In the area between the Glenlo Abbey Hotel and Menlo Pier, the River Corrib is within the ZoI of general construction works. Any disturbance effects associated with construction works in this area are likely to be temporary given that it is a pipeline, attenuation facilities and a drainage outfall, and that only a small proportion of the works are within 300m of the River Corrib. Given the scarce records for the species from that part of the River Corrib within the ZoI of the proposed road development, and the temporary nature of the works in the vicinity, there is a low risk of any disturbance or displacement effects. The majority of the river corridor (locally) is beyond the ZoI of any disturbance effects and would be available to accommodate displaced grebes. Therefore, disturbance from construction works is not likely to affect the species' conservation status and will not result in a likely significant negative effect, at any geographic scale.

Little grebe

Little grebe were recorded at four winter bird sites within the ZoI of general construction works and potentially prolonged blasting at Lackagh Quarry: Ballindooley Lough (WB02), the Coolagh Lakes (WB02), west of Lough Inch (WB08) and along the River Corrib corridor (WB12).

Lough Inch is c.740m from the proposed road development, at its nearest point. At this distance, and given that the nearest potential blasting location is c.800m from the lake shore, construction works are not likely to have any perceptible disturbance effects at this site.

Little grebe were recorded frequently at Ballindooley Lough, Coolagh Lakes and on the River Corrib; although five was the maximum number recorded at any one location or on any given survey visit (estimated to be c.4.3% of the local population). As discussed above in relation to Bittern, construction related disturbance at the Coolagh Lakes is not likely to displace wintering birds from most of the lake habitat—even as a consequence of any blasting that might be required, and the effects of which would be of a brief duration.

On the River Corrib, Little grebe were recorded along the river corridor from Galway City to Menlough; the majority of records were from upstream of the NUIG Sporting Campus and between the Coolagh Lakes and Waterside in the city. Both locations are beyond the ZoI of general construction activities and any blasting requirements that may be associated with works within 800m of the River Corrib are likely to be minimal and with only a brief disturbance effect. Construction works near the River Corrib will probably result in some level of construction related disturbance but this will be short-term (c.18 months). Considering that most of the river habitat will be beyond the ZoI of construction related disturbance, and given the low numbers of Little grebe potentially affected along the river, any disturbance/displacement will not have any long-term effects on the species.

As Ballindooley Lough is within the ZoI of (potentially) long-term blasting activity between Lackagh Quarry and the N83 Tuam Road Junction there is the potential for construction works to displace wintering birds from Ballindooley Lough over several winter seasons (estimated/predicted to be three). This could potentially have long term effects on the local population and result in a likely significant negative effect, at the local geographic scale. Mitigation measures will be implemented to limit noise related disturbance during construction (see **Section 8.6.9.2.1**).

Merlin

A single Merlin was recorded in the area west of Lough Inch (WB08) in December 2014; flying to the south of the site. The area covered by the winter bird surveys here that lies within the ZoI of construction works, represents only a small proportion of what is an extensive upland habitat complex extending for more than 50km to the north west, including the Connemara Bog Complex SPA, c.9km away, for which Merlin is a SCI species. Given the scarce presence of the species in habitats near to the proposed road development, and the temporary nature of the works and any potential for disturbance, construction works are not likely to have any long-term effects on the species.

Therefore, disturbance from construction works is not likely to affect the species' conservation status and will not result in a likely significant negative effect at any geographic scale.

Mute swan

Mute swans were recorded at five winter bird sites within the ZoI of general construction works and potentially prolonged blasting at Lackagh Quarry: Ballindooley Lough (WB02), the Coolagh Lakes (WB02), west of Lough Inch (WB08) and along the River Corrib corridor (WB12).

As discussed above, Lough Inch is beyond the disturbance ZoI of the proposed road development and at the Coolagh Lakes disturbance/displacement effects are likely to be minimal and short-term.

On the River Corrib, Mute swan were frequently recorded but, bar a single record of 14 birds in February 2014 (estimated to be c.2.9% of the local population), numbers present ranged from four to eight individuals.

Construction works near the River Corrib will probably result in some level of construction related disturbance but this will be short-term (c.18 months). Considering this, that most of the river habitat will be beyond the ZoI of construction related disturbance, and given the low numbers of Mute swan potentially affected along the river, any disturbance/displacement will not have any long-term effects on the species.

Therefore, disturbance from construction works is not likely to affect the species' conservation status and will not result in a likely significant negative effect, at any geographic scale.

Oystercatcher

Oystercatcher were recorded widely across the study area: the River Corrib corridor (WB12), Merlin Park (WB21), Galway Racecourse (WB23), Ballybane Playing Fields (WB24), NUIG Sporting Campus (WB45), Gort na Bró Playing Fields (WB48) and the Bearna Woods Playing Fields (WB50).

The Merlin Park and Ballybane sites have a significant buffer of urban development between them and the proposed road development, and works in these areas are predominantly on-line. Therefore, no disturbance effects at those sites are likely because of construction works.

Although Galway Racecourse grounds lie within the potential disturbance ZoI, Oystercatcher were only recorded here on one occasion (and only a single individual). In WB12, the species was only recorded on a single occasion and in low numbers (in lands at Menlo Castle where seven individuals were recorded in February 2014). At the Bearna Woods Playing Fields, numbers recorded were also low — one in November 2014, two in December 2014 and five in February 2015. The frequency of use and numbers recorded were similar at the Gort na Bró site—five in both November 2014 and January 2015, three in February 2015 and 20 in March 2015. Therefore, any temporary displacement at these sites during construction will not affect the local population which is estimated to be c.740.

Oystercatcher were recorded at the NUIG Sporting Campus on nine separate occasions over the winter of 2014/15 and it was the most frequently used of the winter bird survey sites by the species. The majority of records ranged between three and 22 individuals; the exception being a record of 34 in December 2014 which is estimated to represent c.4.6% of the local population. It was noted during the surveys at this site that birds were regularly disturbed and temporarily displaced from the playing fields by users of the sports facilities, returning to the same field or to another nearby. This would suggest that Oystercatcher using this site have adapted to a certain degree of habitual disturbance and despite this, frequently use the playing fields. Construction works at the NUIG Sporting Campus will result in some level of construction related disturbance but this will be short-term (c.18 months). Considering this, that there are alternative sites available locally beyond the ZoI of construction related disturbance, and given the relatively low numbers of Oystercatcher potentially affected here, any disturbance/displacement will not have any long-term effects on the species.

Therefore, disturbance from construction works is not likely to affect the species' conservation status and will not result in a likely significant negative effect, at any geographic scale.

Peregrine falcon

During the winter of 2014/15, Peregrine falcon were recorded at one winter bird survey site within the potential ZoI of construction works—the Roadstone Quarry (WB17)—on three occasions in December, February and March when a single bird was observed. The results of the Peregrine falcon survey carried out in 2016 confirmed the presence of three local breeding pairs, and it would be expected that they would maintain a local presence over the winter period.

Peregrines are highly adaptable species and not highly sensitive to construction related disturbance away from the nest site; as evidenced by the species regularly breeding in active quarry sites and in the urban environment. Therefore, construction works are not likely to have any perceptible effect on the local population during the winter period, is not likely to affect the species' conservation status and will not result in a likely significant negative effect, at any geographic scale.

Snipe

Snipe were distributed widely across the study area: recorded at eight of the winter bird survey sites. Although Snipe were frequently recorded across these sites, the numbers were generally low (<10 birds). The exception being records of 28 and 34 at Ballindooley Lough in December 2014 and March 2015, respectively.

In the western part of the study area, four winter bird sites within the ZoI of construction related disturbance supported wintering Snipe — Cappagh (WB03), An Chloch Scoilte (WB07), west of Lough Inch (WB08) and Ballagh (WB10). The areas within those sites potentially affected by disturbance during construction represent only a small proportion of the locally available habitat resource for the species during the winter (i.e. rough wet grassland/heath habitat offering good ground cover). Given the low numbers potentially affected at these sites, and the temporary nature of any construction related disturbance, disturbance/displacement effects are not likely to affect the local Snipe population in the long-term.

Where the proposed road development crosses the River Corrib (WB12), there is little habitat suitable for the species within the disturbance ZoI. As discussed above for Bittern, Little grebe and Mute swan, at Coolagh Lakes disturbance/displacement effects are likely to be minimal and short-term at most. Therefore, even temporary effects during construction are unlikely to affect the local population.

The Terryland River Valley (WB14) is beyond the ZoI of general construction works with a buffer of residential development between it and the proposed road development. Even if prolonged blasting in this area were required during construction, the effects would remain brief and most of this winter bird site would remain unaffected by disturbance.

As Ballindooley Lough is within the ZoI of (potentially) long-term blasting activity between Lackagh Quarry and the N83 Tuam Road Junction there is the potential for construction works to displace wintering birds from Ballindooley Lough over several winter seasons (estimated/predicted to be three). This could potentially have long term effects on the local population and result in a significant negative effect, at the local geographic scale. Mitigation measures will be implemented to limit noise related disturbance during construction (see **Section 8.6.9.2.1**).

<u>Impacts on Important Winter Bird Sites</u>

Given their SPA status, Lough Corrib SPA and Inner Galway Bay SPA are the most sensitive sites for wintering birds locally. A detailed assessment of the potential for the proposed road development to affect both Lough Corrib SPA and Inner Galway Bay SPA is presented in the NIS. This assessment concluded that the proposed road development would not result in an adverse effect on the integrity of either SPA.

However, this conclusion was dependant on the implementation of mitigation measures relating to the protection of surface water, groundwater and disturbance—which are also reflected in the mitigation strategy presented in **Section 8.6** of this chapter.

Ballindooley Lough is also considered to be a locally important wintering bird site given the diversity of bird species of conservation concern for their wintering populations recorded there; fourteen in total, which included species listed as SCIs for Lough Corrib SPA and Inner Galway Bay SPA. The site regularly supported Coot, Curlew, Teal, Tufted duck and Shoveler—all species listed as SCIs for the nearby Lough Corrib SPA and Inner Galway Bay SPA. Although recorded less frequently and/or in low numbers, other SCI bird species recorded over the winter period were Bar-tailed godwit, Black-headed gull, Cormorant, Grey heron, Lapwing and Wigeon. The BoCCI Amber listed wintering species Little grebe, Mute swan and Snipe were also regularly recorded at Ballindooley Lough. As Ballindooley Lough is within the ZoI of (potentially) long-term blasting activity between Lackagh Quarry and the N83 Tuam Road Junction there is the potential for construction works to displace wintering birds from Ballindooley Lough over several winter seasons (estimated/predicted to be three). This could potentially have long term effects on the local population and result in a significant negative effect, at the local geographic scale. Mitigation measures will be implemented to limit noise related disturbance during construction (see **Section 8.6.9.2.1**).

The River Corrib corridor (including the NUIG Sporting Campus) and Coolagh Lakes were also important sites for wintering birds of conservation concern. Between them they supported three BoCCI Red list species (Black-headed gull, Curlew and Redshank) and ten Amber listed species—Cormorant, Coot, Great-black backed gull, Little grebe, Mute swan, Snipe, Teal, Common gull, Great crested grebe and Oystercatcher. The areas where most of these species were most frequently recorded (and recorded in the greatest numbers) are generally in the lower parts of the river between Coolagh Lakes and the Salmon Weir, or upstream of Menlo Castle. The exception being Oystercatcher who were frequently recorded at the NUIG Sporting Campus but there are alternative amenity grassland areas available to the species elsewhere in the complex.

As discussed above, and in the NIS, in relation to the species recorded at each of these sites, the potential impacts associated with the proposed road development, either at each site or cumulatively, are not likely to affect the conservation status of the local wintering populations at these winter bird sites and will not result in a likely significant negative effect, at any geographic scale.

Habitat Degradation – Surface Water Quality

During construction, contaminated or heavily silted surface water runoff, pump discharges 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 on aquatic habitats and species supporting the wintering bird populations. This could be either directly (e.g. bird species coming into direct contact with pollutants) or indirectly (e.g. acute or sub-lethal toxicity from pollutants affecting their food supply or supporting habitats).

The effects of frequent and/or prolonged pollution events in lake systems could potentially have significant long-term effects. 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 and detailed mitigation measures are required to further minimise the risk of the proposed road development having any perceptible effect on water quality during construction.

Habitat degradation as a result of effects on surface water quality during construction has the potential to affect the conservation status of affected wintering bird species and result in a likely significant negative effect, at a local geographic scale. Mitigation measures have been designed to protect water quality during construction (see **Section 8.6.4**).

Habitat Degradation – Groundwater

Any effects on the existing hydrogeological regimes at Coolagh Lakes and Ballindooley Lough have the potential to negatively impact upon the aquatic habitats and wintering bird species they support.

Based on the findings of the hydrogeological impact assessment in **Chapter 10, Hydrogeology**, the proposed road development does not pose a risk to the groundwater supply to Ballindooley Lough. The proposed road development does however, have the potential to affect the quantity of groundwater supplying the Coolagh Lakes. Although the magnitude of the impact cannot be fully quantified, on a precautionary basis it is assessed as having has the potential to affect winter bird usage of the Coolagh Lakes and result in a likely significant negative effect, at the local. Mitigation measures have been designed to protect the existing groundwater regime during construction (see **Section 8.6.5**).

8.5.8.2.2 Operation Phase Impacts

Disturbance/displacement

During operation, the proposed road development has the potential to disturb and displace wintering bird species from habitat near the proposed road development because of the noise and visual disturbance associated with road traffic. The focus of research, and attempting to quantify, the effect of operational roads on bird populations has been largely focussed on breeding populations. Although the operational disturbance/displacement effect cannot be quantified it would be expected to be much less than the 300m ZoI associated with construction works. Most species of wintering birds are likely to habituate to the presence of a new road, particularly when there is a barrier in place, as is the case for the proposed road development in the form of the boundary fencing or where the proposed road is in a deep cutting. Also, background noise levels are predicted to increase in the western part of the study area from a current range of 45-55dB to between 50 and 60dB during operation—a noise level at which birds would not be expected to be displaced from the area. In the zone between the N83 Tuam Road and the existing N6, background noise levels are currently in the 50-60dB range and any operational noise/traffic is not likely to alter the existing baseline effect on wintering birds using habitats locally.

Although there is still likely to be some level of displacement effect, a perceptible effect would be expected to be limited to habitats immediately adjacent to the proposed road development. Although it is likely to add to the effect of habitat loss, in terms of additional habitat area unavailable or unlikely to be used by wintering birds, it is not predicted to have a detrimental population level effect—particularly given the relatively infrequent and/or low numbers of wintering birds generally recorded at affected winter bird sites.

Therefore, any displacement of birds from habitat areas during operation of the proposed road development is not likely to affect the conservation status of wintering bird species and will not result in a likely significant negative effect, at any geographic scale.

Mortality Risk

The proposed River Corrib Bridge poses a collision risk to birds commuting along the river corridor. 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.

Surveys carried out in 2005/2006 as part of the 2006 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).

The bridge structure is clear-span with no supporting cable structures and as such, poses a minimal risk to wintering birds passing along the river corridor. Given the bird numbers and crossing frequencies observed during the 2006 surveys, a bridge such as that proposed in the design (refer to **Section 5.5.4.6** of **Chapter 5, Description of Proposed Road Development**) would not be expected to pose a collision risk of a magnitude that it would result in long-term effects on local bird populations.

Nor would the presence of the proposed road development 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, any collision risk posed by the proposed road development is not likely to affect the conservation status of wintering bird species and will not result in a likely significant negative effect, at any geographic scale.

Habitat Degradation – Surface Water

There are proposed drainage outfalls to all river/stream catchments crossed by the proposed road development. Therefore, there is a risk that discharges from the proposed road drainage network could affect water quality, potentially over the long-term, and consequently impact upon the aquatic environment and supported bird species. In a worst-case-scenario, this could result in a long-term decline in aquatic/wetland bird species abundance and distribution on affected rivers or lakes.

The proposed drainage design for the mainline of the proposed road development incorporates pollution control measures (this includes petrol interceptors, wetland and other measures, such as SuDS) followed by either infiltration ponds (where discharging to ground) or attenuation ponds (where drainage will be discharged to the existing surface water/storm sewer), as described in detail in **Chapter 5, Description of Proposed Road Development**.

Those sections of the proposed road drainage that are to be discharged to ground, pose no risk to surface water quality. It is extremely unlikely that the normal operating water quality of the drainage outfalls discharging to the existing surface water/drainage network, even in the unlikely event of a pollution incident, would have any perceptible long-term effect on water quality in receiving watercourses. The functioning and effectiveness of both elements of the proposed road drainage network are discussed in more detail in the hydrology chapter (**Chapter 11, Hydrology**).

Habitat degradation because of effects on surface water or groundwater during operation are not predicted to affect the conservation status of aquatic or wetland bird species and will therefore, not result in a likely significant negative effect, at any geographic scale.

8.5.9 Amphibians

8.5.9.1 Construction Phase Impacts

Habitat Loss

The construction of the proposed road development will result in the permanent loss of both confirmed and potentially suitable amphibian habitat within the proposed development boundary. The presence of potentially suitable amphibian breeding habitat is of note as, even though both Common frog and Smooth newt were only confirmed at a small number of sites within the proposed development boundary (see **Figures 8.10.1** to **8.10.8**), it is possible that any wetland/peatland habitat or drainage ditches could be colonised and used by this species at the time of construction.

Given the low number of habitat features supporting amphibian species directly impacted by the proposed road development, and that these areas supported relatively few individuals, and the abundance of alternative suitable habitat available locally, the effects of habitat loss associated with construction works are unlikely to affect the ability of the local frog or newt populations to maintain themselves in the long-term.

Therefore, habitat loss associated with the proposed road development is not likely to affect the species' conservation status or result in a likely significant negative effect, at any geographic scale.

As amphibian breeding habitat will be directly impacted by the proposed road development, and given the legal protection afforded to amphibian species under the Wildlife Acts (which prohibits wilful destruction or interference with an amphibian breeding or resting places), a mitigation strategy has been developed (see **Section 8.6.10.1**).

Disturbance & Mortality Risk

Site clearance works also have the potential to result in disturbance to, and the direct mortality of, Common frog and Smooth newt. The potential for direct mortality to occur, and the magnitude of any effects, would be expected to be greater where (a) suitable habitat exists and either Common frog and/or Smooth newt have been previously recorded (b) works affecting suitable habitat are undertaken during the breeding season, when adults and/or frog spawn/newt eggs may be present, or during the winter hibernation period when individuals are in refugia. Based on the survey results, the number of individuals that would potentially be at risk is low and would be unlikely to affect the local populations in the long-term.

Therefore, the proposed road development is not likely to affect the species' conservation status in that regard or result in a likely significant negative effect, at any geographic scale.

Amphibian species have been confirmed using habitat areas within, and immediately adjacent to, the proposed road development that have the potential to be killed, injured, or affected by construction related disturbance. Given the legal protection afforded to amphibian species under the Wildlife Acts, which prohibits their intentional killing or injury, or the wilful interference with an amphibian breeding or resting places, a mitigation strategy has been developed (see **Section 8.6.10.1**).

Habitat Severance/Barrier Effect

The temporary to short-term physical disruption of the existing landscape during site clearance and construction will fragment wetland and peatland habitats used by amphibian species. As a temporary to short-term impact, this is unlikely to present a significant barrier to the movement of amphibian species such that it would affect the local Common frog or Smooth newt populations in the long-term. Therefore, habitat severance during construction and any associated barrier effect are not predicted to result in a likely significant negative effect to amphibian species, at any geographic scale.

Habitat Degradation – Surface Water Quality

An accidental spillage or pollution event into a surface water feature supporting Common frog or Smooth newt will probably have a negative impact. The magnitude and significance of such an impact would be entirely dependent on the nature, scale and duration of the pollution event. Although unlikely, in a worst case scenario this could result in extensive degradation of amphibian habitat and/or the mortality of amphibians in affected habitats. There is the potential for such impacts to have long-term effects on the local populations of both the Common frog and the Smooth newt and result in a likely significant negative effect, at the local geographic scale. Habitat degradation therefore, has the potential to affect the species' conservation status and result in a likely significant negative effect, at the local geographic scale. Mitigation measures have been designed to protect water quality during construction (see **Section 8.6.4**).

8.5.9.2 Operational Phase Impacts

Habitat Severance/Barrier Effect

The presence of the proposed road development will create a permanent barrier in the landscape to the movement of Common frog and Smooth newt. This is likely to affect foraging behaviour and dispersal corridors, e.g. the movement of species between breeding and hibernation sites. Populations on the fringes of Galway City may be isolated from habitat areas and populations beyond, having long-term effects on genetic diversity and gene flow, at a local geographic scale.

Habitat severance and barrier effect has the potential to have long-term effects on the local populations of both the Common frog and the Smooth newt, affect the species' conservation status and result in a likely significant negative effect, at the local geographic scale. Mitigation measures have been designed to minimise the long-tern effects of any barrier effect posed by the proposed road development (see **Section 8.6.10.2**).

Mortality Risk

Amphibians species are vulnerable to road mortality and the presence of the proposed road development will pose a permanent mortality risk to Common frog and Smooth newt. Although it is not possible to quantify the magnitude of this impact, it is unlikely to have long-term effects that would result in a decline of the local Common frog and Smooth newt populations. Particularly, given the high degree of permeability across the proposed road development included within the design which will minimise the potential interaction of amphibians with the proposed road carriageway.

Therefore, mortality risk is not likely to affect the species' conservation status or result in a likely significant negative effect, at any geographic scale.

Habitat Degradation – Surface Water Quality

There will be outfall points to surface water features from the proposed road drainage network during operation. Therefore, there is a risk that discharges from the proposed road drainage network could affect water quality in receiving surface water features and consequently impact upon amphibian habitat.

The proposed drainage design for the mainline of the proposed road development incorporates pollution control measures (this includes petrol interceptors, wetland and other measures, such as SuDS) followed by either infiltration ponds (where discharging to ground) or attenuation ponds (where drainage will be discharged to the existing surface water/storm sewer), as described in detail in **Chapter 5, Description of Proposed Road Development**.

Those sections of the proposed road drainage that are to be discharged to ground, pose no risk to surface water quality. It is extremely unlikely that the normal operating water quality of the drainage outfalls discharging to the existing surface water/drainage network, even in the unlikely event of a pollution incident, would have any perceptible long-term effect on water quality in receiving watercourses. The functioning and effectiveness of both elements of the proposed road drainage network are discussed in more detail in **Chapter 11, Hydrology**.

Habitat degradation as a result of effects on surface water quality during operation is not predicted to affect the conservation status of amphibian species and will therefore, not result in a likely significant negative effect, at any geographic scale.

8.5.10 Reptiles

8.5.10.1 Construction Phase Impacts

Habitat Loss

Construction of the proposed road development will result in the permanent loss of Common lizard habitat within the proposed development boundary (see **Figures 8.10.1** to **8.10.8**). There are three distinct areas, where Common lizard were recorded, that are affected directly by the proposed road development: a mosaic of heath, scrub, bracken and wet grassland at Na Foraí Maola/An Chloch Scoilte (Area A); a similar habitat mosaic between Bearna Woods and na hAille (Areas B & C); and, at Ballagh (Areas E & F). This is consistent with the species favouring structurally diverse habitat mosaics to provide foraging areas, refuges and hibernacula, and basking sites within their territories.

In all areas, only single individual Common lizard were recorded on any given visit. Given the relatively low numbers of Common lizard that are likely to be affected, and the abundance of alternative suitable habitat available locally, the effects of habitat loss associated with construction works are unlikely to affect the long-term viability of the local Common lizard population. Therefore, habitat loss is not likely to affect the species' conservation status or result in a likely significant negative effect, at any geographic scale.

As Common lizard habitat will be directly impacted by the proposed road development, and given the legal protection afforded to the species under the Wildlife Acts (which prohibits wilful destruction or interference with their breeding or resting places), a mitigation strategy has been developed (see **Section 8.6.11.1**).

Disturbance & Mortality Risk

Site clearance works have the potential to result in disturbance to, and the direct mortality of, Common lizard. The potential for direct mortality to occur, and the magnitude of any effects, would be expected to be greatest where (a) suitable habitat exists and Common lizard have been previously recorded (b) works affecting suitable habitat are undertaken during the winter hibernation period (October to mid-March) and affect potential hibernacula (e.g. stone walls), when lizards are less active and therefore less able to escape any works being undertaken.

Based on the survey results, the number of individuals that would potentially be at risk is low and would be unlikely to affect the local populations in the long-term. Therefore, disturbance or mortality risk are not likely to affect the species' conservation status or result in a likely significant negative effect, at any geographic scale.

Common lizard have been confirmed using habitat areas within, and immediately adjacent to, the proposed road development and there is therefore, the potential for individuals to be killed, injured, or affected by construction related disturbance. Given the legal protection afforded to the Common lizard under the Wildlife Acts (which prohibits their intentional killing or injury, or the wilful interference with their breeding or resting places) and a mitigation strategy has been developed (see **Section 8.6.11.1**).

Habitat Severance/Barrier Effect

The temporary to short-term physical disruption of the existing landscape during site clearance and construction will fragment habitat used by Common lizard. As a temporary to short-term impact, this is unlikely to present a significant barrier to the movement of the species such that it would affect the local Common lizard population in the long-term. Therefore, habitat severance during construction and any associated barrier effect are not likely to affect the species' conservation status and are not predicted to result in a likely significant negative effect to the Common lizard, at any geographic scale.

8.5.10.2 Operational Phase Impacts

Habitat Severance/Barrier Effect

The presence of the proposed road development will create a permanent barrier in the landscape to the movement of Common lizard. This is likely to affect foraging behaviour and dispersal corridors, e.g. the movement of individuals within their territories and between breeding and hibernation sites. Populations on the fringes of Galway City may be isolated from habitat areas and populations beyond, having long-term effects on genetic diversity and gene flow, at a local geographic scale.

Habitat severance and barrier effect has the potential to have long-term effects on the local Common lizard population, affect the species' conservation status and result in a likely significant negative effect, at the local geographic scale. Mitigation measures have been designed to minimise the long-tern effects of any barrier effect posed by the proposed road development (see **Section 8.6.11.2**).

Mortality Risk

Common lizard are vulnerable to road mortality and the presence of the proposed road development will pose a permanent mortality risk to the species. Although it is not possible to quantify the magnitude of this impact, it is unlikely to have long-term effects that would result in a decline of the local Common lizard population. Particularly, given the high degree of permeability across the proposed road development included within the proposed design which will minimise the potential interaction of lizards with the proposed road carriageway.

Therefore, mortality risk is not predicted to affect the species' conservation status or result in a likely significant negative effect to amphibians, at any geographic scale.

8.5.11 Fish

8.5.11.1 Construction Phase Impacts

Habitat Loss

The proposed road development will result in the permanent loss of fisheries habitat where it crosses Sruthán na Líbeirtí, the Trusky Stream, the Bearna Stream (and tributary), the Tonabrocky Stream, the Knocknacarra Stream. A reduction in habitat availability could potentially have long-term effects on fish populations within a given river/stream catchment.

Sruthán na Líbeirtí

Sruthán na Líbeirtí is crossed by the proposed road development at two locations: between Ch. 0+650 and Ch. 0+750 (refer to **Figure 5.1.1**) where the length of channel directly affected is c.130m, and between Ch. 0+850 and Ch. 1+000 where c.120m will be lost. There is an additional 240m of the watercourse that lies within, or along, the proposed development boundary and is likely to be affected to some degree by construction, construction works could potentially result in further habitat loss. Construction works to install the proposed drainage outfall and road carriageway near where the stream passes beneath the R336 has the potential to result in further habitat loss, although the areas involved are likely to be small ($<10m^2$). The impact associated with the loss of instream habitat will be offset slightly by the creation of a new section of river channel, c.40m in length.

Sruthán na Líbeirtí is a seasonal watercourse with low fisheries value in the upper reaches, where it is impacted by the proposed road development. Considering this and the design requirements relating to new crossing structures and the proposed realigned channel, the loss of habitat is predicted not to affect the conservation status of the fish species within that catchment and will not therefore, result in a likely significant negative effect, at any geographic scale.

Trusky Stream

Approximately 160m of instream habitat will be lost on the Trusky Stream (Ch. 2+750 to Ch. 2+900 - refer to **Figure 5.1.1** and **Figure 5.1.2**) with a new channel, c.60m in length, being constructed in its place. There is also an additional 65m of the watercourse that lies within the proposed development boundary and is likely to be affected to some degree by construction works, e.g. the construction of the proposed drainage outfall will require installing a permanent structure on the stream bank.

The Trusky Stream is a seasonal watercourse with low fisheries value in the upper reaches, where it is impacted by the proposed road development. Considering this, the loss of habitat is not likely to affect the conservation status of the fish species within that catchment and will not therefore, result in a likely significant negative effect, at any geographic scale.

<u>Bearna Stream</u>

The Bearna Stream is crossed by the proposed road development at Ch. 4+125 (refer to **Figure 5.1.3**) where c.40m of existing instream habitat will be lost. There is an additional 285m of the watercourse that lies within, or along, the proposed development boundary and is likely to be affected to some degree by construction. Construction works could potentially result in further habitat loss such as that associated with installing the drainage outfall from the attenuation ponds. At Ch. 3+950, approximately 40m of instream habitat in a small tributary of the Bearna Stream will be lost; there is also c.110m of additional stream channel within the proposed development boundary with the same potential construction impacts as outlined above for the main channel of the Bearna Stream.

The main channel of the Bearna Stream is more than 4km in length. Considering that the linear length of stream channel that will be lost represents less than 1% of the total, the habitat loss is not likely to be of a magnitude to affect the conservation status of the fish species within that catchment and will not therefore, result in a likely significant negative effect, at any geographic scale. The unnamed tributary of the Bearna Stream is a seasonal watercourse with a relatively lower fisheries value in the upper reaches, where it is crossed by the proposed road development. Considering this, the loss of habitat is not likely to affect the conservation status of the fish species within that catchment and will not therefore, result in a likely significant negative effect, at any geographic scale.

<u>Tonabrocky Stream</u>

Approximately 450m of the Tonabrocky Stream channel will be lost as a result of the proposed road development between Ch. 4+850 and Ch. 5+225 (refer to **Figure 5.1.4**). As with many of the other watercourses crossed by the proposed road development, a further c.80m of the stream channel lie within the proposed development boundary and may also be directly impacted by construction works. A new section of stream channel, c.250m in length, which will offset the habitat loss to a degree.

The main channel of the Tonabrocky Stream is more than 5km in length. Although the linear length of stream channel that will be lost represents c.9% of the total, when the new length of stream channel is considered (reducing the permanent loss to c.4%) the habitat loss is not likely to be of a magnitude to affect the conservation status of the fish species within that catchment, particularly given that the impacted area is in the upper reaches of the catchment where the fisheries value was assessed as low. Habitat loss on the Tonabrocky Stream will not therefore, result in a likely significant negative effect, at any geographic scale.

<u>Knocknacarra Stream</u>

As a seasonal stream with a low fisheries value (where impacted by the proposed road development), the loss of habitat is predicted not to affect the conservation status of the fish species within that catchment and will not therefore, result in a likely significant negative effect, at any geographic scale.

River Corrib

There are no instream works proposed at the River Corrib. Habitat loss here will be restricted to the permanent loss of riparian/bankside habitat to install the drainage outfalls; one on each bank of the river which will affect c.3m of riparian habitat (refer to **Figure 5.1.7** and for habitats **Figures 8.14.7** and **8.15.7**). In the context of the River Corrib, where there is no spawning habitat or habitat suitable to support lamprey ammocoetes present in the immediate vicinity of the proposed River Corrib Bridge, this level of habitat loss is not likely to have any perceptible impact upon the fish species using the river. Therefore, habitat loss is not likely to have any long-term effect on the fish populations of the River Corrib or their conservation status, and therefore will not result in a likely significant negative effect, at any geographic scale.

Even though habitat loss is not predicted to result in any likely significant negative effect on affected watercourses/catchments, mitigation measures are proposed to minimise the loss of fisheries habitat, to protect that which is being retained within the proposed development boundary, and through the design of new channels and the culverts, minimise its effects on the local fish populations.

Coolagh Lakes, Ballindooley Lough and Galway Bay

There will be no habitat loss associated with the proposed road development at the Coolagh Lakes, Ballindooley Lough or in Galway Bay.

Habitat Degradation – Surface Water Quality

During construction, contaminated or heavily silted surface water runoff, pump discharges 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 on aquatic habitats and fish species, and potentially also in the marine environment downstream. This could be either directly (e.g. acute or sub-lethal toxicity from pollutants or siltation events damaging spawning habitat downstream) 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. 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 and detailed mitigation measures are required to further minimise the risk of the proposed road development having any perceptible effect on water quality during construction.

Habitat degradation as a result of effects on surface water quality during construction has the potential to affect the conservation status of affected fish species and result in a likely significant negative effect, at a local geographic scale. Mitigation measures have been designed to protect water quality during construction (see **Section 8.6.4**).

Habitat Degradation – Groundwater

Any effects on the existing hydrogeological regimes at the Coolagh Lakes and Ballindooley Lough have the potential to negatively impact upon the aquatic habitats and the fish species they support.

Based on the findings of the hydrogeological impact assessment in **Chapter 10, Hydrogeology**, the proposed road development does not pose a risk to the groundwater supply to Ballindooley Lough. The proposed road development does however, have the potential to affect the quantity and quality of groundwater supplying the Coolagh Lakes. Although the magnitude of the impact cannot be fully quantified, on a precautionary basis it is assessed as having the potential to affect fish species' conservation status in the Coolagh Lakes and result in a likely significant negative effect, at the local geographic scale. Mitigation measures have been designed to protect the existing hydrogeological regime during construction (see **Section 8.6.5**).

Mortality Risk

Construction works to install culverts on Sruthán na Líbeirtí, the Trusky Stream, the Bearna Stream (and tributary), the Tonabrocky Stream, the Knocknacarra Stream and the River Corrib will require instream works, and in some cases realignment of a section of the stream channel. Instream works, or works associated with channel diversions, stream realignments or general construction activities (e.g. dewatering channels or water abstraction for dust control), have the potential to result in the direct mortality of fish species. This section assesses the risk associated with mortality due to species interacting with construction vehicles, machinery such as pumps, or as a result of dewatering. The potential effects of accidental pollution events, which can also result in fish mortality, are discussed separately under the heading of *Habitat Degradation – Surface Water*.

Given the seasonal nature of the upper reaches of many of the streams, where the proposed road development will be impacting upon the channel, and the low numbers of fish species recorded there during the electrofishing surveys, the mortality risk posed by the construction works is unlikely to affect the conservation status of any of the fish species present in the catchments of Sruthán na Líbeirtí, the Trusky Stream, the Bearna Stream (and tributary), the Tonabrocky Stream, or the Knocknacarra Stream.

Instream works on the River Corrib are limited to construction of the drainage outfalls (one on each river bank) which will require the installation of a head wall and concrete base. Given the scale of the works, they do not pose a risk of fish mortality such that it is likely to affect the conservation status of any of the fish species present in the River Corrib catchment.

The mortality risk from construction works is not likely to have any long-term effect on the local fish populations or their conservation status, and therefore will not result in a likely significant negative effect, at any geographic scale.

Given the legal protection afforded to fish species under the Fisheries Acts, a mitigation strategy has been developed to avoid an offence being committed during construction works (see **Section 8.6.12.1**).

Disturbance/Displacement

Increased human presence, and noise and vibration associated with the construction works (e.g. the installation of culverts and piles) is likely to result in the displacement of fish species from the area. long-term disturbance/displacement effects on the local fish populations are not likely given 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), that there are no spawning grounds near any of the proposed watercourse crossings.

Disturbance/displacement during construction is not predicted to affect the conservation status of the local fish populations and therefore, will not result in a likely significant negative effect, at any geographic scale.

Habitat Severance/Barrier Effect

Instream construction works have the potential to sever fisheries habitat and result in a barrier to fish passage, at least temporarily. Restricting fish access to food resources, or spawning grounds, could have long-term effects on the local fish populations.

The habitat affected by, and upstream of, the proposed road development in the catchments of Sruthán na Líbeirtí, the Trusky Stream, the Bearna Stream (and tributary), the Tonabrocky Stream, and the Knocknacarra Stream were considered to be of a low fisheries value – most being seasonal in nature with few, or no, fish species recorded during the fisheries surveys. Therefore, any temporary severance or barrier effect during construction is not likely to result in long-term effects on the local fish populations in these catchments.

As the proposed River Corrib Bridge is a clear span bridge structure with no instream structures or works with the potential to block the river channel, no habitat severance or barrier effect will occur on the River Corrib.

Overall, habitat severance and barrier effect during construction is not likely to have any long-term effect on the local fish populations or their conservation status, and therefore will not result in a likely significant negative effect, at any geographic scale.

8.5.11.2 Operation Phase Impacts

Habitat Degradation – Surface Water

There will be drainage outfalls to all river/stream catchments crossed by the proposed road development. Therefore, there is a risk that discharges from the proposed road drainage network could affect water quality, potentially over the long-term, and consequently impact upon aquatic habitats and fish species. In a worst-case-scenario, this could result in a permanent decline in fish species abundance and distribution.

The proposed drainage design for the mainline of the proposed road development incorporates pollution control measures (this includes petrol interceptors, wetland and other measures, such as SuDS) followed by either infiltration ponds (where discharging to ground) or attenuation ponds (where drainage will be discharged to the existing surface water/storm sewer), as described in detail in **Chapter 5, Description of Proposed Road Development**.

Those sections of the proposed road drainage that are to be discharged to ground, pose no risk to surface water quality. It is extremely unlikely that the normal operating water quality of the drainage outfalls discharging to the existing surface water/drainage network, even in the unlikely event of a pollution incident, would have any perceptible long-term effect on water quality in receiving watercourses. The functioning and effectiveness of both elements of the proposed road drainage network are discussed in more detail in the hydrology chapter (**Chapter 11, Hydrology**).

Habitat degradation because of effects on surface water or groundwater during operation is not predicted to affect the conservation status of fish species and will therefore, not result in a likely significant negative effect, at any geographic scale.

Habitat Severance/Barrier Effect

The structures have been designed in consultation with IFI and the design criteria set out in *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes* (National Roads Authority, 2005) and the *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016). This will maintain fish passage during the operation of the proposed road development and therefore, will result in a neutral impact to fish species.

8.5.12 Local Biodiversity Areas

The Coast Road (R336) to the N59 Moycullen Road (which includes the Cappagh – Ballymoneen and the Ballagh – Barnacranny Hill local biodiversity areas from the draft Galway City Biodiversity Action Plan 2014-2024)

In terms of biodiversity effects, the proposed road development will result in habitat loss across this area, including the loss of areas of the Annex I habitats Wet heath, Dry heath and Molinia meadow (see **Section 8.5.4** above for habitat impacts). It will also impact upon mammal species including Otter and Badger (see **Section 8.5.6** above), bat species (see **Section 8.5.6.2** above), the Marsh fritillary butterfly (see **Section 8.5.7.4**), breeding and wintering birds (see **Section 8.5.8** above), the Common frog and Smooth newt (see **Section 8.5.9**), the Common lizard (see **Section 8.5.10** above), and fish species in Sruthán na Líbeirtí, the Trusky Stream, the Bearna Stream, the Tonabrocky Stream and the Knocknacarra Stream (see **Section 8.5.11** above).

Rusheen Bay – Barna Woods – Illaunafamona

The proposed road development has the potential to affect habitats and species in Rusheen Bay if it were to result in a deterioration in water quality in the receiving surface water network, which discharges to Rusheen Bay (the Bearna Stream, the Tonabrocky Stream and the Knocknacarra Stream). For example, this is discussed above in **Section 8.5.4.1** in relation to habitats (including watercourses), in **Section 8.5.6.1.1** in relation to Otter, and in **Section 8.5.8.2.1** in relation to wintering birds. The proposed road development also has the potential to present a barrier to Otter movement in watercourses connected to Rusheen Bay (features that are important in supporting the local Otter populations), and road traffic has the potential to present a mortality risk to Otter (see **Section 8.5.6.1** above).

The River Corrib and the Coolagh lakes (which includes the River Corrib and adjoining wetlands local biodiversity areas from the draft Galway City Biodiversity Action Plan 2014-2024)

In terms of biodiversity effects, the proposed road development will result in habitat loss in the vicinity of the proposed River Corrib crossing, has the potential to affect water quality in the receiving environment, has the potential to affect groundwater quality and quantity supplying the Coolagh Lakes, to disturb species using the River Corrib corridor and the Coolagh Lakes (e.g. aquatic species and breeding/wintering birds). These impacts have the potential to affect both habitats and the assemblage of fauna species supported by those habitats; which include Otter, fish species, wintering and breeding birds, bats (including the Lesser horseshoe bat) and mollusc species. Construction of the River Corrib Bridge has the potential to affect aquatic species through the risk of construction materials dropping into the river, with operation of the proposed road development posing a mortality risk to Otter.

The effects on the River Corrib and the Coolagh Lakes are discussed briefly in **Section 8.5.3.1** in relation to Lough Corrib cSAC and in Section **8.5.3.2.2** in relation to Lough Corrib pNHA. However, a more detailed assessment is presented in the NIS in the context of impacts on the River Corrib/Coolagh Lakes and Lough Corrib cSAC, which considers all of the aforementioned potential impacts, as the cSAC designation includes the River Corrib and the Coolagh Lakes. This area is also included within the Lough Corrib pNHA.

Menlough to Coolough Hill (including Lackagh Quarry)

In terms of biodiversity effects, the proposed road development will result in habitat loss across this area, including semi-natural grasslands, woodland, scrub, calcareous springs and exposed limestone rock – this includes the loss of areas of the Annex I habitats Petrifying springs, Limestone pavements, Calcareous grasslands and Residual alluvial forests. There is also the potential for groundwater impacts to affect a Turlough feature (see **Section 8.5.4** above for habitat impacts). It will also impact upon mammal species including Badger (see **Section 8.5.6** above), bat species (and in particular the Lesser horseshoe bat and the maternity roost at Menlo Castle, see **Section 8.5.6.2** above), breeding birds (including Barn owl, see **Section 8.5.8** above), and potentially amphibian species (see **Section 8.5.9**).

A portion of this area also lies within Lough Corrib cSAC, this is discussed briefly in **Section 8.5.3.1** in relation to Lough Corrib cSAC. However, a more detailed assessment is presented in the NIS in the context of impacts on that portion of this area that lies within Lough Corrib cSAC

Ballindooley – Castlegar (which is linked to the River Corrib by the Terryland River valley)

In terms of biodiversity effects, the proposed road development will result in habitat loss at Ballindooley Lough, including the loss of an area of *Molinia* meadow, and also has the potential to affect surface water quality in the lakes during construction (see **Section 8.5.4** above for habitat impacts). These impacts will also likely impact upon mammal species generally (see **Section 8.5.6** above), bat species including the Lesser horseshoe bat (see **Section 8.5.6.2** above), breeding and wintering birds (see **Section 8.5.8** above), fish species in the lakes (see **Section 8.5.11** above), and potentially amphibian species (see **Section 8.5.9**).

Galway Racecourse, Ballybrit

The semi-natural habitats present at this site are not directly impacted or likely to be affected in any way by the proposed road development.

Doughiska

In terms of biodiversity effects, the proposed road development will result in habitat loss within this area, including the loss of areas of the Annex I habitats Calcareous grassland and Limestone pavement (see **Section 8.5.4** above for habitat impacts). It is also likely to impact upon mammal species generally (see **Section 8.5.6** above), bat species (see **Section 8.5.6.2** above) and breeding and wintering birds (see **Section 8.5.8** above).

Galway Bay (which includes the Mutton Island and Nearby Shoreline local biodiversity areas from the draft Galway City Biodiversity Action Plan 2014-2024)

The proposed road development has the potential to affect habitats and species in Galway Bay if it were to result in a deterioration in water quality in the receiving surface water network, which discharges to Galway Bay. The proposed road development also has the potential to present a barrier to Otter movement in watercourses connected to Galway Bay (features that are important in supporting the local Otter populations), and road traffic has the potential to present a mortality risk to Otter.

8.5.13 Summary of Potential Impacts

Table 8.34 below presents an overall summary of the likely significant effects of the proposed road development on biodiversity, in the absence of mitigation measures.

Table 8.34: Summary of Likely Significant Effects of the Proposed Road Development on Biodiversity (pre-mitigation)

Ecological Receptor	**Ecological Valuation (after National Roads Authority, 2009)**	**Impacts with the Potential to result in Likely Significant Effects**	**Potential Impact Significance**
Designated Areas for Nature Conservation			
Lough Corrib cSAC (including Lough Corrib pNHA)	International (National)	**Construction** Habitat loss Habitat degradation – tunnelling/excavation Habitat degradation – hydrogeology	Likely significant effect at the international geographic scale

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance
		Habitat degradation – hydrology Habitat degradation – air quality Habitat degradation – non-native invasive plant species Mortality risk **Operation** Habitat degradation – hydrogeology Habitat degradation – non-native invasive plant species Mortality risk	
Galway Bay Complex cSAC (including Galway bay Complex pNHA)	International (National)	**Construction** Habitat degradation – hydrology Habitat degradation – non-native invasive plant species Barrier effect Mortality risk	Likely significant effect at the international geographic scale
Lough Corrib SPA (including Lough Corrib pNHA)	International (National)	**Construction** Habitat degradation – hydrogeology Habitat degradation – hydrology Disturbance/displacement **Operation** Habitat degradation – hydrogeology	Likely significant effect at the international geographic scale
Inner Galway Bay SPA including Galway bay Complex pNHA)	International (National)	**Construction** Habitat degradation – hydrogeology Habitat degradation – hydrology Disturbance/displacement **Operation** Habitat degradation – hydrogeology	Likely significant effect at the international geographic scale
Moycullen Bogs NHA	National	**Construction** Habitat degradation – air quality Habitat degradation – non-native invasive plant species Habitat degradation – hydrology **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the national geographic scale
Habitats (outside of designated areas for nature conservation)			
Limestone pavement [*8240]	International Importance	**Construction** Habitat loss Habitat degradation – air quality	Likely significant effect at the international geographic scale

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance
		Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	
Petrifying springs [*7220]	International Importance	**Construction** Habitat loss	Likely significant effect at the county geographic scale (see **Section 8.5.4.3** under petrifying springs)
Calcareous grassland [*6210/6210]	International/ National Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the national geographic scale (No *6210 affected – see **Section 8.5.4.3** under Calcareous grassland))
Dry heath [4030]	National Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the national geographic scale
Wet heath [4010][80]	National Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – groundwater **Operation** Habitat degradation – groundwater	Likely significant effect at the national geographic scale
Molinia meadow [6410]	National Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the national geographic scale

[80] Including areas of Wet heath/Dry heath/*Molinia* meadow [4010/4030/6410] mosaic

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance
Residual alluvial forest [*91E0]	International Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the international geographic scale
Turloughs [*3180]	International Importance	**Construction** Habitat loss Habitat degradation – surface water quality Habitat degradation – groundwater Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – groundwater Habitat degradation – non-native invasive plant species	Likely significant effect at the international geographic scale
Hard water lakes [3140]	National Importance	**Construction** Habitat degradation – surface water quality (Ballindooley Lough)	Likely significant effect at the national geographic scale
Mesotrophic lakes (FL4) *Part of Ballindooley complex*	County Importance[81]	**Construction** Habitat degradation – surface water quality	Likely significant effect at the county geographic scale
Eutrophic lakes (FL5) *Part of Ballindooley complex*	County Importance[82]	**Construction** Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the county geographic scale
Calcareous springs (FP1) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat loss	Likely significant effect at the local geographic scale
Cladium fen [*7210]	International Importance	**Construction** Habitat degradation – surface water quality (Ballindooley Lough)	Likely significant effect at the international geographic scale

[81] On the basis that it forms part of the wetland complex at Ballindooley Lough
[82] On the basis that it forms part of the wetland complex at Ballindooley Lough

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance
Hydrophilous tall herb [6430]	International Importance	(see Lough Corrib cSAC above) **Construction** Habitat degradation – hydrogeology Habitat degradation – hydrology **Operation** Habitat degradation – hydrogeology	Likely significant effect at the international geographic scale
Alkaline fens [7230]	National Importance	**Construction** Habitat degradation – surface water quality (Ballindooley Lough)	Likely significant effect at the national geographic scale
Reed and large sedge swamps (FS1) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality	Likely significant effect at the local geographic scale
Tall-herb swamps (FS2) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale
Eroding/upland rivers (FW1)	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality	Likely significant effect at the local geographic scale
Depositing /lowland rivers (FW2) River Corrib	International Importance	The River Corrib forms part of see Lough Corrib cSAC (see above and NIS)	Likely significant effect at the international geographic scale
Terryland River	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale
Drainage ditches (FW4)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale
Marsh (GM1)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale
Dry calcareous and neutral grassland (GS1) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance
Dry meadows and grassy verges (GS2) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale
Dry-humid acid grassland (GS3) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale
Wet grassland (GS4) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale
Rich fen and flush (PF1) Non-Annex I habitat type	County Importance	**Construction** Habitat degradation – surface water quality Habitat degradation – air quality	Likely significant effect at the county geographic scale
Poor fen and flush (PF2) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality **Operation** Habitat degradation – groundwater	Likely significant effect at the local geographic scale
(Mixed) broadleaved woodland (WD1)	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale
Mixed broadleaved/conifer woodland (WD2)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale
(Mixed) conifer woodland (WD3)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale

Ecological Receptor	**Ecological Valuation (after National Roads Authority, 2009)**	**Impacts with the Potential to result in Likely Significant Effects**	**Potential Impact Significance**
Hedgerows (WL1)	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale
Treelines (WL2)	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale
Oak-ash-hazel woodland (WN2) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat degradation – air quality Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale
Scrub (WS1) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale
Fauna Species			
Badger	Local Importance (Higher Value)	**Construction** Loss of breeding/resting sites Disturbance/displacement **Operation** Habitat severance/barrier effect Mortality risk	Likely significant effect at the local geographic scale
Otter	International Importance	**Construction** Habitat degradation - water quality **Operation** Habitat severance/barrier effect Mortality risk	Likely significant effect at the local geographic scale
Other mammal species protected under the Wildlife Acts	Local Importance (Higher Value)	**Construction** Habitat degradation - water quality **Operation** Habitat severance/barrier effect	Likely significant effect at the local geographic scale

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance
		Mortality risk	
Lesser horseshoe bat	National Importance	**Construction** Roost loss Habitat loss Habitat fragmentation Disturbance/displacement **Operation** Mortality Barrier/severance effects Disturbance/displacement	Likely significant effect at the national geographic scale
All other bat species	Local Importance (Higher Value)		Likely significant effect at the local geographic scale
Marsh whorl snail	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality Habitat degradation – groundwater **Operation** Habitat degradation – groundwater	Likely significant effect at the local geographic scale
Marsh fritillary butterfly	County Importance	**Construction** Mortality risk	Likely significant effect at the local geographic scale
SCI bird species	International	*see Lough Corrib SPA and Inner Galway Bay SPA above*	*see Lough Corrib SPA and Inner Galway Bay SPA above*
Barn owl	County Importance	**Operation** Mortality risk	Likely significant effect at the county geographic scale
Peregrine falcon	County Importance	**Construction** Disturbance/displacement **Operation** Disturbance/displacement	Likely significant effect at the county geographic scale
All other breeding bird species (non SCI)	Local Importance (Higher Value)	**Construction** Mortality risk Disturbance/displacement **Operation** Mortality risk Disturbance/displacement	Likely significant effect at the local geographic scale
All other wintering bird species (non-SCI)	Local Importance (Higher Value)	**Construction** Disturbance/displacement (Ballindooley Lough) Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the local geographic scale

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance
Smooth newt Common frog	Local Importance (Higher Value)	**Construction** Habitat loss Disturbance & mortality risk Habitat degradation – surface water quality **Operation** Habitat severance/barrier effect	Likely significant effect at the local geographic scale
Common lizard	Local Importance (Higher Value)	**Construction** Habitat loss Disturbance & mortality risk **Operation** Habitat severance/barrier effect	Likely significant effect at the local geographic scale
Atlantic salmon European eel	International Importance	**Construction** Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the local geographic scale
All other fish species recorded	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the local geographic scale
Local Biodiversity Areas			
Local biodiversity areas	The value of the biodiversity receptors recorded in the vicinity of the proposed road development, across the local biodiversity areas, range from Local Importance (Lower Value) to Internationally Important	Combinations of all of the potential impacts noted above. The specific impacts are related to and dependent upon the potential impacts of the proposed road development on each of the individual ecological receptors that make up the biodiversity resource within a given local biodiversity area	Likely significant effects from local up to the international geographic scale

8.6 Mitigation Measures

This section presents the mitigation measures to avoid or reduce the potential impacts of the proposed road development on biodiversity. **Section 8.6.1.1** summarises the mitigation measures that relate to the protection of European sites. All other mitigation measures are described in **Sections 8.6.2** to **8.6.12** below. All of these mitigation measures are included in the Schedule of Environmental Commitments which will be implemented by the contractor under supervision of both the Project Ecologist (employed by the Employer) and the Ecological Clerk of Works (employed by the Contractor).

8.6.1 Designated Areas for Nature Conservation

8.6.1.1 European Sites

The mitigation measures that are specifically required to ensure that the proposed road development will not result in a likely significant effect (i.e. adversely affect the integrity of) on the European sites within its ZoI (Lough Corrib cSAC, Lough Corrib SPA, Galway Bay Complex cSAC and Inner Galway Bay SPA) are presented in Section 10 of the NIS. Following a consideration and assessment of the proposed road development on the identified relevant European sites, mitigation measures were developed to address the following potential impacts that were identified:

- Habitat loss/fragmentation: mitigation measures to minimise habitat loss in Lough Corrib cSAC and to avoid loss of QI habitats within Lough Corrib cSAC during construction
- Habitat degradation – tunnelling/excavation: mitigation measures to maintain the structural integrity of rock mass supporting QI habitats in Lough Corrib cSAC during the construction of the proposed Lackagh Tunnel (and its western approach)
- Habitat degradation – hydrogeology: mitigation measures to avoid habitat degradation in Lough Corrib cSAC as a result of potential hydrogeological impacts during construction and operation
- Habitat degradation – hydrology: mitigation measures to protect water quality in receiving watercourses during construction
- Habitat degradation – air quality: mitigation measures to control dust emissions during construction to prevent impacts on vegetation in Lough Corrib cSAC
- Habitat degradation – non-native invasive plant species: mitigation measures to avoid the introduction or spread of non-native plant invasive species to European sites during construction or operation
- Disturbance/displacement: mitigation measures to avoid/reduce the disturbance/displacement effects of blasting on wintering birds using Ballindooley Lough
- Barrier effect: mitigation measures to avoid the proposed road development restricting Otter movement within the Bearna Stream catchment

- Mortality risk: mitigation measures to avoid mortality of the QI species of Lough Corrib cSAC. These include both measures to ensure that construction materials are not introduced into the River Corrib and to remove the risk of Otter being killed/injured due to collisions with road traffic

8.6.1.2 Natural Heritage Areas and proposed Natural Heritage Areas

As discussed in **Section 8.5.3.2**, the potential for the proposed road development to significantly affect Lough Corrib pNHA or Galway Bay Complex pNHA is as per the corresponding European sites (Lough Corrib cSAC and Lough Corrib SPA in relation to Lough Corrib pNHA, and Galway Bay Complex cSAC and Inner Galway Bay SPA in relation to Galway Bay Complex pNHA). Therefore, the mitigation measures outlined above in **Section 8.6.1.1**, and as detailed in Section 10 of the NIS, will prevent the proposed road development resulting in a significant negative effect on Lough Corrib pNHA or Galway Bay Complex pNHA at the national geographic scale.

The mitigation measures that are required to ensure that the proposed road development will not significantly affect Moycullen Bogs NHA are as follows:

- Measures to control dust emissions during construction to prevent impacts to vegetation/habitats within Moycullen Bogs NHA at Tonabrocky – see **Section 8.6.2** below and **Chapter 16, Air Quality and Climate**. These include control measures such as spraying of exposed earthwork activities and site haul roads during dry weather, wheel washes, control of site vehicle speeds, road sweeping and dust screens
- Measures to avoid the introduction or spread of non-native invasive plant species to Moycullen Bogs NHA during construction or operation. These are detailed in the Non-native Invasive Species Management Plan which forms part of the Construction Environmental Management Plan (CEMP) – (**Appendix A.7.5**)
- Measures to control surface water runoff from the construction site to prevent an accidental pollution event affecting peatland habitats within Moycullen Bogs NHA at Tonabrocky – see **Section 11.6.2** of **Chapter 11, Hydrology**

8.6.2 Habitats

8.6.2.1 Mitigation Measures to Minimise Habitat Loss

To minimise the loss of Annex I habitat, areas of these habitat types within the proposed development boundary but which are not required to construct the proposed road development will be retained and fenced off for the duration of construction. These areas will also not be directly impacted during the operation of the proposed road development. These are shown on **Figures 8.23.1** to **8.23.14**.

To minimise the loss of habitat associated with the proposed road development, there are also areas within the proposed development boundary which are included for mitigation planting where general construction works will not be undertaken. These are shown on **Figures 8.23.1** to **8.23.15**.

Where possible, woodland, scrub, treelines and hedgerows which lie within, or along the boundary of the proposed road development, that are not directly impacted by the proposed road alignment or drainage will be retained. These areas will be protected for the duration of construction works and fenced off at an appropriate distance. Vegetation to be retained is shown on **Figures 8.23.1** to **8.23.15** and on **Figures 12.2.01** to **12.2.15**.

Where possible, areas of river channel and bankside vegetation which lie within, or along the boundary of the proposed road development, that are not directly impacted by the proposed road alignment or drainage will be retained. These areas will be protected for the duration of construction works and fenced off at a distance of 5m from the stream/river bank.

The Petrifying spring feature present in Lackagh Quarry, which lies c.25m to the north of the mainline of the proposed road development at Ch. 11+400, will be retained and shotcrete[83] will not be used as part of the quarry face stabilisation measures at the spring site.

8.6.2.2 Measures to Reduce the Potential for Impacts on Vegetation to be retained

Any vegetation (including trees, hedgerows or scrub adjacent to, or within, the proposed development boundary) which is to be retained shall be afforded adequate protection during the construction phase in accordance with the Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub Prior to, During and Post Construction of National Road Schemes (National Roads Authority, 2006b), as follows:

- All trees along the proposed development boundary that are to be retained, both within and adjacent to the proposed development boundary (where the root protection area of the tree extends into the proposed development boundary), will be fenced off at the outset of works and for the duration of construction to avoid structural damage to the trunk, branches or root systems of the trees. Temporary fencing will be erected at a sufficient distance from the tree so as to enclose the Root Protection Area (RPA) of the tree. The RPA will be defined based upon the recommendation of a qualified arborist
- Where fencing is not feasible due to insufficient space, protection for the tree/hedgerow will be afforded by wrapping hessian sacking (or suitable equivalent) around the trunk of the tree and strapping stout buffer timbers around it
- The area within the RPA will not be used for vehicle parking or the storage of materials (including soils, oils and chemicals). The storage of hazardous

[83] A concrete product which is sprayed at high velocity into a rock face as a structural/stabilising component.

materials (e.g. hydrocarbons) or concrete washout areas will not be undertaken within 10 m of any retained trees, hedgerows and treelines

- A qualified arborist shall assess the condition of, and advise on any repair works necessary to, any trees which are to be retained or that lie outside of the proposed development boundary but whose RPA is impacted by the works. Any remedial works required will be carried out by a qualified arborist
- A buffer zone of at least 5m will be maintained between construction works and retained hedgerows to ensure that the root protection areas are not damaged

8.6.3 Measures to Reduce the Potential for Air Quality Impacts during Construction

To control dust emissions during construction works standard mitigation measures shall include: spraying of exposed earthwork activities and site haul roads during dry and/or windy conditions; provision of wheel washes at exit points; control of vehicle speeds and speed restrictions (20km/h on any un-surfaced site road); covering of haulage vehicles; and, sweeping of hard surface roads. These procedures will be strictly monitored and assessed on a daily basis.

Dust screens will be implemented at locations where there is the potential for air quality impacts during the construction phase i.e. at locations where sensitive receptors are located within 100m of the works. In addition, a 2m dust screen will be provided at the locations in the areas of the overlap of the proposed road development and the Lough Corrib cSAC and adjacent to Moycullen Bogs NHA.

These measures are detailed further in **Section 16.6.2** of **Chapter 16, Air Quality and Climate** and in the CEMP in **Appendix A.7.5**.

8.6.4 Mitigation Measures to Reduce the Potential for Impacts to Water Quality in Receiving Watercourses

The mitigation measures to protect surface water during construction are detailed in **Section 11.6.2** of **Chapter 11, Hydrology**.

As is normal practice the Construction Environmental Management Plan (CEMP) included in **Appendix A.7.5** will be finalised by the Contractor in advance of the commencement of construction and the following will be implemented as part this plan:

- An Incident Response Plan detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, logging of non-compliance incidents and any such risks that could lead to a pollution incident, including flood risks (Refer to Section 10 of the CEMP in **Appendix A.7.5**)
- A Sediment Erosion and Pollution Control Plan (Refer to Section 8 of the CEMP in **Appendix A.7.5**). This shall include water quality monitoring and method statements to ensure compliance with environmental quality standards specified in the relevant legislation (i.e. surface water regulations and Salmonid Regulations 1988)

Refer to Section **11.6.2** of **Chapter 11, Hydrology** for further mitigation measure details.

8.6.5 Measures to Protect Groundwater Quantity and Groundwater Quality

The mitigation measures to protect groundwater quantity and quality during construction and operation are detailed in **Section 10.6.2** (construction) and **Section 10.6.3** (operation) of **Chapter 10, Hydrogeology**.

Mitigation measures are included in **Section 9.6** of **Chapter 9, Soils and Geology** to restrict the use of fill material in areas where there is the potential for run off/infiltration to affect pH levels in adjoining peatland habitats within the operational hydrogeological ZoI.

8.6.6 Measures to Control and Prevent the Spread of Non-native Invasive Plant Species

The mitigation strategy in relation to non-native invasive plant species is based on the *Guidelines on the Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads* (National Roads Authority, 2010) with the objectives of managing non-native invasive plant species within the working area and preventing the spread of any established populations present with the boundary of the proposed road development (a legal requirement for species such as Japanese knotweed).

A Non-native Invasive Species Management Plan has been prepared and included in the CEMP (see **Appendix A.7.5**) and will be implemented sufficiently far in advance of the proposed construction works commencing so as to allow time to adequately control all target non-native invasive plant species populations within the ZoI of the proposed road development, having regard to the specific timing/seasonal constraints that apply in relation to each individual species. The Non-native Invasive Species Management Plan will direct the construction contractor in implementing the specific mitigation measures required in relation to individual non-native invasive plant species.

As species may have spread, or their distribution may have changed, between the habitat surveys carried out for this EIAR and the commencement of construction works, the implementation of the Non-native Invasive Species Management Plan will include a pre-construction re-survey within the proposed development boundary. In accordance with the NRA guidance this survey will include accurate 1:5,000 scale mapping for the precise location of non-native invasive plant species. The pre-construction surveys will be undertaken by suitable experts with competence in identifying the species concerned.

In accordance with the National Roads Authority, 2010a guidelines, where cut, pulled or mown noxious weed or non-native invasive plant species material arises, its disposal will not lead to a risk of further spread of the plants. Care will be taken near watercourses as water is a fast medium for the dispersal of plant fragments and seeds. Material that contains flower heads or seeds will be disposed of either by composting or burial at a depth of no less than 0.5m in the case of noxious weeds, or by incineration (at a licenced facility having regard to relevant legislation) or disposal to licensed landfill in the case of non-native invasive plant species.

The taproots of docks and roots of creeping thistle are not suitable for composting or shallow burial, requiring disposal to landfill, incineration or burying at a depth of no less than 1.5m (practical only during the construction phase). Where burial is being used to dispose of Japanese knotweed, the material will be buried to a depth of 5m and overlain with a suitable geotextile membrane. All disposals will be carried out in accordance with the Waste Management Acts 1996-2011.

In relation to aquatic non-native invasive plant species all construction works, and any aquatic survey work that may be carried out (e.g. electrofishing), will comply with best practice biosecurity protocols for aquatic work – for example IFI's Biosecurity Protocol for Field Survey Work (IFI, 2010).

8.6.7 Mammals

8.6.7.1 Otter

Otter are listed on Annex II and Annex IV of the EU Habitats Directive. Otter are strictly protected under the Birds and Habitats Regulations. Otter, and their breeding and resting places, are also protected under the Wildlife Acts and it is an offence under that legislation to intentionally kill or injure an Otter or to wilfully interfere with or destroy their breeding or resting places (holts/couches).

8.6.7.1.1 Measures to Protect Otter during Construction

Habitat degradation - water quality

The mitigation measures relating to the protection of water quality in receiving watercourses during construction are outlined in **Section 8.6.4** and detailed in **Section 11.6.2** of **Chapter 11, Hydrology**.

Loss of breeding/resting sites

As in the future Otter could potentially establish new holt or couch sites within the ZoI of the proposed road development, a pre-construction check of all suitable Otter habitat will be required within 12 months of any constructions works commencing.

8.6.7.1.2 Measures to Protect Otter during Operation

Habitat Severance/Barrier Effect and Collision Risk

Otters use many of the watercourses crossed by the proposed road development. To avoid Otter road casualties, Otter passage facilities will be provided at all watercourses used by Otter (e.g. raised ledges within structures, or separate dry 600mm pipes installed adjacent to culverts). Mammal underpasses will be constructed in accordance with the *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes* (National Roads Authority, 2008c).

The locations where Otter passage facilities will be provided are listed below in **Table 8.36** and are shown on **Figures 8.23.1** to **8.23.14**.

Mammal-resistant fencing will be required to prevent Otter accessing the proposed road development and to guide Otters to the mammal underpasses. Mammal-resistant fencing will be installed in accordance with the specification outlined in *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes* (National Roads Authority, 2008c) and TIIs mammal resistant fencing specification (currently CC-SCD-00320/00319). The locations where mammal-resistant fencing is to be installed are shown on **Figures 8.23.1** to **8.23.14**.

In accordance with the recommendations described in the *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes* (National Roads Authority, 2008c), quarterly monitoring of the effectiveness of the mitigation measures will be undertaken in the first year after the completion of construction works (for example, fencing inspections to check for gaps and underpass inspection to check for blockages).

8.6.7.2 Bats

Bats are listed on Annex IV of the EU Habitats Directive and are therefore, strictly protected under the Birds and Habitats Regulations. Bats, and their breeding and resting places, are also protected under the Wildlife Acts and it is an offence under that legislation to intentionally kill or injure bats or to wilfully interfere with or destroy their breeding or resting places.

8.6.7.2.1 Measures to Protect Bats during Construction

Measures to Protect Bats during removal of Roosts

This assessment has identified that 14 properties that are confirmed bat roosts may be required to be removed as part of the proposed road development. A further 18 properties may be indirectly affected due to their proximity to the corridor or the proposed road development or are connected via known flight paths and in some cases disturbance to the roost may result.

All species and their roost sites are strictly protected under both European and Irish legislation including:

- Wildlife Act 1976 and Wildlife (Amendment) Act, 2000 (S.I. No. 38 of 2000)
- Council Directive on the Conservation of Natural Habitats and of Wild Flora and Fauna 1992 (Council Directive 92/43/EEC)
- European Communities (Birds and Natural Habitats) Regulations, 2011

It is an offence under Section 23 of the Wildlife Acts 1976-2017 and under Section 51 of the European Communities (Birds and Natural Habitats) Regulations, 2011 to kill a bat or to damage or destroy the breeding or resting place of any bat species. Under the European Communities (Birds and Natural Habitats) Regulations it is not necessary that the action should be deliberate for on offence to occur. This places an onus of due diligence on anyone proposing to carry out works that might result in such damage or destruction. Under Section 54 of S.I. 477 of 2011, a derogation may be granted by the Minister where there is no satisfactory alternative and the derogation is not detrimental to the maintenance of the populations of the species to which the Habitats Directive relates at a favourable conservation status in their natural range. Given the impacts on bats that are predicted for the proposed road development, a derogation licence under Section 54 of S.I. 477 of 2011 will be required. The Bat Derogation Licence application is included in **Appendix A.8.25**.

The following mitigation measures are proposed in relation to structures either confirmed as supporting bat roosts or considered to have the potential to support roosting bats:

- Prior to demolition of the 14 structures containing confirmed bat roosts, replacement artificial roosts will be in place to ensure that bats are able to access alternative resting places at the earliest opportunity
- Where possible, buildings with the confirmed bat roosts will not be demolished during the breeding period or hibernation period (April to mid-August and November-March) as the risk of accidental death or injury is higher at this time. Bats may use roosts in smaller numbers in winter but may nevertheless be present. Outside of these periods, the approach to demolition of bat roosts will be determined on a case-by-case basis and subject to relevant licence conditions
- Buildings confirmed as bat roosts proposed for demolition will be marked on the ground with agreed paint marking to permit identification by Contractors
- Prior to demolitions, all structures that were confirmed as either having bats or having high potential for bats will be re-examined immediately prior to demolition to assess whether bats are present at the time of demolition. This will be an all-night examination to determine if bats enter the building during the night or early morning. This will provide adequate information to proceed with demolitions unless weather conditions were unsuitable for feeding bats. If bats are present, then they will require exclusion from the property over several nights or if possible physical removal by hand by a licenced bat specialist to be placed in a bat box or similar for release in the evening after capture. For structures which have not been confirmed as bat roosts but regarded to have high potential for bats, a bat detector assessment of the property to be demolished will be carried out. If demolitions are proposed during the period May – August (note this time period will not be permitted in the case of the confirmed bat roosts to be demolished). This will be an all-night examination to determine if bats enter the building during the night or early morning. This will provide adequate information to proceed with demolition unless weather conditions were unsuitable for feeding bats. If bats are present, then they will require exclusion from the property over several nights or if possible physical removal by hand by a licenced bat specialist to be placed in a bat box or similar for release in the evening after capture
- Once structures containing roosts are deemed to be clear of bats, the bat specialist will be on site to supervise the demolition procedure until the structure is no longer deemed able to support a bat roost. Bats may re-enter a partially demolished structure overnight so the bat specialist may be required to be present during demolition works until they are completed

The following mitigation measures are proposed in relation to those trees identified as having high potential to support roosting bats. These include the two trees confirmed to have had bats present (PTR43, PTR48) or the 13 other trees to have high suitability, where either obvious potential roosting features are present, or where obscured by dense ivy cover, the tree is of an age and condition that there is a high chance that roosting features are present. **Figures 8.16.1** to **8.16.15** shows the locations of these trees but a more detailed drawing will be provided to the contractor prior to any felling works. Bats could occupy suitable roosting features at any time prior to the commencement of works. Therefore there is an inherent risk that bats could be affected by the proposed felling works. The following mitigation procedures will be followed:

- Felling of confirmed and potential tree roosts will be undertaken during the period September – October as during this period bats are capable of flight and may avoid the risks from tree felling if proper measures are undertaken, but also are neither breeding nor in hibernation
- Use of detectors alone may not be sufficient to record bat emergence and re-entry in darkness. Therefore, prior to felling of confirmed and potential tree roosts, an emergence survey using infra-red illumination and video camera(s) and bat detectors will be carried out on the night immediately preceding the felling operation to determine if bats are present
- Where it is safe and appropriate to do so for both bats and humans, such trees may be felled using heavy plant to push over the tree. In order to ensure the optimum warning for any roosting bats that may still be present, the tree will be pushed lightly two to three times, with a pause of approximately 30 seconds between each nudge to allow bats to become active. The tree should then be pushed to the ground slowly and should remain in place until it is inspected by a bat specialist
- Trees should only be felled “in section” or “soft felled” where the sections can be rigged to avoid sudden movements or jarring of the sections
- Where remedial works (e.g. pruning of limbs) is to be undertaken to trees deemed to be suitable for bats, the affected sections of the tree will be checked by a bat specialist (using endoscope under a separate derogation licence held by that individual) for potential roost features before removal. For limbs containing potential roost features high in the tree canopy, this will necessitate the rigging and lowering of the limb to the ground (with the potential roost feature intact) for inspection by the bat specialist before it is cut up or mulched. If bats are found to be present, they will be removed by a bat specialist licenced to handle bats and released in the area in the evening following capture

Prior to felling the two confirmed tree roosts (PTR43 and PTR48) replacement bat boxes will be in place to ensure that bats are able to access alternative resting places at the earliest opportunity. The location of the bat boxes in these instances will be within the proposed development boundary but the precise height and location will be decided by the bat specialist. If any additional bat tree roosts are confirmed, and will be removed by the proposed felling works, then appropriate alternative roosting sites will be provided in the form of replacement bat boxes.

Measures to preserve flight paths across Construction areas

It has been identified that during the construction phase, the removal of woodland and hedgerows and other intervention in the landscapes used by bats can open up habitats to the extent that bats will not want to risk crossing the new open space to reach other roosts and foraging areas on the other side. This severance of flight paths will continue throughout the construction phase.

The Report WC1060 *Development of a Cost-Effective Method for Monitoring the Effectiveness of Mitigation for Bats crossing linear infrastructure* includes best practice principles to address the general lack of evidence to show that many "conventional" mitigation measures work. These principles are reproduced below and have been adopted in the mitigation strategy for the proposed road development.

- *"Mitigation should be integrated into the scheme from the earliest opportunity*
    - *Mitigation should be considered during the planning and design stage of the infrastructure so that it can be incorporated effectively*
- *Crossing structures should be placed on the exact location of existing bat commuting routes*
    - *Attempts should not be made to divert bats from their existing commuting routes*
- *Crossing structures should not require bats to alter flight height or direction.*
    - *This will depend on the topography of the site. If the road is to be elevated above ground level an underpass may be used to preserve the commuting route below it, or if the road is in a cutting a green bridge may be used to carry the commuting route over the road*
- *Crossing structures should maintain connectivity with existing bat commuting routes*
    - *Connectivity must be maintained with undisturbed bat flight paths (e.g. treelines, hedgerows, woodland rides and streams), and bat habitat (e.g. woodland) within the surrounding landscape. Crossing structures should not be exposed or sited within open ground*
- *Over-the-road structures such as green bridges should be planted with vegetation*
    - *Vegetation should be continuous and connected (see above) and sufficiently mature before road construction (e.g. by planting either relatively mature trees or fast growing tree species in advance of construction commencing)*
- *Underpasses should be of sufficient height*
    - *Underpasses should be as spacious as possible with height being the critical factor. The minimum requirements for underpass height will be species-specific. Required heights will generally be lower for woodland-adapted species (~3 m) compared to generalist edge-adapted species (~6 m), but larger underpasses will accommodate more species.*
- *Green bridges should be of sufficient width*

- *In addition to being vegetated, green bridges should be as wide as possible, to provide a large area for bats to commute across. Further research is needed to determine exact dimensions. We found a 30m wide green bridge to be effective in this study.*

- *Crossing structures should be unlit*
  - *The effects of light on bats are species-specific and lighting should be avoided*
- *Access and connectivity must be maintained*
  - *It is important that access to crossing structures is maintained (e.g. grilles should not be installed on underpasses) and that connecting vegetation is retained indefinitely or for as long as the mitigation structure is required*
- *Disturbance should be minimised during installation of mitigation structures*
  - *For example, by limiting noise and light pollution along the bat flight path, minimising vegetation clearance, installing suitable temporary crossing structures (which should also be subject to monitoring and evaluation), completing the installation as quickly as possible and ideally avoiding the summer months when bats are most active".*

The installation of temporary fencing across sites to replace connecting features has been used and appears to have only been monitored as part of one project in Switzerland (Britschgi et al, 2004)[84]. In this study, a 1m wide x 1.5-2m high artificial hedgerow was recorded to be followed by a proportion of the bats in a roost. It is proposed to apply similar measures in key locations to ensure that there are linear features to connect habitats across the construction footprint.

In order to inform siting of mitigation measures, including the temporary fencing described above during the construction phase, a series of infra-red/thermal camera surveys using a series of cameras and bat detectors along linear features in the following locations will be carried out in the optimum activity season. This will help to identify the preferred crossing points at the following sections:

Area 1: North of Bearna Woods

Area 2: Aughnacurra

Area 3: River Corrib to Coolough Road

Area 4: West of N84 Headford Road

Area 5: Ballindooley to Castlegar

Each area will be surveyed three times to record bats in flight in these locations with the precise vantage points for cameras to be determined during daytime surveys.

Any existing features that are identified as preferred crossing points and are scheduled for removal will be retained until the last moment and a portable artificial

[84] Britschgi A., Theiler A. & Bontadina F. (2004) *Wirkungskontrolle von Verbindungsstrukturen. Teilbericht innerhalb der Sonderuntersuchung zur Wochenstube der Kleinen Hufeisennase in Friedrichswalde-Ottendorf / Sachsen*.

crossing structure put alongside it prior to its removal, so at no stage there is a gap across the construction site at night. The use of the temporary fence as an artificial crossing structure will be monitored three times over two weeks following installation. If the artificial crossing structure is not at the same location as a proposed permanent crossing point (e.g. the wildlife overpass at Castlegar) then it shall be moved gradually over several nights to realign it with the permanent crossing point.

The nature of the artificial crossing structure may comprise lengths of camouflage netting, recycled Christmas trees roped together, portable planters or artificial plants that can be easily moved at morning and evening to ensure that the crossing is in place each night.

8.6.7.2.2 Measures to Protect Bats during Operation

Measures to reducing mortality risk and barrier effects within the design and operation of the proposed road development

The mitigation to address significant barrier effects has been designed to reflect current best practice. The last 10 years has seen an improvement in the monitoring of the effectiveness of bat mitigation measures for roads and there is considerable evidence that whilst bats may "use" measures designed to get them over or under a road, in the context of the overall population these measures may not be "effective" as they are often in the wrong place or simply not attractive to bats to use. Measuring bat mortality as a result of collisions has also been studied in greater detail in recent years.

The two main approaches employed for the proposed road development include underpasses of a suitable size where the design of the proposed road development is on embankment and a wildlife overpass where it is in cut. These two measures are the only options that have been demonstrated to be effective at a population level (CEDR, 2016, (Elmeros and Dekker, 2016, Abbot et al 2012a, 2012b).

Underpasses are proposed in important crossing point areas and are aligned with existing landscape features that are known to be used by bats as a result of the surveys. Underpasses in the Menlough - Bóthar Nua area and N84 Headford Road areas are regarded to be of critical importance for Lesser horseshoe bat and other bat movements across this landscape.

The section from the N84 Headford Road to N83 Tuam Road is almost entirely in cut and installing underpasses is not possible, therefore the only effective option is a wildlife overpass (referred to throughout this report as the Castlegar Wildlife Overpass).

The Castlegar Wildlife Overpass is a critical component of the strategy. It will allow bats to fly across the proposed road development between the roosts and foraging habitats on the north side and Coopers Cave and foraging areas to the south at this location.

From 2013-2015, bats were recorded using hedgerows at many locations in places between the N84 Headford Road and the N83 Tuam Road – a distance of 1750m. The western section of the proposed road development in this area includes for underpasses which would be used by Lesser horseshoe bats and other bat species in areas where they have been recorded, (approximately 400m in length) whilst the remainder of the proposed road development is in a cutting or it is not feasible to include such underpasses.

In the absence of the Castlegar Wildlife Overpass, it is possible that bats would attempt to cross the proposed road development at the location of the existing crossing points[85]. This would increase the risk of collisions with vehicles at this key location and for Lesser horseshoe bats this could have an adverse impact that could deplete the population to an unsustainably low level.

In the absence of the Castlegar Wildlife Overpass the Lesser horseshoe bats would not be able to use Cooper's Cave for mating in late summer and as a result they could be forced to use less suitable locations (no other mating roosts were recorded). Mating sites that are accessible to a geographically wide population and mixes of males and females from different roosts is an essential attribute to ensure genetic heterogeneity in the local bat population. At present, bats are able to get to Cooper's Cave from a variety of directions.

A potential worst case scenario barrier effect isolating the Menlo Castle roost would therefore lead to reduced genetic diversity and possible reduced reproductive rates in that population. Similarly, the bats using Cooper's Cave would be confined to sub-optimal habitats and it is not unreasonable to conclude that, in a worst-case-scenario, the cave would cease to be used by Lesser horseshoe bats.

The location of the Castlegar Wildlife Overpass is crucial to its success. Research published since 2008 by Berthinussen & Altringham (2015[86]) and evidence presented in the CEDR Safe Bat Paths reports (2016[87]) and Natural England (2015[88]) reports have identified that bats will cross a road along existing known flight paths in preference to new artificial crossings at alternative locations. Whilst this may be truer of species that are known to fly across open spaces such as Pipistrelle species, it is not known if Lesser horseshoe bats would also act in the same way. In the absence of data to the contrary the precautionary principle has been applied and the wildlife overpass has been located at known Lesser horseshoe bat crossing points. The proposed location at Ch. 12+690 – Ch. 12+720 ties in with records of Lesser horseshoe bats, Common and Soprano pipistrelle bats recorded by static bat detector in 2015. It will be essential to quantify the number of bats using each crossing point (especially the Castlegar Wildlife Overpass) immediately prior to construction in order to provide data against which post-construction surveys can be compared.

The width and design of the Castlegar Wildlife Overpass has followed simple assumptions that are based on the target species ecology and has followed best available knowledge and information as outlined below.

---

[85] Lighting of the proposed road development at this location may create a barrier effect, making crossing the proposed road development even more problematic for bats.

[86] *WC1060 Development of a Cost-Effective Method for Monitoring the Effectiveness of Mitigation for Bats crossing Linear Transport Infrastructure*. Final Report 2015. Anna Berthinussen & John Altringham. School of Biology, University of Leeds, Leeds LS2 9JT/

[87] http://bios.au.dk/om-instituttet/organisation/faunaoekologi/projekter/safe-bat-paths/documents/

[88] http://publications.naturalengland.org.uk/publication/6312886965108736

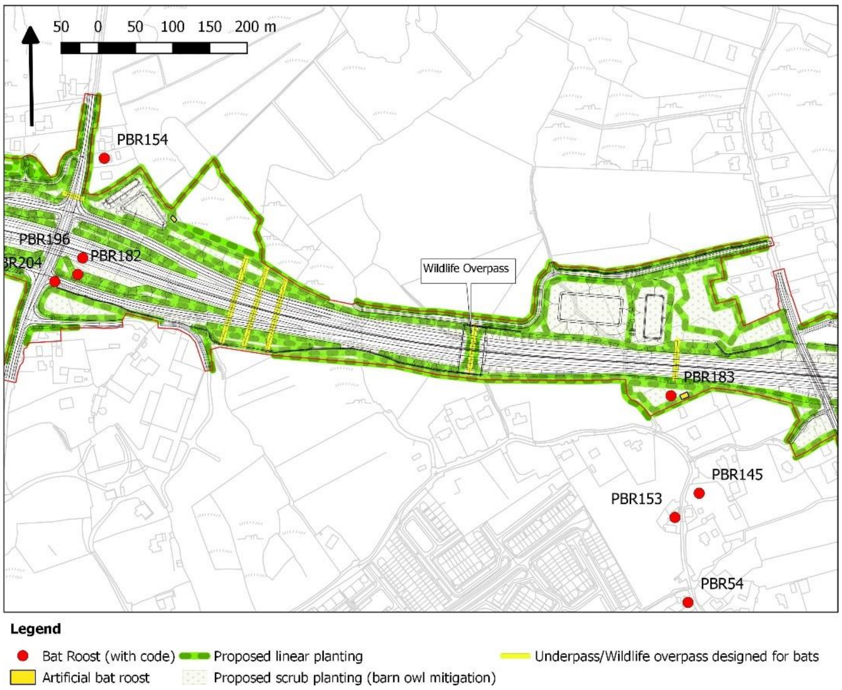
Guidance from Natural England (2015) can be summarised as follows:

- The COST 341 handbook (2003) identifies four types of 'over structure' to provide faunal passage; landscape bridges, wildlife bridges, modified bridges/ multi use bridges and tree top overpasses. A clear distinction between landscape bridges and wildlife bridges is not given, but in terms of design this appears to be based on scale aspects, with landscape bridges being larger structures over 80m wide and wildlife bridges being small in width with a recommendation of between 40 and 50m. The handbook does not use the term 'green bridge' to describe these structures
- Findings of the WC1060 Report (Berthinussen & Altringham, 2015) can be summarised as follows:
    - Although green bridges have the potential to be effective crossing structures for bats over infrastructure, there are other issues that also need to be considered such as the cost, the landtake required for construction of the bridge and the detrimental effects there may be on bats while it is being constructed. However, one expensive yet effective structure will always make more sense than cheaper structures that do not work: mitigation structures must be cost effective and functional. Green bridges may also provide mitigation for other wildlife. Eight mammal species have been found to use Scotney Castle landscape bridge, including deer, badger and breeding dormice (National Trust, 2012), and similar structures are commonly built throughout Europe and North America for large mammals. Combining mitigation for a range of wildlife may be a cost-effective solution, but would require careful planning, project management and monitoring
    - The two most widespread forms of wire bat bridge do not provide effective mitigation and should not be built, particularly since there is evidence that bats do not adapt to them with time. Our results suggest that green bridges and underpasses have the greatest potential but they must be designed correctly and many factors are important such as size, position, connectivity, topography, and the density and maturity of vegetation. Green bridges should be of sufficient width
    - Best practice principles for bat mitigation along linear transport infrastructure include that in addition to being vegetated, green bridges should be as wide as possible, to provide a large area for bats to commute across. Further research is needed to determine exact dimensions. A 30m wide green bridge was found to be effective in this study

A width below 20m is not recommended as although evidence shows that species will still use these bridges, the frequency of use is reduced. The proposed overpass bridge at Castlegar is 30m wide.

The proposed planting design comprises of a double hedgerow in the middle section of the overpass (to mimic a 4m wide bóithrín). Each of the hedgerows will then diverge out to create a “mouth" at the entrance to the overpass on both sides of the proposed road development to funnel bats in to the centre of the overpass. **Plate 8.3** shows the schematic design and location of the proposed overpass.

Plate 8.3: Castlegar Wildlife Overpass



No lighting will be provided at or on any of the structures which have been designed to provide bat passage, with the exception of S06/01 where lighting will be provided to allow for safe use by pedestrians. All of the bat underpasses (as well as artificial roosts) that are designed for Lesser horseshoe bats will have connecting woody vegetation features. Other bats species are not as reliant [89] on hedgerows and woodland edges. Whilst there are many existing landscape features outside of the proposed development boundary, the bat mitigation strategy cannot rely on these in the long term as they may be subject to interventions by third parties. In effect, what will be created is a hedgerow corridor leading up to underpasses in the section of the proposed road development between Aughnacurra and Castlegar. This planting provides a guaranteed green corridor connecting up the underpasses/overpasses and will allow bats to adapt more easily to any future landscape scale losses of connecting habitat features. The hedgerow planting leading up to underpasses will be maintained and the growth of the hedgerow monitored for 5 years following completion and remediation works undertaken if deemed necessary.

Table 8.35 below sets out the schedule of structures which provide bat passage and states the function that they serve in terms of mitigating the potential barrier effect. The size and location of the underpasses and culverts took into account the research carried out by Abbott (2012a, b) and the advice provided in the CEDR, COST341 and WC1060 reports. Design parameters included:

- Identifying where roosts are close to the proposed road development or where bat activity has been identified close to the proposed road development

[89] Although it is noted that Lesser horseshoe bats cross the River Corrib over 120m of open water at Menlo Castle.

- Identifying where the proposed vertical profile of the proposed road development (i.e. in cut, on fill or at grade) can permit bat passage underneath the proposed road development
- Where river culverts and minor roads pass under the proposed road development, it was considered if these can fulfil a role in conveying bats underneath the proposed road development
- New underpasses provided should be a minimum of 2.5m high to permit the passage of bats. Research by Abbott showed that this height would allow 90% of the bats to pass through an underpass 2.5m to 3.1m high as seen in the except from her research below

Plate 8.4: Results of surveys carried out by Abbott (2012c)

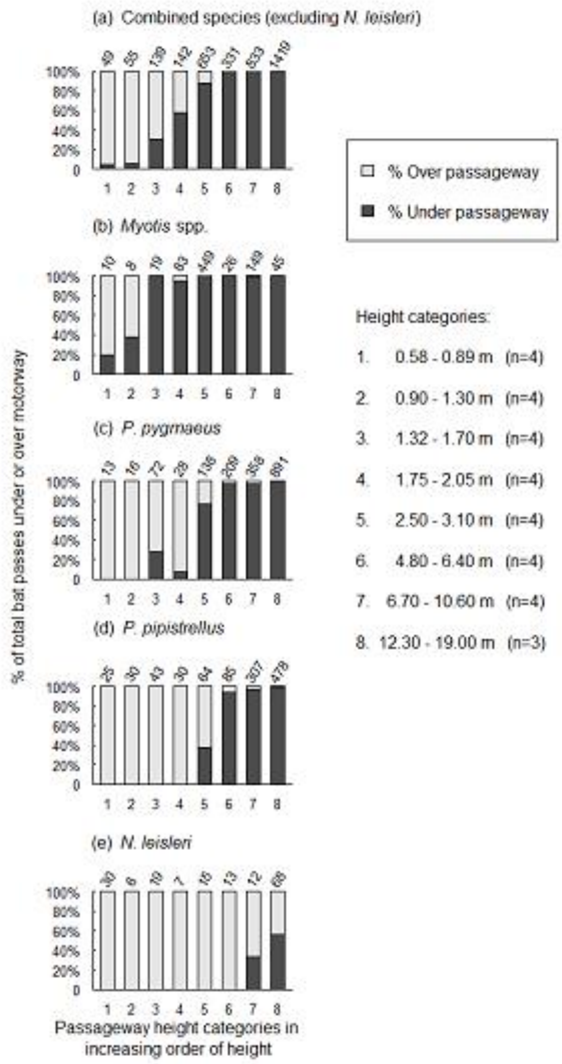


Fig. 4.17 Percentage of bat passes for **(a)** combined species (excluding *N. leisleri*), **(b)** *Myotis* spp., **(c)** *P. pygmaeus*, **(d)** *P. pipistrellus* and **(e)** *N. leisleri* (**b - e** in order of decreasing degree of clutter-adaptation) detected flying through underpasses (% Under) compared to flying over the traffic lanes of the motorway directly above underpasses (% Over) during simultaneously paired recordings. Bat pass counts (Over + Under) per height category (see legend) are shown above each bar for each species

Table 8.35: Schedule of structures designed to serve for bat passage

Structure	Description	Mitigation Function
Culvert C00/01	A 2.5m wide by 1.35m high culvert designed to provide bat passage beneath the proposed road development	Six species of bats recorded near this location. A combined hydraulic and wildlife culvert which will cater for Lesser horseshoe and Myotis species of bats which have been recorded here
Culvert C02/01b	A 2.5m wide by 2.5m high culvert designed to provide for bat passage beneath the proposed road development	A combined hydraulic and wildlife culvert which will cater for Pipistrelle species which were recorded nearby
Culvert C03/01	A 2.5m wide by 1.2m high culvert designed to provide for bat passage beneath the proposed road development	A combined hydraulic and wildlife culvert which will cater for Pipistrelle species which were recorded nearby
Culvert C03/03	A 2.5m wide by 2.5m high culvert designed to provide for bat passage beneath the proposed road development	Records of Pipistrelle, Lesser horseshoe and Myotis species of bats species nearby. A combined hydraulic and wildlife culvert which will cater for bats and will also cater for the commuting route for Lesser horseshoe bats to Bearna Woods
Culvert C03/04	A 2.5m wide by 2.5m high culvert designed to provide for bat passage beneath the proposed road development	Records of Pipistrelle, Lesser horseshoe and Myotis species of bats nearby. A combined hydraulic and wildlife culvert which will cater for bats and will also cater for the commuting route for Lesser horseshoe bats to Bearna Woods
Culvert C04/01	A 5m wide by 2.5m high culvert designed to provide for bat passage beneath the proposed road development	Records of Pipistrelle, Lesser horseshoe and Myotis species of bats nearby. A combined hydraulic and wildlife culvert which will cater for bats and will also cater for the commuting route for Lesser horseshoe bats to Bearna Woods.
Culvert C04/02	A 3.1m wide by 2.5m high culvert designed to provide for bat passage beneath the proposed road development	Records of Pipistrelle, Brown long-eared and Myotis species of bats nearby. A combined hydraulic and wildlife culvert which will cater for bats
Underbridge S06/01	Proposed road underbridge	The existing Rahoon Road will allow continued bat passage underneath the proposed road development. Records of Pipistrelle species of bat nearby. There will be lighting to allow safe pedestrian access
Culvert C06/00	A 2.5m wide by 2.5m high culvert designed to provide for bat passage beneath the proposed road development	Culvert will convey bats underneath proposed road development as the proposed road development severs the existing road which is used by Pipistrelle species. Records of Pipistrelle species of bat nearby, culvert

Structure	Description	Mitigation Function
		connects linear feature each side of the proposed road development
Culvert C06/01	A 2.5m wide by 2.5m high culvert designed to provide for bat passage beneath the proposed road development	Culvert allows passage across proposed road development in area of fill whereas there are no areas for underpasses to the west for c.500m. Connects to attenuation ponds which may be used for foraging
Culvert C07/00	A 2.5m wide by 2m high culvert designed to provide for bat passage beneath the proposed road development	Culvert will connect across landscape used by Pipistrelle and Brown long-eared bats. Roosts to the east which will be surrounded by the proposed road development will be reconnected via this culvert and also culverts to the north
Culvert C07/02A	A 2.5m wide by 2.5m high culvert designed to provide for bat passage beneath the proposed road development	Culvert will connect across landscape used by Pipistrelle and Brown long-eared bats. Roosts to the east which will be surrounded by the proposed road development will be reconnected via this culvert and also culverts to the north. The culvert carries a small stream and ties into a ditch and hedgerow on the eastern side and will join a proposed landscaped strip on the western side, to connect it to the existing Rahoon Road
Culvert C08/01A	A 2.5m wide by 2.5m high culvert designed to provide for bat passage beneath the proposed road development	This culvert is in an area of fill west of the N59 Moycullen Road and offers an opportunity for bats to cross under the proposed road development in this section. Pipistrelle and Lesser horseshoe bats have been recorded in the surrounding area
Culvert C08/05	2.5m wide by 2.5m high culverts will provide for bat passage beneath the proposed road development	These culverts are close to the artificial roost proposed to address the loss of the bat roosts at Aughnacurra (PBR178, 256, 255, 177, 210). As such it is essential to maximise permeability of the proposed road development in this section. Brown long-eared and Lesser horseshoe bats will be facilitated by this culvert. Proposed landscape planting strips will connect the culvert to retained vegetation at the perimeter
Culvert C08/04		
Culvert C08/02		
Culvert C09/01	A 5m wide by 4m high culvert will provide for bat passage beneath the proposed road development	Series of five culverts providing permeability underneath the proposed road development for Lesser horseshoe, Pipistrelle, Brown long-eared and other bat species. The culverts will open into the retained edges of Menlough woods with additional planting provided
Culvert C09/02	A 5m wide by 4m high culvert will provide for bat passage beneath the proposed road development	

Structure	Description	Mitigation Function
Culvert C09/03	A 5m wide by 4m high culvert will provide for bat passage beneath the proposed road development	
Culvert C09/04	A 5m wide by 4m high culvert will provide for bat passage beneath the proposed road development	
Culvert C09/05	A 5m wide by 4m high culvert will provide for bat passage beneath the proposed road development	
Road Underbridge S09/01	Proposed road underbridge (9.6m wide 5.3m high) Menlo Castle Bóithrín will provide for bat passage beneath the proposed road development	Key crossing point in the landscape for Lesser horseshoe bats permitting flights between Menlo Castle roost (and future new roost) and foraging areas near the Coolagh Lakes. Proven by radio-tracking data. The unlit existing road will allow continued bat passage underneath the proposed road development. Records of several species of bat nearby including being within the recorded foraging area for Lesser horseshoe bats and being in an important area for crossings
Culvert C09/06	A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	This culvert connects woodland edges that will be retained at the edge of the culvert. Records of several species of bat nearby including being within the recorded foraging area for Lesser horseshoe bats and being in an important area for crossings
Culvert C09/07	A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	In low area in local topography within the recorded foraging area for Lesser horseshoe bats and being in an important area for crossings
Underpass C10/01	A 18m wide by 2.35m high structure will provide for bat passage beneath the proposed road development	This structure connects woodland edges that will be retained at the edge of the culvert. Records of several species of bat nearby including being within the recorded foraging area for Lesser horseshoe bats and being in an important area for crossings as proven by radio-tracking data
Road Underbridge S10/02	Proposed road underbridge (9.6m wide by 5.3m high)	The proposed underbridge will allow continued bat passage beneath the proposed road development. Records of several species of bat nearby including Lesser horseshoe bats and being in an important area for crossings as proven by radio-tracking data

Structure	Description	Mitigation Function
Culvert C12/02	A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	Series of 3 culverts, each 25m apart, connects lands north and south and allows bats to cross. A key crossing point for Lesser horseshoe bats, Brown long-eared bats and roosts for both species are nearby
Culvert C12/03	A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the road	
Culvert C12/04	A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the road	
Castlegar Wildlife Overbridge S12/02	The Castlegar Wildlife Overpass (60m long x 30m wide) will provide for bat passage over the proposed road development	Key crossing point in the landscape for Lesser horseshoe bats permitting flights between Castlegar and Ballindooley/Menlough areas. See text above this table for rationale for wildlife overpass location and design
Structure S08/04	River Corrib bridge will provide for bat passage over the proposed road development	An important crossing point for all bat species especially Lesser horseshoe and Daubenton's bats as proven by radio-tracking data. Roosts for both species are nearby

In addition to the structures specifically designed for bat passage, there are other structures such as where minor roads pass underneath the proposed road development which will be used by bats as safe crossing points.

8.6.7.2.3 Proposed monitoring programme

As the baseline level of bat activity and roost occupancy can change over time, pre-construction monitoring will be carried out in advance of construction works commencing to ensure that the data against which the post-construction monitoring will be compared to is as up-to-date as possible.

Monitoring of the effectiveness of the bat mitigation and compensation measures will also be undertaken during and post-construction. Where the monitoring identifies issues with either the mitigation or compensation measures (e.g. light spill affecting usage), these will be remediated to ensure that those measures will achieve their aims with respect to mitigating or compensating for impacts on the local bat populations.

Pre- construction monitoring

Pre-construction monitoring is required to provide data against which the post-construction monitoring can be compared. Parameters will include:

- Occupancy levels in roosts (Menlo Castle, proposed artificial roost buildings including retrofitted retained buildings, bat boxes)
- Bat passage structures (culverts, underpasses and the Castlegar Wildlife Overpass)

- Diversity of bat species and abundance of bat activity adjacent to the proposed road development

Occupancy levels in Menlo Castle will be measured by emergence surveys using infra-red video camera recording monthly from mid-April to September in the year of or immediately prior to construction commencing (whichever of the two is closer to the construction commencement).

Monitoring for bat usage of proposed bat passage structures will focus on recording bats using existing flight paths at proposed underpasses near Menlo Castle, the N59 Letteragh Junction and the proposed Castlegar Wildlife Overpass. Pre-construction baseline data is required on numbers of bats and flight height so that this can be compared to a post-construction scenario. Such data will be collected using focused infra-red camera and detector surveys carried out at least on three separate occasions at each location in the optimum survey period. In accordance with CEDR (2016) guidance it is proposed that this pre-construction monitoring involves a minimum of two separate surveys in the breeding season and two separate (in time) surveys in mid-August to late-September, to reflect periods of landscape-scale movements, and that these surveys take place for two bat activity seasons (May-August) following completion of the construction of the proposed road development.

The risk of adverse effects on bat diversity and abundance adjacent to the proposed road development can never be ruled out completely; but not all populations will be affected in the same location in the same way and therefore ongoing monitoring is regarded to be good practice to enhance our understanding of the effects of road developments and the effectiveness of mitigation measures. Diversity of bat species and abundance of bat activity adjacent to the proposed road development will be monitored using standardised survey transects from the edge of the proposed road development outwards as described by Berthinussen & Altringham (2015). These transects will be used to record bat activity across the lands flanking the corridor of the proposed road development. It is proposed that six transects are surveyed pre-construction in locations of high bat activity where underpasses or an overpass are proposed.

During and post-construction monitoring

Roost monitoring

Monitoring of occupancy of the artificial roost buildings (including retrofitted retained buildings) and bat boxes will commence immediately after their installation to determine how soon they are used. They will be installed prior to the main site clearance phase; therefore, all monitoring can be by visual inspection according to the following schedule:

- Emergence counts at Menlo Castle roost: emergence counts will be undertaken during the construction works and in 5 years following construction in May, July and August. These counts will be made using infra-red video camera recording at the same time as visual inspections of bats using the proposed new roost site adjacent to Menlo Castle in order to get an overall count of bats at this location

- Artificial roost buildings: Occupancy of the proposed artificial roost buildings (including retrofitted structures) during the works and post-construction will be undertaken in the 5 years following completion of construction. Surveys will be undertaken in mid-winter for hibernation use and in May and July for use during breeding season. Surveys will include checks for individuals and also for droppings (where necessary using DNA analysis). Droppings will be removed after each check to ensure that the subsequent survey only records usage in the interim period. The roosts will be monitored annually for Lesser horseshoe bats and counts sent to the NPWS as part of the national Lesser horseshoe bat monitoring programme. This monitoring may be undertaken by NPWS staff, Galway bat group or others to be decided by the local authority. Remote modes of monitoring using new technology may mean that visits to the roosts are not always required and that infra-red images inside the roost can be sent wirelessly. Should the monitoring of the roosts suggest that bats are not using them, additional focused surveys will be undertaken to try to understand bat movements in the locality and aim to address any issues. Any changes that may be deemed necessary will be coordinated and communicated to ensure that they do not conflict with any of the impact predictions or mitigation measures prescribed in this report. Temperature and humidity probes coupled with data loggers will be installed in the roosts for two years post construction of the roost and measures taken (e.g. fitting vents, increasing period of water tanks in the hibernation roost area) to address any issues arising
- Bat boxes: The authors are not aware of any minimum or recommended standard for bat box monitoring. After installation, boxes will be visually inspected quarterly per year for the first two years. Research into the effectiveness of mitigation measures has indicated that occupancy of bat boxes averages 50%[90] since bats may prefer existing alternative roost sites in the locality. Any boxes not showing signs of occupancy after that time may be relocated to alternative locations within the proposed development boundary nearby where they may be of benefit to the local bat population. In years 3-5 after installation the boxes will be checked in late March and September to record usage in winter and summer and to avoid disturbance during the sensitive hibernation times
- Bat boxes will be checked for a minimum of 5 years after erection

<u>Monitoring crossing points</u>

Monitoring will comprise acoustic detector and infra-red camera recording at the culverts at the five locations previously surveyed pre-construction, namely:

- Area 1: North of Bearna Woods
- Area 2: Aughnacurra
- Area 3: River Corrib to Bothár Nua
- Area 4: West of N84 Headford Road
- Area 5: Ballindooley to Castlegar, including the Castlegar Wildlife Overpass

[90] Paul Lynott, pers. comm 2017.

This will quantify the usage by bats compared to non-usage (e.g. using other flight paths). This will allow a determination as to whether the bat passage structures are being effective at a population level (where it is assumed that 90% of the bats are able to pass underneath the proposed road development). Monitoring will be repeated at all locations to provide a robust dataset. In the event that the proposed bat passage structures including the Castlegar Wildlife Overpass are not deemed to be effective, then further focused surveys will be required to determine the causes and address them in a reasonable manner where possible (for example, controlling lighting, addressing local landscape changes). Any changes that may be deemed necessary will need to be coordinated and communicated to ensure that they do not conflict with any of the impact predictions or mitigation measures prescribed in this report.

In accordance with CEDR (2016) guidance it is proposed that this post-construction monitoring involves a minimum of two separate surveys in the breeding season and two separate (in time) surveys in mid-August to late-September, to reflect periods of landscape-scale movements, and that these surveys take place for two bat activity seasons (May-August) following completion of the construction of the proposed road development.

The monitoring programme described above also relates to the compensation measures for bats described in **Section 8.9.2**.

<u>Diversity and abundance adjacent to the proposed road development corridor</u>

Transects of bat activity will be taken across the same locations as the pre-construction transects in order to identify any displacement effects caused by disturbance impacts during construction and operation. Whilst the application of the Berthinussen & Altringham (2015) methodology is not without its limitations as it has only been applied to open agricultural landscapes, it is nevertheless a foundation for a reproducible survey method that is appropriate to the proposed road development. If a displacement effect is detected (decreased abundance and diversity close to the proposed road development) then further focused surveys will be required to determine the causes and address them where possible (for example, controlling lighting, addressing local landscape changes through additional planting). Any changes that may be deemed necessary will need to be coordinated and communicated to ensure that they do not conflict with any of the impact predictions or mitigation measures prescribed in this report. It is proposed that monitoring takes place during construction and two bat activity seasons following completion of the construction of the proposed road development.

8.6.7.3 Badger

Badger, and their breeding and resting places, are protected under the Wildlife Acts and it is an offence under that legislation to intentionally kill or injure a Badger or to wilfully interfere with or destroy their breeding or resting places (setts).

A comprehensive suite of mitigation measures have been incorporated into the proposed road development to ensure that Badgers are not intentionally killed or injured and that any impacts to their breeding or resting places will not affect their conservation status, at any geographic scale, and will not give rise to any likely significant effects on the species.

The mitigation measures described below follow the recommendations set out in the *Guidelines for the Treatment of Badgers during the Construction of National Road Schemes* (National Roads Authority, 2006). These guidelines set out the best practice approach in considering and mitigating impacts on Badgers during construction works.

8.6.7.3.1 Measures to Protect Badger during Construction

A detailed summary of the mitigation measures as they relate to each of the Badger setts within the ZoI of the proposed road development is presented in **Appendix A.8.24**. The non-interference zones (30m, 50m and 150m), as they relate to each of the Badger setts within the ZoI of the proposed road development, are shown on **Figures 8.23.1** to **8.23.14**.

As the usage of setts by Badgers can change over time, a pre-construction check of the activity status of all setts will be required within 12 months of any constructions works commencing within the ZoI of the setts discussed below.

Disturbance/displacement

In order to prevent any disturbance to Badger setts not directly affected by the proposed road development, no heavy machinery shall be used within 30m of Badger setts at any time. No works shall be under taken within 50m of active setts during the breeding season. Lighter machinery (generally wheeled vehicles) shall not be used within 20m of a sett entrance. Neither blasting nor pile driving shall be undertaken within 150m of active setts during the breeding season (December to June inclusive).

Prior to works commencing, a non-interference zone of 30m will be established around each of the Badger setts within the ZoI of the proposed road development, as shown on **Figures 8.23.1** to **8.23.14**. If the sett is active, a non-interference zone will be extended to 50m during the breeding season (December to June inclusive). The fencing shall be as noted in **Chapter 7, Construction Activities** and of a sufficient durability to maintain the exclusion zone throughout the construction period or, if required, until such time as the sett in question is excluded/removed.

The mitigation measures, as they relate to each of the Badger setts within the ZoI of the proposed road development, are summarised in **Table 8.36** and illustrated on **Figures 8.23.1** to **8.23.14**.

Loss of breeding/resting sites

Where setts require exclusion and removal, or temporary exclusion for the duration of the construction period, this will be undertaken in accordance with the methodology detailed in the *Guidelines for the Treatment of Badgers during the Construction of National Road Schemes* (National Roads Authority, 2006):

- All Badger setts requiring exclusion and removal will require a monitoring period of at least five days to confirm activity status in advance of any construction works commencing

- If the sett is active, then it shall not be removed within the Badger breeding season (December to June inclusive). To exclude or remove an active Badger sett outside of this period, inactive entrances shall be soft and hard-blocked with one-way gates installed on active entrances. One-way gates will be tied open for three days before being set to exclude, and then monitored for a period of at least 21 days before the sett is deemed inactive and destroyed. If at any time during the monitoring period the sett becomes active, the exclusion process/programme must commence again from day 1 of the 21-day monitoring period
- For inactive setts, entrances will be soft-blocked (lightly blocked with vegetation and soil) and if all entrances remain undisturbed for a period of five days the sett should be destroyed immediately. This can be undertaken at any time of the year for inactive setts

An artificial sett is required to mitigate for the loss of the main sett (S9), in conjunction with a subsidiary sett (S11), of the Lackagh Badger group. The requirements relating to the provision and design of the artificial sett are set out in **Appendix A.8.24**. The location of the artificial sett is shown on **Figures 8.23.1** to **8.23.14**[91].

Inaccessible areas (see **Figures 8.3.1** to **8.3.14**) will require a pre-works survey for badger setts in advance of site clearance. If a sett is uncovered, works must cease and a non-interference zone of 30m established; extended to 50m during the breeding season if set is active (December to June inclusive). Sett removal will follow the process outlined above.

8.6.7.3.2 Measures to Protect Badger during Operation

Habitat Severance/Barrier Effect and Mortality Risk

Badgers typically follow the same pathways between setts, feeding areas and latrines. To avoid badger road casualties, mammal passage facilities will be provided at strategic locations along the route of the proposed road development. Mammal underpasses will be constructed in accordance with the *Guidelines for the Treatment of Badgers during the Construction of National Road Schemes* (National Roads Authority, 2006). Mammal underpasses which are at least 600mm in width, have adequate drainage, have good vegetation cover around the entrances and good habitat connectivity have been proven to be used by badgers (Eldridge & Wynn, 2011)[92].

---

[91] The closer an artificial sett is to the main sett being removed, the more likely it is to be used by the affected Badger group. Therefore, the artificial sett is proposed to be located approximately 60m to the north of S9. As the sett must be in place several months before works commence and the sett S9 is removed, the affected Badgers will have sufficient time to either adjust to the construction works in the vicinity of the artificial sett (which will involve blasting and rock breaking), relocate to another sett (e.g. S10), or construct a new sett elsewhere within their territory. Any disturbance from the construction works will be short-term and, even if the artificial sett is vacated during construction, its proximity to the operational road is not likely to deter badgers from occupying the sett at that time.

[92] Eldridge, B. & Wynn, J. (2011) Use of badger tunnels by mammals on Highways Agency schemes in England. *Conservation Evidence 8*. Pages 53-57

Where engineering constraints conflict with the recommended locations at construction, mammal underpasses may be moved to the nearest most suitable location, but not more than c.250 m away. The locations where Badger passage facilities will be provided are listed below in **Table 8.36** and are shown on **Figures 8.23.1** to **8.23.14**.

A number of the mammal passage structures lie within the modelled light spill zone and artificial lighting may affect their usage by Badger: structures C07/04, C07/01(b) and C12/01. Screening will be provided to ensure that the approaches and entrances to these structures are unaffected by light spill.

Table 8.36: Mammal passage facilities [93]

Ref. No.	Structure	Species and Description
C00/00	Pipe	Badger Dedicated 600mm concrete pipe will provide for mammal passage beneath the proposed road development
C00/01	Culvert	Bats A 2.5m wide by 1.35m high culvert will provide for bat passage beneath the proposed road development
C02/01b	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development
C03/01	Culvert	Bats A 2.5m wide by 1.2m high culvert will provide for bat passage beneath the proposed road development
C03/03	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development
C03/04	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development
C04/01	Culvert	Otter, Badger and Bats Raised mammal ledge, sited above flood water levels, incorporated into structure or a dedicated 600 mm concrete pipe on the east bank of the river/stream will provide for Otter and Badger passage A 5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development
C04/02	Culvert	Otter, Badger and Bats Raised mammal ledge, sited above flood water levels, incorporated into structure or a dedicated 600 mm concrete pipe on the east bank of the river/stream will provide for Otter and Badger passage

[93] Some of thes are also included in **Table 8.35** as part of the bat mitigation strategy but will also provide passage for many other mammal species

Ref. No.	Structure	Species and Description
		A 3.1m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development
C05/01	Pipe	Badger Dedicated 600mm concrete pipe will provide for mammal passage beneath the proposed road development
S06/01	Road Overbridge	Bats The unlit road overbridge will provide for bat passage across the proposed road development
C06/00	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development
C06/01	Culvert	Badger A 2.5m wide by 2.5m high culvert will provide for bat and badger passage beneath the proposed road development
C07/00	Culvert	Bats A 2.5m wide by 2m high culvert will provide for bat passage beneath the proposed road development
C07/02A	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development
C07/04	Pipe	Badger Dedicated 600mm concrete pipe will provide for mammal passage beneath the proposed road development
C07/01(b)	Pipe	Badger Dedicated 600mm concrete pipe will provide for mammal passage beneath the proposed road development
C08/01(a)	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development
C08/04	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development
C08/05	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development
C08/02	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development

Ref. No.	Structure	Species and Description
C09/01	Culvert	Bats and Badgers A 5m wide by 4m high culvert will provide for bat and badger passage beneath the proposed road development
C09/02	Culvert	Bats and Badgers A 5m wide by 4m high culvert will provide for bat and badger passage beneath the proposed road development
C09/03	Culvert	Bats and Badgers A 5m wide by 4m high culvert will provide for bat and badger passage beneath the proposed road development
C09/04	Culvert	Bats and Badgers A 5m wide by 4m high culvert will provide for bat and badger passage beneath the proposed road development
C09/05	Culvert	Bats and Badgers A 5m wide by 4m high culvert will provide for bat and badger passage beneath the proposed road development
S09/01	Road Overbridge	Bats and Badgers The road overbridge (9.6m wide by 5.3m high) will provide for bat and badger passage beneath the proposed road development
C09/06	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development
C09/07	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development
C10/01	Underpass	Bats and Badgers A 18m wide by 2.35m high underpass will provide for bat and badger passage beneath the proposed road development
S10/02	Road Overbridge	Bats The road overbridge (9.6m wide by 5.3m high) will provide for bat passage beneath the proposed road development
C10/02	Pipe	Bats and Badger Dedicated 1200mm concrete pipe will provide for mammal passage beneath the proposed road development
C12/01	Pipe	Badger Dedicated 600mm concrete pipe will provide for mammal passage beneath the proposed road development
C12/02	Culvert	Bats

Ref. No.	Structure	Species and Description
		A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development
C12/03	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development
C12/04	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development
S12/02	Green bridge	Bats and Badgers The Green Bridge (30m in width) will provide for bat and mammal passage over the proposed road development
C13/01	Culvert	Bats and Badger A 2.5m wide by 1.5m high culvert will provide for bat and badger passage beneath the proposed road development

Mammal-resistant fencing will be required to guide badgers to the underpasses and will be installed in accordance with the specification outlined in *Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes*, and TIIs mammal resistant fencing specification (currently CC-SCD-00320/00319), and will include badger proofing of emergency access roads and other similar access points, where located in areas where mammal-resistant fencing is to be installed. The locations where mammal-resistant fencing is to be installed are shown on **Figures 8.23.1** to **8.23.14**.

In accordance with the recommendations described in the *Guidelines for the Treatment of Badgers during the Construction of National Road Schemes* (National Roads Authority, 2006), quarterly monitoring of the effectiveness of the mitigation measures will be undertaken in the first year after the completion of construction works (for example, fencing inspections to check for gaps and underpass inspection to check for blockages).

8.6.7.4 Other Mammal Species

8.6.7.4.1 Measures to Protect Other Mammal Species during Construction

Habitat degradation - water quality

The mitigation measures relating to the protection of water quality in receiving watercourses during construction are outlined in **Section 8.6.4** and detailed in **Section 11.6.2** of **Chapter 11, Hydrology**.

8.6.7.4.2 Measures to Protect Other Mammal Species during Operation

Habitat Severance/Barrier Effect

The combination of the network of dedicated mammal passage facilities, along with the bridge and viaduct structures (the proposed River Corrib Bridge and the Menlough Viaduct), and the retained lands above the proposed Lackagh Tunnel and the Galway Racecourse Tunnel provide a high degree of landscape permeability along the route of the proposed road development for all of the other mammal species recorded, or likely to be present, within the study area. The locations are described above in **Table 8.36** and are shown on **Figures 8.23.1** to **8.23.14**.

Wildlife passage facilities have been shown to be used by small mammal species such as Hedgehog, Pygmy shrew and Wood mouse (Dolan 2006; Eldridge & Wynn 2011); although their effectiveness has not been tested. However, it is likely that the high permeability of the proposed road development will reduce the effects of any severance or barrier effect that may be associated with the proposed road development (Haigh, 2012) such that the species' conservation status would not be affected. Therefore, habitat severance and barrier effect are not likely to result in a significant negative residual effect, at any geographic scale.

Collision Risk

There are no practical or effective means of preventing small mammals or arboreal mammal species (such as the Pine marten and Red squirrel, which are highly skilled climbers) from accessing the proposed road development. As discussed above in relation to severance and barrier effect, the design of the proposed road development provides for a high degree of permeability across the proposed road development and this offers the most practical solution to minimise the potential interaction of small mammals with the proposed road development. Collision risk is therefore, not likely to affect the species' conservation status and not likely to result in a significant negative residual effect, at any geographic scale.

8.6.8 Invertebrates

8.6.8.1 Marsh whorl snail

8.6.8.1.1 Measures to Protect the Marsh whorl snail during Construction

Habitat Degradation – Surface Water Quality

The mitigation measures relating to the protection of water quality in receiving watercourses during construction are outlined in **Section 8.6.4** and detailed in **Section 11.6.2** of **Chapter 11**, **Hydrology**.

Habitat Degradation – Groundwater

The mitigation measures relating to the protection of the groundwater regime during construction are described in **Section 10.6.2** of **Chapter 10, Hydrogeology**.

8.6.8.1.2 Measures to Protect the Marsh whorl snail during Operation

Habitat Degradation – Groundwater

The mitigation measures relating to the protection of the groundwater regime during operation are described in **Section 10.6.3** of **Chapter 10, Hydrogeology**.

8.6.8.2 Marsh fritillary butterfly

8.6.8.2.1 Measures to Protect the Marsh fritillary butterfly during Construction

Mortality Risk

To avoid the destruction of Marsh fritillary eggs or the mortality of Marsh fritillary caterpillars, the following mitigation strategy will be implemented in relation to the site clearance works:

- All areas within the proposed development boundary, which have been identified as suitable habitat to support the Marsh fritillary butterfly, will be subject to a pre-construction larval web survey. This will be undertaken during the mid-August to the end of September window immediately preceding site clearance works
- If larval webs are present, they will be translocated to another area of suitable habitat; either outside of the proposed development boundary or, if within, to an area of suitable habitat that will remain unaffected by construction works for the duration
- Once all larval webs have been removed from the affected areas, or if no larval webs were recorded, the vegetation will be immediately cleared or cut to ground level to render the area unsuitable for the species to recolonise. The vegetation shall be maintained in this state until such time as the topsoil is removed.

8.6.9 Birds

8.6.9.1 Breeding Birds

8.6.9.1.1 Measures to Protect Breeding Birds during Construction

Habitat Loss, Disturbance and Destruction of Breeding Habitat

General

Where feasible, vegetation (*e.g.* hedgerows, trees, scrub and grassland) will not be removed, between the 1 March and the 31 August, to avoid direct impacts on nesting birds. Where the construction programme does not allow this seasonal restriction to be observed, then these areas will be inspected by a suitably qualified ecologist for the presence of breeding birds prior to clearance. Areas found not to contain nests will be cleared within 3 days of the nest survey, otherwise repeat surveys will be required.

Barn owl

To minimise the effects of current levels of disturbance to the Barn owl nest site at Menlo Castle, and thereby reduce any cumulative effect that construction activities nearby may have, alternative nesting sites will be provided in the vicinity. Three Barn owl nest boxes will be erected across the area shown on **Figures 8.23.1** to **8.23.14** and will consist of either nest boxes erected on suitable trees or pole-mounted nest boxes. Preference will be given to erecting nest boxes on suitable trees, where possible.

Tree mounted boxes will be erected at least 3m above ground level on a mature tree with few or no low branches to obscure the nest box. The selected tree shall be either isolated in a hedgerow or situated on a woodland edge with the access hole facing open ground.

Pole-mounted nest boxes will be erected at a minimum height of 4.5m above ground.

The nest box design (e.g. entrance hole size, floor area and depth from the bottom of the entrance hole to the nest) shall be in accordance with the design requirements published by The Barn Owl Trust (http://www.barnowltrust.org.uk/). Nest boxes will be inspected annually for defects/damage and cleaned out/repaired as required to ensure waterproofness and the internal box depth.

Peregrine falcon

To minimise the potential for construction works near Lackagh Quarry to disturb the Peregrine falcon nest site, works from the Lackagh Tunnel to the N84 Headford Road Junction will commence prior to mid-February. This will ensure that any construction related disturbance, if its magnitude displaces Peregrine from the quarry for the duration of construction works, can influence the selection of the nest site and will not impact upon an incubating female on the nest. The installation of rock bolts on the cliff faces in the vicinity of the nest site will be undertaken in a sensitive manner (as advised by a suitably experienced ecologist) so as to minimise any potential disturbance to the nest site during the breeding season, particularly if the nest site is occupied.

8.6.9.1.2 Measures to Protect Breeding Birds during Operation

Habitat loss, Habitat Severance/Barrier Effect and Mortality Risk

General

Planting of woodland, hedgerow and grassland habitats along the proposed road development as detailed in the landscape drawings (**Figures 12.2.01** to **12.2.15**) will provide compensatory habitat for some bird species. In some instances, such as in large areas of improved agricultural grassland with no vegetated field boundaries, this will improve the diversity of bird habitat.

Many species may not nest near a road development due to disturbance (e.g. drowning out of bird song by traffic noise). Whilst the planting is not likely to fully offset the loss of breeding habitat (due to the proximity of road traffic disturbance on the operational road) it is likely to provide additional foraging habitat for some species.

To further minimise the effects of breeding habitat loss, a total of 20 nest boxes will be erected by a qualified ecologist in suitable locations away from the busy junctions/roadways. The siting and type of nest boxes will be decided on by an ecologist at locations where trees will be planted or retained along the proposed road development; as shown on **Figures 12.2.01** to **12.2.15**.

Barn owl

Sections along the proposed road development will be planted with dense low growing scrub cover (e.g. blackthorn) to discourage Barn owls from foraging near the proposed road development. The planting will be of a density to minimise the lag time between planting and obtaining sufficient ground cover to deter foraging Barn owl.

In areas where there is a high probability that Barn owls may regularly attempt to cross the proposed road development (the section of embankment between Ch. 9+600 and Ch. 10+100), lines of closely spaced (approximately 2m centres) trees, greater than 3m in height, will be planted along the top of the embankments of the proposed road development; outside of the safety barrier and clear zone. The understorey will also be densely planted. This is to present a solid vegetated barrier to deflect Barn owl from these high-risk areas and/or force birds to fly over the proposed road development above the road traffic.

All mitigatory planting will be in place at the earliest feasible stage during construction to ensure that the mitigation is functioning as soon as possible, following the opening of the proposed road development.

The locations where planting will be used to reduce the risk of Barn owl mortality from road traffic are shown on **Figures 8.23.1** to **8.23.14** and on the landscape drawings (**Figures 12.2.01** to **12.2.14**).

Following implementation of all mitigation measures and completion of construction of the proposed road development, the following monitoring measures are proposed:

- Surveys will be undertaken of roadside planting schemes at the end of years one and two with the objective of identifying and replacing failed plantings
- A road casualty survey to record barn owl mortalities along the route of the proposed road development will be conducted once per week for a period of two years by a suitably qualified and experienced ornithologist. The proposed road development will be driven at a steady pace in both directions so that all sections and both sides of the route will be surveyed correctly. Where noted, all barn owl mortalities will be assigned to either the “breeding” season (March to July) or “non-breeding” season (August to January). Location details of the casualty will be recorded, including a 10-digit GPS co-ordinate, position on the route (central median, hard shoulder, or verge) and orientation (southbound,

northbound, eastbound, and westbound). The age class of the bird will be determined and classed as either "pre-breeding" if first or second calendar year recovered before March, or "adult" if the bird is second calendar year recovered later than March or older. The adjacent habitat feature will be noted. This methodology is in line with that utilised for *Barn Owl population status and the extent of road mortalities in relation to the Tralee Bypass* (O'Clery et al., 2016)

- Monitoring to determine activity and breeding status of all active sites within 5km of the proposed road development over two breeding seasons (March to July). This will be carried out concurrently with the road casualty survey, and will involve visits to known and potential nesting sites to determine brood size and breeding success. Where accessible, nests will be visited in order to ring owlets (subject to an appropriate licence from the NPWS)

A report summarising the findings of the above monitoring will be submitted at the end of year two to the NPWS. The report may include further recommendations pending survey outcomes.

8.6.9.2 Wintering Birds

8.6.9.2.1 Measures to Protect Wintering Birds during Construction

Construction noise will be kept to a minimum in accordance with BS 5228 (2009).

The contract documents will specify that the Contractor, undertaking the construction of the works, will be obliged to take specific noise abatement measures and will comply with the best practice outlined in British Standard BS 5228 – 1: 2009 +A1 2014: *Code of practice for noise and vibration control on construction and open sites – Noise* and the NRA (now TII) guidelines *Good Practice Guideline for the Treatment of Noise during the planning of National Road Schemes* (National Roads Authority, 2014).

Blasting associated with the eastern approach to Lackagh Quarry (Ch. 11+800 to Ch. 12+100) will be carried out between the months of April to September (inclusive) to minimise the exposure of wintering birds at Ballindooley Lough to blasting-related disturbance.

Blasting associated with the cutting at Castlegar (Ch. 12+550 to Ch. 13+650) will take approximately nine months to complete, with an estimated five blast events per week. To minimise the exposure of wintering birds at Ballindooley Lough to blasting-related disturbance, all of those nine months must be in the April to September period (inclusive) within consecutive years.

8.6.9.2.2 Measures to Protect Wintering Birds during Operation

Disturbance/Displacement

Despite the assessment conclusion that disturbance during operation of the proposed road development is not likely to result in any population level effects on wintering birds, hedgerow planting along the proposed development boundary (at the locations shown on the landscape drawings (**Figures 12.2.01** to **12.2.14**) will further minimise the potential disturbance to wintering birds from road traffic.

8.6.10 Amphibians

8.6.10.1 Measures to Protect Amphibians during Construction

Habitat Loss, Disturbance & Mortality Risk

If works to clear any of the habitat features suitable to support amphibian species are to begin during the season where frogspawn or tadpoles may be present (February – mid-summer), or where breeding adult newts, their eggs or larvae may be present (mid-March – September), a pre-construction survey will be undertaken to determine whether breeding amphibians are present.

In the case of Common frog, any frog spawn, tadpoles, juvenile or adult frogs present will be captured and removed from affected habitat by hand net and translocated to the nearest area of available suitable habitat, beyond the ZoI of the proposed road development.

In the case of Smooth newt, individuals will be captured and removed from affected habitat either by hand net or by trapping and translocated to the nearest area of available suitable habitat, beyond the ZoI of the proposed road development. If used, the type and design of traps shall be approved by the NPWS. This is a standard and proven method of catching and translocating Smooth nest.

If the size or depth of the habitat feature is such that it cannot be determined whether all amphibians have been captured, it will be drained under the supervision of a suitably experienced ecologist to confirm that no amphibian species remain before it is destroyed or infilled. Any mechanical pumps used to drain the habitat feature will have a screen fitted, and be sited, such that no amphibian species can be sucked into the pump mechanism.

Any capture and translocation works shall be undertaken immediately in advance of site clearance/construction works commencing.

Habitat Degradation – Surface Water Quality

The mitigation measures relating to the protection of water quality in receiving watercourses during construction are outlined in **Section 8.6.4** and detailed in **Section 11.6.2** of **Chapter 11, Hydrology**.

8.6.10.2 Measures to Protect Amphibians during Operation

Habitat Severance & Barrier Effect

The combination of the network of wildlife passage facilities, culverts, bridges and viaduct structures (e.g. the proposed River Corrib Bridge and the Menlough Viaduct) provide a high degree of landscape scale permeability along the proposed road development. This will serve to maintain connectivity at a local scale between sites used by amphibian species and is predicted to reduce any long-term severance or barrier effects associated with the proposed road development such that the conservation status of amphibian species is not likely to be negatively affected.

The locations of the wildlife passage facilities are described above in **Table 8.36** and are shown on **Figures 8.23.1** to **8.23.14**.

8.6.11 Reptiles

8.6.11.1 Measures to Protect Reptiles during Construction

Habitat Loss, Disturbance & Mortality Risk

Given the broad range of habitat types favoured by the Common lizard, and that the majority of the proposed road development passes through mosaics of such habitats, site clearance works at any time of year in suitable habitat are highly likely to encounter the species, cause disturbance and have the potential to kill or injure individuals.

In order to minimise the risk of site clearance and construction works disturbing, or causing the mortality of, Common lizard the following schedule of site clearance works will be followed in the areas highlighted on **Figures 8.10.1** to **8.10.8**, where the presence of Common lizard has been confirmed:

- grass, scrub or heath vegetation will be removed during the winter period, where possible, avoiding potential Common lizard hibernacula sites (dry sites which provide frost-free conditions e.g. stone walls, underground small mammal burrows, piles of dead wood or rubble)
- where this is not possible and clearance will be undertaken during the active season (March through to September, inclusive), vegetation will be cut first to approximately 15cm, and then to the ground, under supervision of an ecologist. This will allow the opportunity for lizards to be displaced by the disturbance and leave the affected area
- stone walls (or other potential hibernacula sites) will be removed during the active season (March through to September, inclusive) under the supervision of an ecologist, when they are less likely to be in use by torpid lizards

8.6.11.2 Measures to Protect Reptiles during Operation

Habitat Severance & Barrier Effect

The combination of the network of wildlife passage facilities, culverts, bridges and viaduct structures (e.g. the proposed River Corrib Bridge and the Menlough Viaduct) provide a high degree of landscape scale permeability along the proposed road development. This will serve to maintain connectivity at a local scale between sites used by reptile species and is predicted to reduce any long-term severance or barrier effects associated with the proposed road development such that the conservation status of reptile species is not likely to be negatively affected.

The locations of the wildlife passage facilities are described above in **Table 8.36** and are shown on **Figures 8.23.1** to **8.23.14**.

8.6.12 Fish

8.6.12.1 Measures to Protect Fish Species during Construction

Habitat Loss

The structures have been designed in consultation with IFI and in accordance with the design criteria set out in *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes* (National Roads Authority**,** 2005) and the *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016). These measures, which include, in broad terms replicating the existing channel profile and substrate, will likely minimise the effects of habitat loss to a degree but it is acknowledged that this will be limited by the fact that they are artificial channels within a light limiting box structure.

To minimise the effects of habitat loss on fish species, all sections of river/stream channel within the proposed development boundary, but not within the footprint of the proposed road development and associated infrastructure, will be protected from site clearance and construction works. Rivers/streams will be fenced off at a minimum distance of 5m from the river bank and within this zone the natural riparian vegetation will be retained.

Habitat Degradation – Surface Water Quality

The mitigation measures relating to the protection of water quality in receiving watercourses during construction are outlined in **Section 8.6.4** and detailed in **Section 11.6.2** of **Chapter 11, Hydrology**.

Habitat Degradation – Groundwater

The mitigation measures relating to the protection of the groundwater regime during construction are described in **Section 10.6.2** of **Chapter 10, Hydrogeology**.

Mortality Risk & Disturbance/Displacement

To minimise the potential effects of construction works on fish species the following mitigation measures will be implemented:

- No instream works will be carried out between the months of October and June (inclusive) to avoid the most sensitive time for fish species and fish species movements
- Design of new sections of river channel shall be in accordance with the principles outlined in *Channels & Challenges. Enhancing Salmonid Rivers*. (O'Grady, 2006)
- Immediately prior to rivers/streams being diverted into a newly constructed river channel or culvert, they will be electrofished (if required) to capture and transfer fish from the original channel to the new one. Once the watercourse has been diverted this will be followed by a manual search of the original watercourse to transfer any remaining fish to the new river/stream channel

- Any water abstraction points required for dust suppression will be agreed with IFI and the suction head shall be screened to ensure that fish are not removed during the abstraction process

Habitat Severance/Barrier Effect

All temporary crossing structures used to cross watercourses during construction will be designed in accordance with the *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016) and *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes* (National Roads Authority**,** 2005) to maintain fish and macroinvertebrate passage, and to prevent sedimentation and erosion.

8.6.13 Summary of Mitigation Measures

Table 8.37 below presents an overall summary of the mitigation measures and how these relate to the likely significant effects of the proposed road development on biodiversity.

Table 8.37: Summary of the Mitigation Measures Required to Address the Likely Significant Effects of the Proposed Road Development on Biodiversity

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures
Designated Areas for Nature Conservation				
Lough Corrib cSAC (including Lough Corrib pNHA)	International (National)	**Construction** Habitat loss Habitat degradation – tunnelling/excavation Habitat degradation – hydrogeology Habitat degradation – hydrology Habitat degradation – air quality Habitat degradation – non-native invasive plant species Mortality risk **Operation** Habitat degradation – hydrogeology Habitat degradation – non-native invasive plant species Mortality risk	Likely significant effect at the international geographic scale	see Section 10 of the NIS
Galway Bay Complex cSAC (including Galway bay Complex pNHA)	International (National)	**Construction** Habitat degradation – hydrology Habitat degradation – non-native invasive plant species Barrier effect Mortality risk	Likely significant effect at the international geographic scale	see Section 10 of the NIS

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures
Lough Corrib SPA (including Lough Corrib pNHA)	International (National)	**Construction** Habitat degradation – hydrogeology Habitat degradation – hydrology Disturbance/displacement **Operation** Habitat degradation – hydrogeology	Likely significant effect at the international geographic scale	see Section 10 of the NIS
Inner Galway Bay SPA including Galway bay Complex pNHA)	International (National)	**Construction** Habitat degradation – hydrogeology Habitat degradation – hydrology Disturbance/displacement **Operation** Habitat degradation – hydrogeology	Likely significant effect at the international geographic scale	see Section 10 of the NIS
Moycullen Bogs NHA	National	**Construction** Habitat degradation – air quality Habitat degradation – non-native invasive plant species Habitat degradation – hydrology **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the national geographic scale	Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5** Water quality during construction – **Section 8.6.4**

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures
Habitats (outside of designated areas for nature conservation)				
Limestone pavement [*8240]	International Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the international geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**
Petrifying springs [*7220]	International Importance	**Construction** Habitat loss	Likely significant effect at the county geographic scale (see **Section 8.5.4.3** under petrifying springs)	To reduce the scale of habitat loss – see **Section 8.6.2.1**
Calcareous grassland [*6210/6210]	International/National Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the national geographic scale (No *6210 affected – see **Section 8.5.4.3** under Calcareous grassland))	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures
				– **Section 8.6.6** and **Appendix A.7.5**
Dry heath [4030]	National Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the national geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**
Wet heath [4010][94]	National Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – groundwater **Operation** Habitat degradation – groundwater	Likely significant effect at the national geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction - **Section 8.6.3** Groundwater during construction and operation – **Section 8.6.5**
Molinia meadow [6410]	National Importance	**Construction** Habitat loss Habitat degradation – air quality	Likely significant effect at the national geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1**

[94] Including areas of Wet heath/Dry heath/*Molinia* meadow [4010/4030/6410] mosaic

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures
		Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species		Air quality during construction - **Section 8.6.3** Groundwater during construction and operation – **Section 8.6.5**
Residual alluvial forest [*91E0]	International Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the international geographic scale	Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**
Turloughs [*3180]	International Importance	**Construction** Habitat loss Habitat degradation – surface water quality Habitat degradation – groundwater Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – groundwater Habitat degradation – non-native invasive plant species	Likely significant effect at the international geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction – **Section 8.6.3** Water quality during construction – **Section 8.6.4** Groundwater during construction and operation – **Section 8.6.5**

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures
				Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**
Hard water lakes [3140]	National Importance	**Construction** Habitat degradation – surface water quality (Ballindooley Lough)	Likely significant effect at the national geographic scale	Water quality during construction – **Section 8.6.4**
Mesotrophic lakes (FL4) *Part of Ballindooley complex*	County Importance[95]	**Construction** Habitat degradation – surface water quality	Likely significant effect at the county geographic scale	Water quality during construction – **Section 8.6.4**
Eutrophic lakes (FL5) *Part of Ballindooley complex*	County Importance[96]	**Construction** Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the county geographic scale	Water quality during construction – **Section 8.6.4** Groundwater during construction – **Section 8.6.5**
Calcareous springs (FP1) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat loss	Likely significant effect at the local geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1**
Cladium fen [*7210]	International Importance	**Construction** Habitat degradation – surface water quality (Ballindooley Lough)	Likely significant effect at the international geographic scale	Water quality during construction – **Section 8.6.4**

[95] On the basis that it forms part of the wetland complex at Ballindooley Lough
[96] On the basis that it forms part of the wetland complex at Ballindooley Lough

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures
Hydrophilous tall herb [6430]	International Importance	(see Lough Corrib cSAC above) **Construction** Habitat degradation – hydrogeology Habitat degradation – hydrology **Operation** Habitat degradation – hydrogeology	Likely significant effect at the international geographic scale	see Section 10 of the NIS
Alkaline fens [7230]	National Importance	**Construction** Habitat degradation – surface water quality (Ballindooley Lough)	Likely significant effect at the national geographic scale	Water quality during construction – **Section 8.6.4**
Reed and large sedge swamps (FS1) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality	Likely significant effect at the local geographic scale	Water quality during construction – **Section 8.6.4**
Tall-herb swamps (FS2) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None
Eroding/upland rivers (FW1)	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality	Likely significant effect at the local geographic scale	Water quality during construction – **Section 8.6.4**
Depositing/lowland rivers (FW2) River Corrib	International Importance	The River Corrib forms part of see Lough Corrib cSAC (see above and NIS)	Likely significant effect at the international geographic scale	see Section 10 of the NIS
Terryland River	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None

Ecological Receptor	**Ecological Valuation (after National Roads Authority, 2009)**	**Impacts with the Potential to result in Likely Significant Effects**	**Potential Impact Significance**	**Mitigation Measures**
Drainage ditches (FW4)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None
Marsh (GM1)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None
Dry calcareous and neutral grassland (GS1) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None
Dry meadows and grassy verges (GS2) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None
Dry-humid acid grassland (GS3) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale	Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**
Wet grassland (GS4) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None

Ecological Receptor	**Ecological Valuation (after National Roads Authority, 2009)**	**Impacts with the Potential to result in Likely Significant Effects**	**Potential Impact Significance**	**Mitigation Measures**
Rich fen and flush (PF1) Non-Annex I habitat type	County Importance	**Construction** Habitat degradation – surface water quality Habitat degradation – air quality	Likely significant effect at the county geographic scale	Water quality during construction – **Section 8.6.4** Air quality during construction – **Section 8.6.3**
Poor fen and flush (PF2) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality **Operation** Habitat degradation – groundwater	Likely significant effect at the local geographic scale	Air quality during construction – **Section 8.6.3**
(Mixed) broadleaved woodland (WD1)	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction – **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**
Mixed broadleaved/conifer woodland (WD2)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures
(Mixed) conifer woodland (WD3)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None
Hedgerows (WL1)	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction – **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**
Treelines (WL2)	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction – **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures
Oak-ash-hazel woodland (WN2) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat degradation – air quality Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale	Air quality during construction – **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**
Scrub (WS1) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None
Fauna Species				
Badger	Local Importance (Higher Value)	**Construction** Loss of breeding/resting sites Disturbance/displacement **Operation** Habitat severance/barrier effect Mortality risk	Likely significant effect at the local geographic scale	Measures to protect Badger during construction – **Section 8.6.7.3.1** Measures to protect Badger during operation – **Section 8.6.7.3.2**
Otter	International Importance	**Construction** Habitat degradation - water quality **Operation** Habitat severance/barrier effect Mortality risk	Likely significant effect at the local geographic scale	Measures to protect Otter during construction – **Section 8.6.7.1.1** Measures to protect Otter during operation – **Section 8.6.7.1.2**

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures
Other mammal species protected under the Wildlife Acts	Local Importance (Higher Value)	**Construction** Habitat degradation - water quality **Operation** Habitat severance/barrier effect Mortality risk	Likely significant effect at the local geographic scale	Measures to protect other mammal species (excl. bats) during construction – **Section 8.6.7.4.1** Measures to protect other mammal species (excl. bats) during operation – **Section 8.6.7.4.2**
Lesser horseshoe bat	National Importance	**Construction** Roost loss Habitat loss Habitat fragmentation Disturbance/displacement **Operation** Mortality Barrier/severance effects Disturbance/displacement	Likely significant effect at the national geographic scale	Measures to protect bats during construction – **Section 8.6.7.2.1** Measures to protect bats during operation – **Section 8.6.7.2.2**
All other bat species	Local Importance (Higher Value)		Likely significant effect at the local geographic scale	Measures to protect bats during construction – **Section 8.6.7.2.1** Measures to protect bats during operation – **Section 8.6.7.2.2**
Marsh whorl snail	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality Habitat degradation – groundwater **Operation** Habitat degradation – groundwater	Likely significant effect at the local geographic scale	Measures to protect the Marsh whorl snail during construction – **Section 8.6.8.1.1** Measures to protect the Marsh whorl snail during

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures
				operation – **Section 8.6.8.1.2**
Marsh fritillary butterfly	County Importance	**Construction** Mortality risk	Likely significant effect at the local geographic scale	Measures to protect the Marsh fritillary butterfly during construction – **Section 8.6.8.2.1**
SCI bird species	International	*see Lough Corrib SPA and Inner Galway Bay SPA above*	Likely significant effect at the international geographic scale	see Section 10 of the NIS
Barn owl	County Importance	**Operation** Mortality risk	Likely significant effect at the county geographic scale	Measures to protect breeding birds during operation – **Section 8.6.9.1.2**
Peregrine falcon	County Importance	**Construction** Disturbance/displacement **Operation** Disturbance/displacement	Likely significant effect at the county geographic scale	Measures to protect breeding birds during construction – **Section 8.6.9.1.1** Measures to protect breeding birds during operation – **Section 8.6.9.1.2**
All other breeding bird species (non SCI)	Local Importance (Higher Value)	**Construction** Mortality risk Disturbance/displacement **Operation** Mortality risk	Likely significant effect at the local geographic scale	Measures to protect breeding birds during construction – **Section 8.6.9.1.1** Measures to protect breeding birds during

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures
		Disturbance/displacement		operation – **Section 8.6.9.1.2**
All other wintering bird species (non-SCI)	Local Importance (Higher Value)	**Construction** Disturbance/displacement (Ballindooley Lough) Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the local geographic scale	Measures to protect wintering birds during construction – **Section 8.6.9.2.1** Measures to protect wintering birds during operation – **Section 8.6.9.2.2**
Smooth newt Common frog	Local Importance (Higher Value)	**Construction** Habitat loss Disturbance & mortality risk Habitat degradation – surface water quality **Operation** Habitat severance/barrier effect	Likely significant effect at the local geographic scale	Measures to protect amphibians during construction – **Section 8.6.10.1** Measures to protect amphibians during operation – **Section 8.6.10.2**
Common lizard	Local Importance (Higher Value)	**Construction** Habitat loss Disturbance & mortality risk **Operation** Habitat severance/barrier effect	Likely significant effect at the local geographic scale	Measures to protect reptiles during construction – **Section 8.6.11.1** Measures to protect reptiles during operation – **Section 8.6.11.2**
Atlantic salmon		**Construction**		

Ecological Receptor	**Ecological Valuation (after National Roads Authority, 2009)**	**Impacts with the Potential to result in Likely Significant Effects**	**Potential Impact Significance**	**Mitigation Measures**
European eel	International Importance	Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the local geographic scale	Measures to protect fish species during construction – **Section 8.6.12.1**
All other fish species recorded	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the local geographic scale	Measures to protect fish species during construction – **Section 8.6.12.1**
Local Biodiversity Areas				
Local biodiversity areas	The value of the biodiversity receptors recorded in the vicinity of the proposed road development, across the local biodiversity areas, range from Local Importance (Lower Value) to Internationally Important	Combinations of all of the potential impacts noted above The specific impacts are related to and dependent upon the potential impacts of the proposed road development on each of the individual ecological receptors that make up the biodiversity resource within a given local biodiversity area	Likely significant effects from local up to the international geographic scale	All of the mitigation measures included within **Section 8.6** The specific mitigation measures are related to and dependent upon the potential impacts of the proposed road development on each of the individual ecological receptors that make up the biodiversity resource within a given local biodiversity area

8.7 Residual Impacts

8.7.1 Designated Areas for Nature Conservation

8.7.1.1 European Sites

The assessment, presented in the NIS, of the potential for the proposed road development to impact upon Lough Corrib cSAC, Lough Corrib SPA, Galway Bay Complex cSAC or Inner Galway Bay SPA concluded that, with the implementation of the mitigation measures proposed, the proposed road development does not pose a risk of adversely affecting (either directly or indirectly) the integrity any European site, either alone or in combination with other plans or projects.

Although the proposed road development will not adversely affect the integrity of any of these European sites, the proposed road development will have some level of residual impact on biodiversity within the boundary of Lough Corrib cSAC. This is not the case of Galway Bay Complex cSAC, Inner Galway Bay SPA and Lough Corrib SPA, which are remote from the proposed development boundary, as the potential impact pathways connecting the proposed road development to these European sites are fully mitigated, as assessed in the NIS (and throughout this chapter).

The residual impacts on non QI habitats and species within Lough Corrib cSAC are as follows:

- At the proposed River Corrib crossing the loss of c.0.15ha of a Dry meadows and grassy verges (GS2), Scrub (WS1), Buildings and artificial surfaces (BL3) and Wet grassland (GS4) mosaic on the west bank and, on the east bank, c.1.25ha of Dry calcareous and neutral grassland (GS1), c.1.45ha of Mixed broadleaved woodland (WD1) and loss of a small area of gravel track
- At the proposed drainage outfall for the N59 Link Road North c.0.03ha of a Treeline (WL2), Scrub (WS1) and Dry meadows and grassy verges (GS2) mosaic
- In the Menlough/Coolagh Lakes area c.0.08ha of Oak-Ash-Hazel Woodland (WN2), c.0.01ha of Wet grassland (GS4), c.0.01ha of Dry calcareous and neutral grassland (GS1), c.0.02ha of Scrub (WS1) along with some local road and gravelled access track
- In the vicinity of the proposed Lackagh Tunnel c.0.21ha of Oak-Ash-Hazel Woodland (WN2) and Scrub (WS1), c.0.09ha of Scrub (WS1), c.0.1ha of Dry calcareous and neutral grassland (GS1), a short section (c.20m) of Treeline (WL2), and c.0.08ha of a mosaic of Treelines (WL2), Scrub (WS1), Dry meadows and grassy verges (GS2) and Spoil and Bare Ground (ED2) habitat
- Impacts of the proposed road development on the local bat populations

None of these residual biodiversity effects compromise the overall biodiversity resource of Lough Corrib cSAC in any way that relates to the integrity of that site and therefore, no likely significant effects are predicted at any geographic scale

Therefore, the proposed road development will not result in a likely significant residual effect on any European site(s).

8.7.1.2 Natural Heritage Areas & proposed Natural Heritage Areas

The residual impacts of the proposed road development on Lough Corrib pNHA and Galway Bay Complex pNHA are as per Lough Corrib cSAC/SPA and Galway Bay Complex cSAC/Inner Galway Bay SPA in **Section 8.7.1.1**. As per the conclusions of that assessment the proposed road development is not likely to have a significant residual effect on either Lough Corrib pNHA or Galway bay Complex pNHA.

Mititgation measures will be implemented to ensure that the peatland habitats for which Moycullen Bogs NHA is designated, and the species they support, will not be affected by the proposed road development during construction or operation.

Therefore, the proposed road development will not affect the integrity of, or result in a likely significant negative residual effect on, any Natural Heritage Areas or proposed Natural Heritage Areas.

8.7.2 Habitats

A mitigation strategy will be implemented during construction and operation to minimise the effects of habitat loss and habitat degradation on biodiversity (**Section 8.6.2**).

Despite these mitigation measures, the proposed road development will result in permanent area loss of a number of Annex I habitat types. None of the areas of Annex I habitat that will be permanently lost are located with any European sites. In the case of the priority Annex I habitats affected, this results in a likely significant negative residual effect at the international geographic scale, as it is adding to an ongoing trend of habitat loss for these habitats of highest conservation concern that are in danger of disappearance at a European level. For non-priority Annex I habitat types, the habitat loss is considered to constitute a likely significant negative residual effect at the national geographic scale, as loss of habitat area affects the conservation status of each of these habitats nationally. The habitat types, and areas affected, are summarised in **Table 8.38** below.

Table 8.38: Summary of *Annex I/Annex I habitat loss

Annex I habitat type	Total Area within the proposed development boundary Potentially Impacted	Area to be Retained	Actual Permanent area of habitat loss	Residual Impact Significance
Turlough [*3180]	c.0.04ha within proposed development boundary (total	All (c.0.04ha)	None	No likely significant residual effect

Annex I habitat type	**Total Area within the proposed development boundary Potentially Impacted**	**Area to be Retained**	**Actual Permanent area of habitat loss**	**Residual Impact Significance**
	area of Turlough is c.0.1ha)			
Petrifying springs [*7220]	Two Petrifying spring feature at Lackagh Quarry	One feature to be retained	One Petrifying spring feature	Likely significant residual effect at the county geographic scale
Residual alluvial forest [*91E0]	c.0.1ha	None	c.0.1ha	Likely significant residual effect at the international geographic scale
Limestone pavement [*8240]	c.2.18ha	c.1.64ha	c.0.54ha	Likely significant residual effect at the international geographic scale
Limestone pavement/Calcareous grassland [*8240/6210]	c.0.12ha	All (Above Lackagh Tunnel – c.0.12ha)	None	No likely significant residual effect
Wet heath [4010]	c.2.06ha	None	c.2.06ha	Likely significant residual effect at the national geographic scale
Dry heath [4030]	c.1.96ha	c.0.11ha	c.1.85ha	Likely significant residual effect at the national geographic scale
Wet heath/Dry heath/*Molinia* mosaic [4010/4030/6410]	c.1.13ha	c.0.26ha	c.0.87ha	Likely significant residual effect at the national geographic scale

Annex I habitat type	Total Area within the proposed development boundary Potentially Impacted	Area to be Retained	Actual Permanent area of habitat loss	Residual Impact Significance
Calcareous grassland [6210]	c.1.14ha	c.0.44ha	c.0.7ha	Likely significant residual effect at the national geographic scale
Molinia meadow [6410]	c.1.02ha	c.0.74ha	c.0.28ha	Likely significant residual effect at the national geographic scale
Total area	c.9.75ha of Annex I habitats and 2 Petrifying spring features	c.3.35ha of Annex I habitats and 1 Petrifying spring feature	c.6.4ha of Annex I habitats and 1 Petrifying spring feature	

Similarly, despite the mitigation measures the proposed road development will result in likely significant negative residual effects, at the local geographic scale, on the following habitat of a local biodiversity value:

- Calcareous springs (FP1) - fifteen features
- Dry-humid acid grassland (GS3) - c.7.81ha
- Poor fen and flush (PF2) - c.0.13ha
- (Mixed) broadleaved woodland (WD1) - c.2.62ha
- Hedgerows (WL1) - c.7.8km
- Treelines (WL2) - c.4km

8.7.3 Rare and protected plant species

As there are no rare or legally protected plant species present within the ZoI of the proposed road development they will not be affected. Therefore, no mitigation measures are required and no residual impacts are predicted.

8.7.4 Mammals

8.7.4.1 Otter

A mitigation strategy will be implemented (and monitored) to minimise the risk of the proposed road development affecting water quality in receiving watercourses/waterbodies during construction which will ensure that there is not a likely significant negative residual effect on the local Otter population (**Section 8.6.7.1**).

Mitigation measures will be implemented (and monitored) to ensure that, during operation, the proposed road development does not result in a significant negative effect on the local Otter population as a result of severance/barrier effects or mortality risk: the provision of mammal passage facilities in conjunction with mammal resistant fencing (**Section 8.6.7.1.2**).

Therefore the proposed road development will not result in a likely significant negative residual effect on Otter, at any geographic scale.

8.7.4.2 Bats

A mitigation strategy will be implemented (and monitored) prior to and during construction to minimise the risk of direct harm to bats during demolition and tree felling, to provide temporary linear features to reduce the effects of severance of flight paths during construction. Significant residual impacts will still remain as some of the activities are unavoidable and can only be mitigated to a certain level of certainty:

- Demolition of 14 buildings within the proposed development boundary which will affect local populations of Soprano pipistrelle bats, Common pipistrelle bats, Brown long-eared bats and Lesser horseshoe bats
    - One maternity roost is being demolished, a Brown long-eared roost at Aughnacurra (PBR256)
    - One satellite roost for Lesser horseshoe bats will be demolished at Aughnacurra (PBR178) (a satellite roost for the Menlo Castle (PBR06) Lesser horseshoe maternity roost)
- Loss of foraging habitat is regarded to be most significant in the Menlough area where woodland-pasture-hedgerow habitat is being lost and is within the CSZ for the nationally-important population of Lesser horseshoe bats
- Inevitable elevated mortality rates due to vehicle collisions
- Mortality and severance/barrier effects caused by the proposed road development on individual bats. Whilst best practice has been followed in the design of the proposed road development and the inclusion of underpasses/culverts and a wildlife overpass, a small proportion of the local bat population will inevitably fly over the proposed road development and be vulnerable to vehicle collisions. A small proportion of the population will also be adversely affected by the barrier effect posed by the proposed road development across the landscape. The effect of this residual impact on Lesser horseshoe bats is predicted to be significant at a national geographic scale. The impact on other bat species is predicted to be significant at a local geographic scale

These residual impacts have been addressed further by the proposal for specific compensatory measures.

8.7.4.3 Badger

A mitigation strategy will be implemented (and monitored) during construction to ensure that the removal of badger setts and the predicted disturbance to Badger that will occur during construction does not contravene the protection afforded to the breeding and resting places of wild animals (including Badger) under Section 23 (5)(d) of the Wildlife Acts (**Section 8.6.7.3.1**).

Mitigation measures will be implemented (and monitored) to ensure that, during operation, the proposed road development does not result in a significant negative effect on the local Badger population as a result of severance/barrier effects or mortality risk: the provision of mammal passage facilities in conjunction with mammal resistant fencing (**Section 8.6.7.3.2**).

Therefore, the proposed road development will not result in a likely significant negative residual effect on Badger, at any geographic scale.

8.7.4.4 Other Mammal Species

A mitigation strategy will be implemented to minimise the risk of the proposed road development affecting water quality in receiving watercourses/waterbodies during construction which will ensure that there is not a significant negative effect on local aquatic or marine mammal populations (**Section 8.6.7.4.1**).

Mitigation measures will be implemented to ensure that, during operation, the proposed road development does not result in a significant negative effect on local mammal populations (excluding bats) as a result of severance/barrier effects or mortality risk: the provision of mammal passage facilities in conjunction with mammal resistant fencing (**Section 8.6.7.4.2**).

Therefore, the proposed road development will not result in a likely significant negative residual effect on any other mammal species (excluding bats), at any geographic scale.

8.7.5 Invertebrates

8.7.5.1 White-clawed crayfish

As there are no records of White-clawed crayfish from within the ZoI of the proposed road development they will not be affected. Therefore, no mitigation measures are required and no residual impacts are predicted.

8.7.5.2 Freshwater pearl mussel

As there are no records of Freshwater pearl mussel from within the ZoI of the proposed road development they will not be affected. Therefore, no mitigation measures are required and no residual impacts are predicted.

8.7.5.3 Marsh whorl snail

A mitigation strategy will be implemented during construction to minimise the risk of the proposed road development affecting water quality in receiving watercourses/waterbodies and to ensure that the existing groundwater regime is not affected. This will ensure that there is not a significant negative impact on the habitats supporting the Marsh whorl snail during construction (**Section 8.6.8.1.1**).

Mitigation measures will be implemented to ensure that the existing groundwater regime is not affected during operation (**Section 8.6.8.1.2**).

Therefore the proposed road development will not result in a likely significant negative residual effect on the Marsh whorl snail, at any geographic scale.

8.7.5.4 Marsh fritillary

A mitigation strategy will be implemented during construction to avoid any Marsh fritillary mortality during site clearance works (**Section 8.6.8.2.1**). No other likely significant effects on the Marsh fritillary butterfly are predicted during construction.

No likely significant negative effects on Marsh fritillary are predicted during operation and no mitigation measures are required.

Therefore the proposed road development will not result in a likely significant negative residual effect on the Marsh fritillary butterfly, at any geographic scale.

8.7.6 Birds

8.7.6.1 Breeding birds

A mitigation strategy will be implemented during construction to minimise the mortality risk and the effects of habitat loss and disturbance to breeding birds (**Section 8.6.9.1.1**). This includes retaining the ledge used as the Peregrine falcon nest site between 2015 and 2017 within the design and a seasonal restriction on construction works in the vicinity of the nest site.

A mitigation strategy will be implemented (and monitored) to minimise the mortality risk to the local Barn owl population posed by the proposed road development during operation (**Section 8.6.9.1.2**). This includes the provision of additional nesting structures and planting to discourage Barn owl from foraging along the proposed road carriageway.

Therefore, the proposed road development will not result in a likely significant negative residual effect on breeding bird species, at any geographic scale, with the exception of the Peregrine falcon. Due to the likely permanent loss of Lackagh Quarry as a nesting site, the proposed road development is likely to result in a significant negative residual effect on Peregrine falcon, at the county geographic scale.

8.7.6.2 Wintering birds

A seasonal restriction on blasting near Ballindooley Lough will ensure that there are no long-term effects on wintering bird populations from construction works associated with the proposed road development (**Section 8.6.9.2**).

No likely significant negative effects on wintering bird species are predicted during operation, and no mitigation measures are required.

Therefore the proposed road development will not result in a likely significant negative residual effect on wintering bird species, at any geographic scale.

8.7.7 Amphibians

A mitigation strategy will be implemented during site clearance works to minimise the risk of the proposed road development affecting water quality in receiving watercourses/waterbodies, to minimise the mortality risk, and to minimise the effects of habitat loss and disturbance, on the local Common frog and Smooth newt populations. This will ensure that construction of the proposed road development will not have any long-term effects, or affect the conservation status, of these amphibian species. It will also ensure that site clearance works will not contravene the protection afforded to the breeding and resting places of wild animals (including the Common frog and Smooth newt) under Section 23 (5)(d) of the Wildlife Acts (**Section 8.6.10.1**).

The design of the proposed road development, in conjunction with the network of mammal passage facilities, will ensure that there are no long-term severance or barrier effects to the local Common frog and Smooth newt populations associated with the proposed road development (**Section 8.6.10.2**).

Therefore the proposed road development will not result in a likely significant negative residual effect on the Common frog or the Smooth newt, at any geographic scale.

8.7.8 Reptiles

A mitigation strategy will be implemented during site clearance works to minimise the mortality risk, and to minimise the effects of habitat loss and disturbance, on the local Common lizard population. This will ensure that construction of the proposed road development will not have any long-term effects, or affect the conservation status, of the Common lizard. It will also ensure that site clearance works will not contravene the protection afforded to the breeding and resting places of wild animals (including the Common lizard) under Section 23 (5)(d) of the Wildlife Acts (**Section 8.6.11.1**).

The design of the proposed road development, in conjunction with the network of mammal passage facilities, will ensure that there are no long-term severance or barrier effects to the local Common lizard population associated with the proposed road development (**Section 8.6.11.2**).

Therefore the proposed road development will not result in a likely significant negative residual effect on the Common lizard, at any geographic scale.

8.7.9 Fish

In conjunction with the design of the proposed road development, mitigation measures will be implemented to minimise the effects of habitat loss on fish species, and to maintain fish passage along all watercourses crossed by the proposed road development, such that no population level effects are predicted (**Section 8.6.12.1**).

A mitigation strategy will be implemented during construction to minimise the risk of the proposed road development affecting water quality in receiving watercourses/waterbodies and to ensure that the existing groundwater regime is not affected. This will ensure that there is not a likely significant negative effect on fish species during construction (**Section 8.6.4**).

Mitigation measures will also be implemented to minimise the potential for disturbance or mortality of fish species during construction, such that no population level effects are predicted.

No likely significant negative effects on fish species are predicted during operation, and no mitigation measures are required.

Therefore the proposed road development will not result in a likely significant negative residual effect on fish species, at any geographic scale.

8.7.10 Local Biodiversity Areas

All of the local biodiversity areas impacted by the proposed road development will be affected to some degree by the likely significant effects associated with the proposed road development on the KERs that have been identified in each of those areas. These likely significant effects are accounted for, and described, above separately and this section provides some context for these residual impacts with respect to the locations of the local biodiversity area through which the proposed road development passes.

The residual impact of the loss of c.0.01ha of Residual alluvial forest [*91E0] habitat will have a residual impact on the Menlough to Coolough Hill local biodiversity area. The residual impact associated with this habitat loss has been assessed as significant at the international geographic scale.

The residual impact of the loss of c.0.54ha of Limestone pavement [*8240] habitat will have a residual impact on the Menlough to Coolough Hill local biodiversity area and the Doughiska local biodiversity area. The residual impact associated with this habitat loss has been assessed as significant at the international geographic scale.

The residual impact of the loss of c.4.78ha of peatland habitat mosaic (Wet heath [4010], Dry heath [4030] and *Molinia* meadow [6410]) will have a residual impact on the Coast Road (R336) to the N59 Moycullen Road local biodiversity area. The residual impact associated with this habitat loss has been assessed as significant at the national geographic scale.

The residual impact of the loss of c.0.7ha of Calcareous grassland [6210] habitat will have a residual impact on the Menlough to Coolough Hill local biodiversity area and the Doughiska local biodiversity area. The residual impact associated with this habitat loss has been assessed as significant at the national geographic scale.

The residual impact of the loss of c.0.28ha of *Molinia* meadow [6410] habitat will have a residual impact on the Ballindooley – Castlegar local biodiversity area. The residual impact associated with this habitat loss has been assessed as significant at the national geographic scale.

The residual impact of the loss of the calcareous springs (FP1) and the Petrifying springs [*7220] at Lackagh Quarry will have a residual impact on the Menlough to Coolough Hill local biodiversity area. The residual impact associated with this habitat loss has been assessed as significant at the local and county geographic scales, respectively.

The residual impact of the loss of c.7.81ha of dry-humid acid grassland (GS3) and c.0.13ha of Poor fen and flush habitat (PF2) will have a residual impact on the Coast Road (R336) to the N59 Moycullen Road local biodiversity area. The residual impact associated with this habitat loss has been assessed as significant at the local geographic scale.

Hedgerows and treelines will be impacted throughout the local area with the greatest concentrations affected in parts of the Coast Road (R336) to the N59 Moycullen Road local biodiversity area around Ballagh, in the Menlough to Coolough Hill local biodiversity area, and in the Doughiska local biodiversity area. The residual impact associated with this habitat loss has been assessed as significant at the local geographic scale.

The residual impact of the loss of Broadleaved woodland (WD1) and Oak-ash-hazel woodland (WN2) will have a residual impact on the Menlough to Coolough Hill local biodiversity area. The residual impact associated with this habitat loss has been assessed as significant at the local geographic scale.

The residual impact on the local Lesser horseshoe bat population will have a residual impact principally on the Menlough to Coolough Hill local biodiversity area, but is also likely to affect the River Corrib and the Coolagh Lakes local biodiversity area and the Ballindooley – Castlegar local biodiversity area. This residual impact associated has been assessed as potentially significant at the national geographic scale.

The residual impact on all other bat species recorded within the study area will have a residual impact on the Coast Road (R336) to the N59 Moycullen Road local biodiversity area, the River Corrib and the Coolagh Lakes local biodiversity area, the Menlough to Coolough Hill local biodiversity area, the Ballindooley – Castlegar local biodiversity area, and the Doughiska local biodiversity area. This residual impact associated has been assessed as significant at the local geographic scale.

The residual impact on the local Peregrine falcon population will have a residual impact on the Menlough to Coolough Hill local biodiversity area. This residual impact associated has been assessed as significant at the county geographic scale.

The residual impacts of the proposed road road development, as they relate to each of the local biodiversity area, are summarised below:

- Coast Road (R336) to the N59 Moycullen Road local biodiversity area
- Residual impact at the national geographic scale

  Peatland habitat mosaic (Wet heath [4010], Dry heath [4030] and *Molinia* meadow [6410])

- Residual impact at the local geographic scale

  Dry-humid acid grassland (GS3), Poor fen and flush habitat (PF2), Hedgerows and treelines (WL1/WL2), bats other than the Lesser horseshoe bat

River Corrib and the Coolagh Lakes local biodiversity area

- Residual impact at the national geographic scale

  Lesser horseshoe bat

- Residual impact at the local geographic scale

  Bat species other than the Lesser horseshoe bat

Menlough to Coolough Hill local biodiversity area

- Residual impact at the international geographic scale

  Limestone pavement [*8240] and Residual alluvial forest [*91E0]

- Residual impact at the national geographic scale

  Calcareous grassland [6210] and the Lesser horseshoe bat

- Residual impact at the county geographic scale

  Petrifying springs [*7220] and the Peregrine falcon

- Residual impact at the local geographic scale

  Calcareous springs (FP1), Broadleaved woodland (WD1), Hedgerows and treelines (WL1/WL2), Oak-ash-hazel woodland (WN2) and bats other than the Lesser horseshoe bat

Ballindooley – Castlegar local biodiversity area

- Residual impact at the national geographic scale

  Molinia meadow [6410] and the Lesser horseshoe bat

- Residual impact at the local geographic scale

  Bats other than the Lesser horseshoe bat

Doughiska local biodiversity area

- Residual impact at the international geographic scale

  Limestone pavement [*8240]

- Residual impact at the national geographic scale

Calcareous grassland [6210]

- Residual impact at the local geographic scale

  Hedgerows and treelines (WL1/WL2) and bats other than the Lesser horseshoe bat

8.8 Cumulative Impacts

This section of the report presents the assessment carried out to examine whether the proposed road development along with any other projects or plans could cumulatively result in a likely significant effect on biodiversity.

The projects which are either in place, or proposed, which are considered in assessing the potential for cumulative impacts to increase the significance of the impacts predicted for the proposed road development on biodiversity are as follows:

- Galway Transport Strategy (GTS)
- M17 Galway to Tuam Road Project
- N18 Oranmore to Gort Road Project
- N83 Tuam Bypass
- M6 Motorway
- M6 (M17/M18) Motorway Service Area
- N59 Clifden to Maam Cross Road Project (objective in the *Galway County Development Plan 2015-2021*)
- N59 Maam Cross to Oughterard Road Project
- N59 Maigh Cuilinn (Moycullen) Bypass Road Project
- Galway to Dublin Cycleway
- Connemara Greenway (from Galway City to Clifden))
- Galway to Spiddal Greenway (Bearna to Spiddal Cycleway)
- R336 Bearna to Scríb via Ros an Mhíl Upgrade/Improvement (objective in the *Galway County Development Plan 2015-2021*)
- Sáilín to Silverstrand Coastal Protection Scheme
- Salthill Coastal Protection Works (Blackrock to Galway Golf Club)
- Proposed Galway Harbour Port Extension

The potential for other plans or projects to act cumulatively with the proposed road development to adversely affect the integrity of any European sites, is considered in Section 12 of the NIS (termed “in combination effects” in the context of the NIS assessment). The four European sites within the ZoI of the proposed road development are Lough Corrib cSAC, Galway Bay Complex cSAC, Lough Corrib SPA and Inner Galway Bay SPA. There is no potential for any other projects to act in combination with the proposed road development to adversely affect the integrity of any other European sites, as they are beyond the ZoI of the proposed road development.

The in combination assessment identified those plans and projects which have the potential to impact on Lough Corrib cSAC, Galway Bay Complex cSAC, Lough Corrib SPA and Inner Galway Bay SPA and assessed whether they had the potential to adversely affect the integrity of these European sites. Any plan or proposed project that could potentially affect these European sites in combination with the proposed road development must adhere to the overarching policies and objectives of the relevant land use plan(s), as dependent on the location of the specific plan or proposed project. These are the *Galway County Development Plan 2015-2021*, the *Galway City Council Development Plan 2017-2023*, the *Clare County Development Plan 2017-2022* and the *Mayo County Development Plan 2014-2020*[97]. The protective policies and objectives in these land use plans will ensure the protection of European sites across the identified potential impact pathways.

As the proposed road development will not affect the integrity of Lough Corrib cSAC, Galway Bay Complex cSAC, Lough Corrib SPA or Inner Galway Bay SPA, and given the protection afforded to European sites under the overarching land use plans, it was concluded that there is no potential for adverse effects on the integrity of any European sites to arise as a consequence of the proposed road development acting in combination (or cumulatively) with any other plans or projects.

The potential for cumulative impacts to arise are limited to those residual impacts associated with the proposed road development and those effects the proposed road development will have on the receiving environment that are measurable in some way, but themselves will not result in a likely significant residual effect on biodiversity.

The residual impacts associated with the proposed road development relate to the following:

- Habitat loss, including both the permanent loss of Annex I habitats and habitats valued as being of local importance
- The potential loss of a Peregrine falcon nest site due to long-term disturbance/displacement impacts
- Impacts on bats as a result of the construction and operation of the proposed road development

The other impacts associated with the proposed road development that are measurable in some way, but themselves will not result in a likely significant effect on biodiversity and these are also discussed below:

- Impacts on the existing hydrological and hydrogeological regimes

[97] Although the regional and national level Plans sit above the county and local plans in the hierarchy (e.g. Project Ireland 2040 – National Planning Framework and the Regional Planning Guidelines for the West Region 2010-2022), the NPF is given effect at a regional level by the RDP and projects to meet its aims will be implemented locally by the relevant local authority and must comply with the statutory planning requirements, and must be in accordance with the objectives and policies of the relevant land use plans (Development Plans, Local Area Plans etc.).

- Impacts on air quality
- Impacts to species as a result of disturbance or displacement

Impacts from habitat loss

As outlined in **Section 8.5.2**, habitat loss to development and land use change has been an ongoing impact locally which may have already had effects on local biodiversity. Those projects listed above have, or are likely to, result in habitat impacts (including those of a high biodiversity value such as Annex I habitat types) which may also have knock-on effects on fauna species. Therefore, land use change and habitat losses are likely to continue to some degree and the loss and fragmentation of habitat associated with the proposed road development will contribute to this trend locally.

The most notable habitat loss impacts are the losses of areas of internationally or nationally valued habitats: Limestone pavement [*8240], Residual alluvial forest [*91E0], Wet heath [4010], Dry heath [4030], Calcareous grassland [6210], *Molinia* meadow [6410] and a Petrifying spring [*7220]. There are also significant areas of habitat types of a local biodiversity value that will be lost: calcareous springs, reed and large sedge swamps, dry-humid acid grassland, poor fen and flush, broadleaved woodland, hedgerows and treelines. Habitat losses, regardless of their own habitat value, also have the potential to have an effect on the local fauna populations that they support. The most significant impact in that regard are the likely effects of habitat loss on the local bat populations; particularly the Menlo Castle Lesser horseshoe bat population (impacts on bats are discussed separately below).

The losses of areas of Annex I habitat associated with the proposed road development are considered to be at the highest level of geographic significance for the habitats involved. In addition, the proposed road development will be contributing to an existing trend of Annex I habitat loss locally. While the cumulative effect of habitat losses would increase the magnitude of the impact, it does not increase the geographic scale of the impact significance associated with the proposed road development. The protective polices in the *Bearna Local Area Plan 2007-2017*, the *Galway City Council Development Plan 2017-2023* and the *Galway County Development Plan 2015-2021* to protect biodiversity will moderate any future impacts on biodiversity, including those related to Annex I habitat types. Where the losses can be compensated for (see **Section 8.9** below), this offsets the contribution of the proposed road development to existing losses of the habitat type in question whilst ensuring that there is no potential for other developments to result in a significant cumulative impact.

In relation to areas of locally important habitats that will be lost, given the habitat types involved and that at any greater geographic scale they are likely to remain in a favourable conservation condition, any cumulative losses of these habitat types are not likely to increase the impact significance. The protective polices in place in the land use plans will also moderate any future losses of habitats of a biodiversity value. Where habitat losses can be compensated for this would also reduce the impact significance and the potential for any cumulative impacts with any future developments.

Impacts on Peregrine falcon

Due to the potential for long-term disturbance and displacement of the Lackagh Quarry Peregrine falcon pair from the existing nest site, the proposed road development is likely to result in a significant negative residual effect on Peregrine falcon, at the county geographic scale.

The two other Peregrine falcon nest sites that are present locally are likely to continue to support breeding Peregrine falcon. One site is a disused quarry which is zoned for agricultural use and is therefore, not likely to see any increased disturbance from development; the second nest site is a regularly occupied site in an active quarry and the baseline levels of disturbance, to which the resident Peregrine pair are habituated, are likely to remain. Neither of these sites are likely to be affected by any of the projects listed above, given their locations relative to where those strategies/projects will be implemented. Existing pressures at the county level on suitable nest site availability are expected to continue and may act cumulatively at the county geographic scale, but there isn't sufficient data available to quantify this. However, any additional pressures on the Peregrine falcon population will not increase the overall significance of the impact of the proposed road development to a national level impact given that the species is currently considered to be of a low conservation concern for its national population.

Therefore, there are no other projects that are likely to cumulatively act along with the proposed road development to increase the predicted impact significance of the proposed road development on Peregrine falcon from the likely significant negative residual effect, at the county geographic scale.

Impacts on bats

There are predicted residual impacts on bats include loss of roosts, loss of foraging habitat and the barrier/severance effect posed by roads.

Some proportion of existing roost sites in the vicinity of the proposed road development may deteriorate over time and become unsuitable for bats to use (e.g. derelict structures and old trees). Therefore, the roost sites that will be affected by the proposed road development could potentially contribute to such natural declines in other roost sites locally.

Loss of foraging habitat and barriers to bat movements may result from development of zoned land within the northern fringes of Galway City. Lands used by bats which are also zoned for development include light industrial zoning (C2.1) near the N84 Headford Road and Ballindooley, which may affect the proposed artificial roost via increased light spill. The recreation and amenity zoning at NUIG may also interact with the flight paths of bats moving between the Aughnacurra roosts and Menlo Castle and the use of those lands by foraging bats (e.g. where additional lighting may be proposed in the future). However, all of these impacts would be controlled by the assessment of individual planning applications which would consider the effects on protected species such as bats as part of their appraisal by the competent authority, having regard to the protective environmental policies outlines in the *Bearna Local Area Plan 2007-2017*, the *Galway City Council Development Plan 2017-2023*, the *Galway County Development Plan 2015-2021* and the *Ardaun Local Area Plan 2018-2024* to protect biodiversity[98]. Therefore, there are no additional cumulative impacts predicted regarding loss of foraging habitat or from barriers to bat movement.

Impacts on the existing hydrological or hydrogeological regimes

The proposed road development will not have any residual impacts on the existing hydrological regime in those surface water catchments crossed by the proposed road development or the receiving marine environment in Galway Bay, either through affecting existing flow conditions or affecting flooding regimes. The proposed road development will also not have any residual impact on the existing hydrogeological regime.

All of the surface water catchments, the groundwater bodies and the transitional waters of Galway Bay lie within the proposed National River Basin District; what was formerly the Western River Basin District (WRBD)[99]. The *River Basin Management Plan for the Western River Basin District in Ireland (2009-2015)*, and the current draft of the *The River Basin Management Plan for Ireland (2018-2021)*, aims to protect all waters within the district and, where necessary, improve waters and achieve sustainable water use. The purpose of the River Basin Management Plan is to reduce pollution levels, to restore good water quality status and to prevent deterioration in water quality in the river basins and groundwater bodies. There are many land use plans and projects that lie within the WRBD that have the potential to affect surface water and groundwater bodies. However, all of the overarching land use plans have environmental protective policies to protect the existing surface water and groundwater network.

Therefore, there are no other plans or projects that are likely to result in a significant effect on biodiversity, cumulatively with the proposed road development, as a consequence of surface water or groundwater impacts.

Impacts on air quality

There will be some change in air quality in the immediate vicinity of the proposed road development during operation, although it will not in itself result in a likely significant effect on biodiversity. The potential for cumulative impacts to occur through air quality effects is limited to the receiving environment in the immediate vicinity of the proposed road development and any future developments that would introduce air quality pollutants to this local area. There are no current or proposed projects that would be likely to contribute to the air quality baseline in any notable way in the vicinity of the proposed road development. Considering the land use zonings and objectives that relate to this area in the *Bearna Local Area Plan 2007-2017*, the *Galway City Council Development Plan 2017-2023*, the *Galway County Development Plan 2015-2021* and the *Ardaun Local Area Plan 2018-2024*, and the protective policies and objectives in both the *Galway City Council Development*

[98] For example, Policy 4.2 of the *Galway City Council Development Plan 2017-2023* which states "Protect and conserve rare and threatened flora and fauna and their key habitats, (wherever they occur) listed on Annex I and Annex IV of the EU Habitats Directive (92/43EEC) and listed for protection under the Wildlife Acts 1976-2000."

[99] For the next cycle of river basin management plans (2018-2021) the Eastern, South Eastern, South Western, Western and Shannon River Basin Districts will be merged to form one national River Basin District

Plan 2017-2023 and the overarching *Galway County Development Plan 2015-2021* to protect air quality and biodiversity, there are no other plans or projects that are likely to result in a significant effect on biodiversity, cumulatively with the proposed road development, as a consequence of air quality impacts.

Impacts on fauna species (excluding bats) as a result of disturbance or displacement

The proposed road development will not result in a likely significant residual effect on any fauna species (excluding bats) as a result of disturbance or displacement effects during either construction or operation.

Disturbance or displacement impacts during construction are temporary or short-term and are not likely to have long-term population level effects, even cumulatively with any future development projects that might be proposed.

During operation, the predicted ZoI from the proposed road development is limited to the immediate vicinity and will not result in a likely significant residual effect on any fauna species (excluding bats) as a result of disturbance or displacement effects. Considering the land use zonings in the areas through which the proposed road development passes (predominantly rural fringe, recreational amenity, amenity and agri-amenity), and the minimal effect of operational disturbance from road traffic, and the abundance of alternative suitable habitat locally to support those fauna species present, future development is not likely to result in in a significant effect on biodiversity, cumulatively with the proposed road development, as a consequence of disturbance or displacement impacts.

8.8.1 Summary of Residual Impacts

Table 8.39 below presents an overall summary of the likely significant effects of the proposed road development on biodiversity, in consideration of the mitigation measures.

Table 8.39: Summary of Likely Significant Residual Effects of the Proposed Road Development on Biodiversity (including mitigation)

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
Designated Areas for Nature Conservation					
Lough Corrib cSAC (including Lough Corrib pNHA)	International (National)	**Construction** Habitat loss Habitat degradation – tunnelling/excavation Habitat degradation – hydrogeology Habitat degradation – hydrology Habitat degradation – air quality Habitat degradation – non-native invasive plant species Mortality risk **Operation** Habitat degradation – hydrogeology Habitat degradation – non-native invasive plant species Mortality risk	Likely significant effect at the international geographic scale	see Section 10 of the NIS	No likely significant residual effect
Galway Bay Complex cSAC (including Galway bay Complex pNHA)	International (National)	**Construction** Habitat degradation – hydrology Habitat degradation – non-native invasive plant species Barrier effect Mortality risk	Likely significant effect at the international geographic scale	see Section 10 of the NIS	No likely significant residual effect

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
Lough Corrib SPA (including Lough Corrib pNHA)	International (National)	**Construction** Habitat degradation – hydrogeology Habitat degradation – hydrology Disturbance/displacement **Operation** Habitat degradation – hydrogeology	Likely significant effect at the international geographic scale	see Section 10 of the NIS	No likely significant residual effect
Inner Galway Bay SPA including Galway bay Complex pNHA)	International (National)	**Construction** Habitat degradation – hydrogeology Habitat degradation – hydrology Disturbance/displacement **Operation** Habitat degradation – hydrogeology	Likely significant effect at the international geographic scale	see Section 10 of the NIS	No likely significant residual effect
Moycullen Bogs NHA	National	**Construction** Habitat degradation – air quality Habitat degradation – non-native invasive plant species Habitat degradation – hydrology **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the national geographic scale	Air quality during construction – **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5** Water quality during construction – **Section 8.6.4**	No likely significant residual effect

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
Habitats (outside of designated areas for nature conservation)					
Limestone pavement [*8240]	International Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the international geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction – **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	Likely significant residual effect at the international geographic scale
Petrifying springs [*7220]	International Importance	**Construction** Habitat loss	Likely significant effect at the county geographic scale (see **Section 8.5.4.3** under petrifying springs)	To reduce the scale of habitat loss – see **Section 8.6.2.1**	Likely significant residual effect at the county geographic scale (see **Section 8.7.2**)
Calcareous grassland [*6210/6210]	International/National Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species	Likely significant effect at the national geographic scale (No *6210 affected – see **Section 8.5.4.3**	To reduce the scale of habitat loss – see **Section 8.6.2.1**	Likely significant residual effect at the national geographic scale

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
		Operation Habitat degradation – non-native invasive plant species	under Calcareous grassland))	Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	(see **Section 8.7.2**)
Dry heath [4030]	National Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the national geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction – **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	Likely significant residual effect at the national geographic scale (see **Section 8.7.2**)
Wet heath [4010][100]	National Importance	**Construction** Habitat loss Habitat degradation – air quality	Likely significant effect at the national geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1**	Likely significant residual effect at the national

[100] Including areas of Wet heath/Dry heath/*Molinia* meadow [4010/4030/6410] mosaic

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
		Habitat degradation – groundwater **Operation** Habitat degradation – groundwater		Air quality during construction – **Section 8.6.3** Groundwater during construction and operation – **Section 8.6.5**	geographic scale (see **Section 8.7.2**)
Molinia meadow [6410]	National Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the national geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction – **Section 8.6.3** Groundwater during construction and operation – **Section 8.6.5**	Likely significant residual effect at the national geographic scale (see **Section 8.7.2**)
Residual alluvial forest [*91E0]	International Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the international geographic scale	Air quality during construction – **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	Likely significant residual effect at the international geographic scale (see **Section 8.7.2**)

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
Turloughs [*3180]	International Importance	**Construction** Habitat loss Habitat degradation – surface water quality Habitat degradation – groundwater Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – groundwater Habitat degradation – non-native invasive plant species	Likely significant effect at the international geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction – **Section 8.6.3** Water quality during construction – **Section 8.6.4** Groundwater during construction and operation – **Section 8.6.5** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	No likely significant residual effect
Hard water lakes [3140]	National Importance	**Construction** Habitat degradation – surface water quality (Ballindooley Lough)	Likely significant effect at the national geographic scale	Water quality during construction – **Section 8.6.4**	No likely significant residual effect

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
Mesotrophic lakes (FL4) *Part of Ballindooley complex*	County Importance[101]	**Construction** Habitat degradation – surface water quality	Likely significant effect at the county geographic scale	Water quality during construction – **Section 8.6.4**	No likely significant residual effect
Eutrophic lakes (FL5) *Part of Ballindooley complex*	County Importance[102]	**Construction** Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the county geographic scale	Water quality during construction – **Section 8.6.4** Groundwater during construction – **Section 8.6.5**	No likely significant residual effect
Calcareous springs (FP1) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat loss	Likely significant effect at the local geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1**	Likely significant residual effect at the local geographic scale
Cladium fen [*7210]	International Importance	**Construction** Habitat degradation – surface water quality (Ballindooley Lough)	Likely significant effect at the international geographic scale	Water quality during construction – **Section 8.6.4**	No likely significant residual effect
Hydrophilous tall herb [6430]	International Importance	(see Lough Corrib cSAC above) **Construction** Habitat degradation – hydrogeology Habitat degradation – hydrology	Likely significant effect at the international geographic scale	see Section 10 of the NIS	No likely significant residual effect

[101] On the basis that it forms part of the wetland complex at Ballindooley Lough
[102] On the basis that it forms part of the wetland complex at Ballindooley Lough

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
		Operation Habitat degradation – hydrogeology			
Alkaline fens [7230]	National Importance	**Construction** Habitat degradation – surface water quality (Ballindooley Lough)	Likely significant effect at the national geographic scale	Water quality during construction – **Section 8.6.4**	No likely significant residual effect
Reed and large sedge swamps (FS1) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality	Likely significant effect at the local geographic scale	Water quality during construction – **Section 8.6.4**	No likely significant residual effect
Tall-herb swamps (FS2) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect
Eroding/upland rivers (FW1)	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality	Likely significant effect at the local geographic scale	Water quality during construction – **Section 8.6.4**	No likely significant residual effect
Depositing/lowland rivers (FW2) River Corrib	International Importance	The River Corrib forms part of see Lough Corrib cSAC (see above and NIS)	Likely significant effect at the international geographic scale	see Section 10 of the NIS	No likely significant residual effect
Terryland River	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect
Drainage ditches (FW4)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
Marsh (GM1)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect
Dry calcareous and neutral grassland (GS1) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect
Dry meadows and grassy verges (GS2) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect
Dry-humid acid grassland (GS3) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale	Air quality during construction – **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	Likely significant residual effect at the local geographic scale
Wet grassland (GS4) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect
Rich fen and flush (PF1) Non-Annex I habitat type	County Importance	**Construction** Habitat degradation – surface water quality Habitat degradation – air quality	Likely significant effect at the county geographic scale	Water quality during construction – **Section 8.6.4**	No likely significant residual effect

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
				Air quality during construction – **Section 8.6.3**	
Poor fen and flush (PF2) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality **Operation** Habitat degradation – groundwater	Likely significant effect at the local geographic scale	Air quality during construction - **Section 8.6.3**	Likely significant residual effect at the local geographic scale
(Mixed) broadleaved woodland (WD1)	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction – **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	Likely significant residual effect at the local geographic scale
Mixed broadleaved/conifer woodland (WD2)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
(Mixed) conifer woodland (WD3)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect
Hedgerows (WL1)	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction – **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	Likely significant effect at the local geographic scale
Treelines (WL2)	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction – **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	Likely significant effect at the local geographic scale

Ecological Receptor	**Ecological Valuation (after National Roads Authority, 2009)**	**Impacts with the Potential to result in Likely Significant Effects**	**Potential Impact Significance**	**Mitigation Measures**	**Residual Impact Significance**
Oak-ash-hazel woodland (WN2) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat degradation – air quality Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale	Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	No likely significant residual effect
Scrub (WS1) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect
Fauna Species					
Badger	Local Importance (Higher Value)	**Construction** Loss of breeding/resting sites Disturbance/displacement **Operation** Habitat severance/barrier effect Mortality risk	Likely significant effect at the local geographic scale	Measures to protect Badger during construction – **Section 8.6.7.3.1** Measures to protect Badger during operation – **Section 8.6.7.3.2**	No likely significant residual effect
Otter	International Importance	**Construction** Habitat degradation - water quality **Operation** Habitat severance/barrier effect	Likely significant effect at the local geographic scale	Measures to protect Otter during construction – **Section 8.6.7.1.1**	No likely significant residual effect

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
		Mortality risk		Measures to protect Otter during operation – **Section 8.6.7.1.2**	
Other mammal species protected under the Wildlife Acts	Local Importance (Higher Value)	**Construction** Habitat degradation - water quality **Operation** Habitat severance/barrier effect Mortality risk	Likely significant effect at the local geographic scale	Measures to protect other mammal species (excl. bats) during construction – **Section 8.6.7.3.1** Measures to protect other mammal species (excl. bats) during operation – **Section 8.6.7.3.2**	No likely significant residual effect
Lesser horseshoe bat	National Importance	**Construction** Roost loss Habitat loss Habitat fragmentation Disturbance/displacement **Operation** Mortality Barrier/severance effects Disturbance/displacement	Likely significant effect at the national geographic scale	Measures to protect bats during construction – **Section 8.6.7.2.1** Measures to protect bats during operation – **Section 8.6.7.2.2**	Likely significant effect at the national geographic scale
All other bat species	Local Importance (Higher Value)		Likely significant effect at the local geographic scale	Measures to protect bats during construction – **Section 8.6.7.2.1** Measures to protect bats during operation – **Section 8.6.7.2.2**	Likely significant effect at the local geographic scale

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
Marsh whorl snail	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality Habitat degradation – groundwater **Operation** Habitat degradation – groundwater	Likely significant effect at the local geographic scale	Measures to protect the Marsh whorl snail during construction – **Section 8.6.8.1.1** Measures to protect the Marsh whorl snail during operation – **Section 8.6.8.1.2**	No likely significant residual effect
Marsh fritillary butterfly	County Importance	**Construction** Mortality risk	Likely significant effect at the local geographic scale	Measures to protect the Marsh fritillary butterfly during construction – **Section 8.6.8.2.1**	No likely significant residual effect
SCI bird species	International	*see Lough Corrib SPA and Inner Galway Bay SPA above*	Likely significant effect at the international geographic scale	see Section 10 of the NIS	No likely significant residual effect
Barn owl	County Importance	**Operation** Mortality risk	Likely significant effect at the county geographic scale	Measures to protect breeding birds during operation – **Section 8.6.9.1.2**	No likely significant residual effect
Peregrine falcon	County Importance	**Construction** Disturbance/displacement **Operation** Disturbance/displacement	Likely significant effect at the county geographic scale	Measures to protect breeding birds during construction – **Section 8.6.9.1.1**	Likely significant residual effect at the county

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
				Measures to protect breeding birds during operation – **Section 8.6.9.1.2**	geographic scale
All other breeding bird species (non SCI)	Local Importance (Higher Value)	**Construction** Mortality risk Disturbance/displacement **Operation** Mortality risk Disturbance/displacement	Likely significant effect at the local geographic scale	Measures to protect breeding birds during construction – **Section 8.6.9.1.1** Measures to protect breeding birds during operation – **Section 8.6.9.1.2**	No likely significant residual effect
All other wintering bird species (non-SCI)	Local Importance (Higher Value)	**Construction** Disturbance/displacement (Ballindooley Lough) Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the local geographic scale	Measures to protect wintering birds during construction – **Section 8.6.9.2.1** Measures to protect wintering birds during operation – **Section 8.6.9.2.2**	No likely significant residual effect
Smooth newt Common frog	Local Importance (Higher Value)	**Construction** Habitat loss Disturbance & mortality risk Habitat degradation – surface water quality **Operation** Habitat severance/barrier effect	Likely significant effect at the local geographic scale	Measures to protect amphibians during construction – **Section 8.6.10.1** Measures to protect amphibians during	No likely significant residual effect

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
				operation – **Section 8.6.10.2**	
Common lizard	Local Importance (Higher Value)	**Construction** Habitat loss Disturbance & mortality risk **Operation** Habitat severance/barrier effect	Likely significant effect at the local geographic scale	Measures to protect reptiles during construction – **Section 8.6.11.1** Measures to protect reptiles during operation – **Section 8.6.11.2**	No likely significant residual effect
Atlantic salmon European eel	International Importance	**Construction** Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the local geographic scale	Measures to protect fish species during construction – **Section 8.6.12.1**	No likely significant residual effect
All other fish species recorded	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the local geographic scale	Measures to protect fish species during construction – **Section 8.6.12.1**	No likely significant residual effect
Local Biodiversity Areas					
Local biodiversity areas	The value of the biodiversity receptors recorded in the vicinity of the proposed road development, across the local	Combinations of all of the potential impacts noted above The specific impacts are related to and dependent upon the potential impacts of the proposed road development on each of the individual ecological receptors that make	Likely significant effects from local up to the international geographic scale	All of the mitigation measures included within **Section 8.6** The specific mitigation measures are related to and dependent upon the potential impacts of	Likely significant effects from local up to the international geographic scale

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance
	biodiversity areas, range from Local Importance (Lower Value) to Internationally Important	up the biodiversity resource within a given local biodiversity area		the proposed road development on each of the individual ecological receptors that make up the biodiversity resource within a given local biodiversity area	Refer to **Section 8.7.10** for breakdown by local biodiversity area

8.9 Compensation

Where there are significant residual biodiversity impacts as a result of the proposed road development, despite the mitigation measures proposed, compensatory measures are proposed to offset or reduce the predicted impacts[103]. These are not compensatory measures in the context of the requirements of Article 6(4) of the Habitats Directive as they are not compensating for an impact that would adversely affect the integrity of any European site. As concluded in the NIS, the proposed road development will not result in such an impact on any European site.

The likely significant residual effects of the proposed road development relate to habitat loss, the potential permanent loss of a Peregrine falcon nest site, and impacts on the local bat populations. Each of these are discussed below with regard to whether compensatory measures are feasible and likely to succeed in compensating for the potential impacts of the proposed road development.

8.9.1 Habitat loss

Limestone pavement [*8240] has a clint and gryke, or shattered pavement, structure which supports the vegetation characteristic of this habitat type. This underlying rock structure is created over millennia by geological and weathering processes and cannot be artificially recreated and is effectively a non-renewable habitat resource. Therefore, the losses of Limestone pavement habitat associated with the proposed road development cannot be compensated.

Petrifying springs [*7220] are a product of the interaction of groundwater and the underlying geology to create a tufa forming spring that supports the associated species assemblage to correspond to this priority Annex I habitat type. Such features cannot readily be artificially recreated with any degree of certainty and, as per Limestone pavement, are effectively a non-renewable habitat resource. Therefore, the loss of a Petrifying spring associated with the proposed road development cannot be compensated.

Wet heath [4010] is a habitat type that forms on shallow peats with impeded drainage. In the western part of the study area, this is due to the underlying bedrock and undulating topography retaining a water table near to the surface. Wet heath cannot readily be artificially recreated with any degree of certainty. Therefore, the loss of Wet heath associated with the proposed road development cannot be directly compensated.

The areas of Residual alluvial forest [*91E0], Dry heath [4030], Calcareous grassland [6210] and *Molinia* meadow [6410] that will be lost as a result of the proposed road development will be compensated. In each case the area of each habitat type being provided is greater than that being lost. In relation to Dry heath, the area of habitat being provided is greater than the combined losses associated with this habitat type and any Wet heath/*Molinia* meadow mosaics (c.4.78ha). Although this does not reduce the residual impact associated with the loss of Wet heath habitat, it is included in order to provide a biodiversity gain for peatland

[103] "Compensation describes measures taken to make up for residual effects resulting in the loss of, or permanent damage to ecological features despite mitigation" (CIEEM, 2016)

habitats in light of the fact that Wet heath cannot in itself be directly compensated for. This is summarised below in **Table 8.40**.

The full details of the Habitat Compensation Management Plan for each of the Annex I habitat types being compensated for, including monitoring, are presented in **Appendix A.8.26**. The areas where compensatory habitats will be created are shown on **Figures 8.23.1** to **8.23.14**.

In compensating for the losses of these habitat types, the proposed road development is not likely to result in a significant residual effect, at any geographic scale, on Residual alluvial forest [*91E0], Dry heath [4030], Calcareous grassland [6210] or *Molinia* meadow [6410].

Table 8.40: Summary of Residual PriorityAnnex I/Annex I habitat loss after compensation

Annex I habitat type	Permanent Area of Habitat Loss	Area of Compensatory Habitat Created	Residual Habitat Loss	Residual Impact Significance Post-compensation
Petrifying springs [*7220]	One Petrifying spring feature	n/a	One Petrifying spring feature	Likely significant residual effect at the county geographic scale
Residual alluvial forest [*91E0]	c.0.1ha	c.0.18ha	None	No likely significant residual effect
Limestone pavement [*8240]	c.0.54ha	n/a	c.0.54ha	Likely significant residual effect at the international geographic scale
Wet heath [4010]	c.2.06ha	n/a	c.2.06ha	Likely significant residual effect at the national geographic scale
Dry heath [4030]	c.1.85ha	c.7.06ha	None	No likely significant residual effect
Wet heath/Dry heath/*Molinia* mosaic [4010/4030/6410]	c.0.87ha	n/a	c.0.87ha[104]	Likely significant residual effect at the national geographic scale
Calcareous grassland [6210]	c.0.7ha	c.7.14ha	None	No likely significant residual effect

[104] Considered as Wet heath habitat for the purposes of the impact assessment, the loss of which cannot be directly compensated for.

Annex I habitat type	Permanent Area of Habitat Loss	Area of Compensatory Habitat Created	Residual Habitat Loss	Residual Impact Significance Post-compensation
Molinia meadow [6410]	c.0.28ha	c.0.49ha	None	No likely significant residual effect

There are a number of habitat types of a local biodiversity importance that will be permanently lost as a result of the proposed road development, and where significant residual negative effects are likely:

- Calcareous springs (FP1)
- Dry-humid acid grassland (GS3)
- Poor fen and flush (PF2)
- (Mixed) broadleaved woodland (WD1)
- Hedgerows (WL1)
- Treelines (WL2)

Of these, the planting proposed in the landscape design will compensate for the loss of the areas of (mixed) broadleaved woodland (WD1), hedgerows (WL1) and treelines (WL2) by providing a greater area to that being permanently lost to the proposed road development, as follows:

- (Mixed) broadleaved woodland (WD1) - > 2.62ha
- Hedgerows (WL1) - > 7.8km
- Treelines (WL2) - > 4km

In compensating for the losses of these habitat types, the proposed road development is not likely to result in a significant residual effect, at any geographic scale, on (mixed) broadleaved woodland (WD1), hedgerows (WL1) and treelines (WL2).

However, the proposed road development is likely to have a significant residual negative effect, at the local geographic scale, as a result of the permanent loss of fifteen Calcareous spring features (FP1), c.7.81ha of Dry-humid acid grassland (GS3) and c.0.13ha of Poor fen and flush habitat (PF2).

8.9.2 Bats

8.9.2.1 Compensation for loss of bat roosts

Loss of the more "significant" roosts (e.g. maternity roosts or roosts used by Lesser horseshoe bats) will be compensated by the erection of replacement structures (artificial roosts) in locations close to the original roost.

There is a dual purpose to the artificial roosts. Firstly, to ensure that there is no net loss of roosting opportunities for the bats confirmed to be roosting within the proposed development boundary. Secondly, it has been recognised that there will be an inevitable increase in mortality rates due to road collisions as suggested by scientific evidence (see **Section 8.5.6.2.2**). So the second function of the replacement roosts is to create improved conditions for bats to breed and to offset the likely increase in mortality.

Four artificial roost structures are proposed as set out below. The detailed fit-out of these artificial roosts will follow the recommendations of an experienced bat ecologist and further consultation with the Vincent Wildlife Trust will take place to ensure that their experiences in these techniques are taken into account.

Artificial roost structures will be screened from the effects of construction phase disturbance by means of solid hoarding or brushwood screens with an appropriate buffer zone around the roost. The dimensions of the planting will depend on the local topography and surrounding landscape and will be decided on a case-by-case basis by the bat ecologist.

It should be noted that the mitigation strategy, outlined above in **Section 8.6.7.2**, has included ensuring that passage underneath the proposed road development in the vicinity of the roosts has been facilitated by including culverts underneath the proposed road development in locations as close to the roosts as possible.

Proposed Aughnacurra maternity/hibernation roost for Lesser horseshoe bats and Brown long-eared bats

The proposed replacement roost will be located close to the existing Aughnacurra roost (PBR178) structure.

The proposed roost within the proposed development boundary will be screened with brushwood fencing or similar semi-solid screens c.2m high for the construction stage and will also be planted up around it as soon as the roost is constructed to provide long-term screening during the operation of the proposed road development. Non-native ornamental species may be used to provide screening in this case as it is in keeping with the suburban setting.

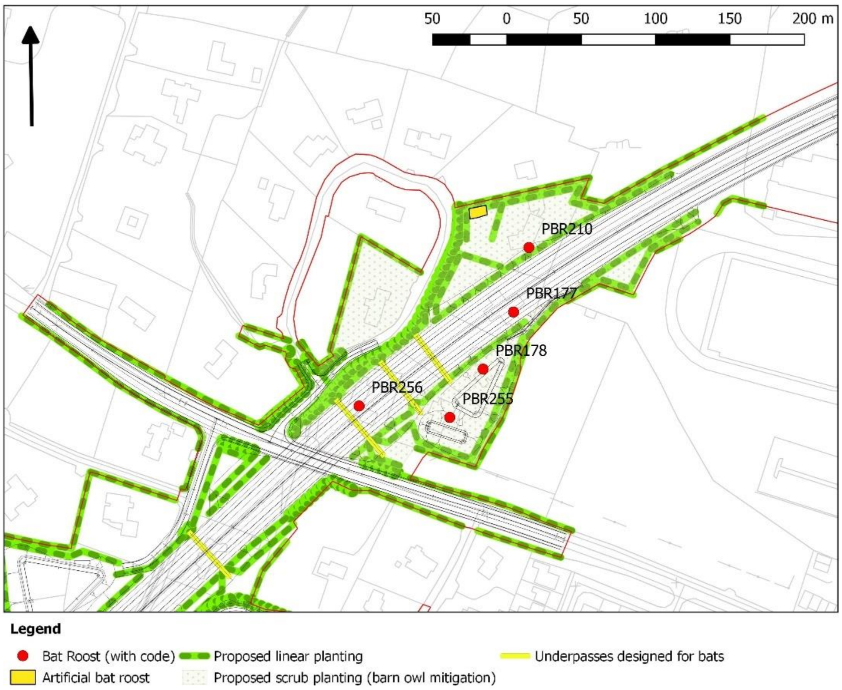
The design of the roost will take account of the Vincent Wildlife Trust (VWT) guidance[105] and will follow the following design parameters:

[105] Vincent Wildlife Trust (2015) *Lesser Horseshoe Bat: Conservation Handbook.*

- The template for the design will be taken from the roost at Garryland, Co. Galway constructed for the N18 Oranmore to Gort road development which has been shown to have worked successfully since its completion in 2011
- Single storey structure with southwest orientation for maximum solar gain on the pitched roof
- Location as set out in **Plate 8.5** below in corner of garden to be acquired
- Rendered block wall structure with natural slate roof. The exterior walls can be clad with rough stone or a material designed to have no adverse visual impact
- The building will have a footprint of c.10m x 8m with a steep pitched slate roof, partitions in the ground floor and roof space and an attic floor laid down with an open hatches for access for bats
- Plywood partitions will be installed within the roof voids to create bat “hotboxes” and separate roosting spaces for different species so that the brown long-eared bat roost can also be accommodated in the same building
- The interior of the roof should be lined with BS747 bituminous felt. All ceilings on the ground floor will be fitted with rough wood
- The entry point for bats shall be on the western side away from the proposed road development and close to the vegetation on the eastern perimeter which will be retained and enhanced. The entry point will be c.500mm x 300mm with bars set 125mm apart and lead flashing to be placed over the window sill under the hatch to prevent predator entry
- The northern corner will include a hibernation room at ground level which will be lined with concrete blocks and insulated to provide suitable conditions for hibernation. Plywood partitions will hang down from the ceiling to provide sheltered pockets at ceiling level. An earth floor will maintain humidity and some of the guttering will be piped inside to create an optional water-filled trough along one wall so that humidity levels can be adjusted if needed
- No water or electricity services are required
- Access for surveyors will be via a door on the southern side. Bats will be allowed to fly around the ground floor via an open hatch in the attic floor near the entry point

The proposed location (within the proposed development boundary) is close to vegetation which is important cover for bats entering and leaving. Additional planting is proposed to link the roost to the perimeter and to connecting features in the wider landscape.

Plate 8.5: Proposed location of Aughnacurra artificial roost structure (not to scale)



Menlo Castle alternative roost - Lesser Horseshoe maternity/hibernation roost

This roost is not replacing any specific loss of roost but is a critical part of the bat compensation measures. It will assist to increase the recruitment in the local Lesser horseshoe bat population so as to offset any increases in mortality as a result of the potential impacts of the proposed road development. The current roost in the chimney of the castle (PBR06) is likely to be unstable, inadequate and vulnerable to being lost if the castle falls into further disrepair. The new Menlo Castle roost would be better in design and aim to increase natural birth rates and thereby neutralise or overturn any negative impacts of the proposed road development. The preferred location is in a field to the east of the castle.

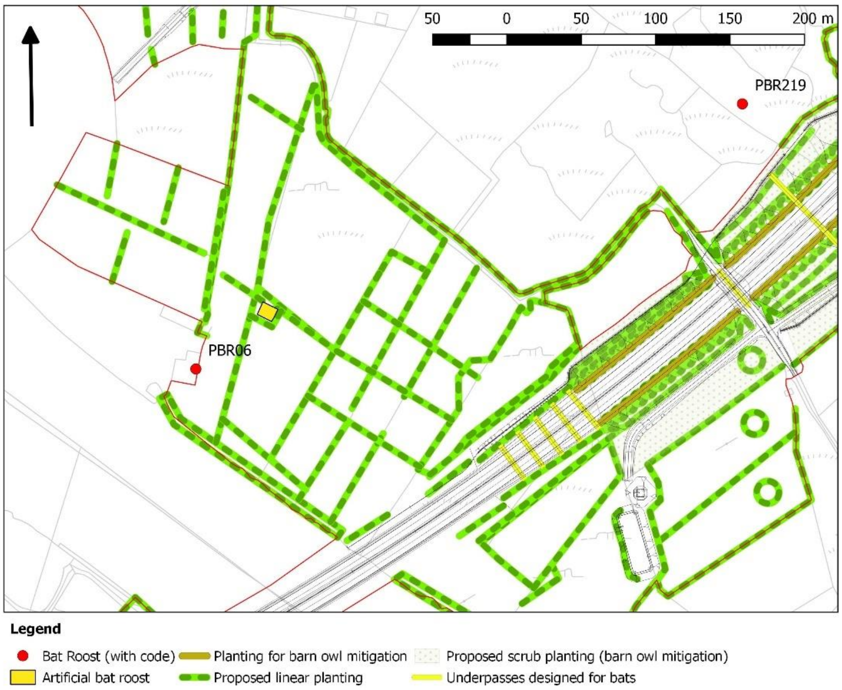
The design of the roost has taken account of the Vincent Wildlife Trust (VWT) guidance and following consultation with Dr Kate McAney and Ruth Hanniffy (VWT) and will follow the following design parameters:

- The template for the design will be taken from the roost at Garryland, Co. Galway constructed for the N18 Oranmore to Gort road development which has been shown to have worked successfully since its completion in 2011.
- Single storey structure with southern orientation for maximum solar gain on the pitched roof.
- Location as set out in **Plate 8.6** below in the northwest corner of the field close to Menlo Castle (PBR06).
- Rendered block wall structure with natural slate roof. The exterior walls can be clad with rough stone or a material designed to have no adverse visual impact.

Additional planting around the perimeter of the building will also screen it from view.

- The building will have a footprint of c.10m x 8m with a steep pitched slate roof, partitions in the ground floor and roof space and an attic floor laid down with an open hatches for access for bats. All ceilings on the ground floor will be fitted with rough wood.
- Plywood partitions will be installed within the roof voids to create bat "hotboxes" and separate roosting spaces for different species so that other bat species roost can also be accommodated in the same building.
- 4 no. wooden Kent bat boxes will be erected on the gable end of the structure to provide roosting opportunities for Daubenton's and Pipistrelle bat species. See: http://www.bats.org.uk/publications_download.php/938/Kent_Bat_Box_Jul2013_copy.pdf
- The interior of the roof will be lined with BS747 bituminous felt or equivalent bituminous felt
- The entry point for bats shall be on the west gable end sides away from the proposed road development and close to the vegetation on the eastern perimeter which will be retained and enhanced. The entry point will be c.500mm x 300mm with bars set 125mm apart and lead flashing to be placed over the window sill under the hatch to prevent predator entry.
- The northern corner will include a hibernation room at ground level which will be lined with concrete blocks and insulated to provide suitable conditions for hibernation. Plywood partitions will hang down from the ceiling to provide sheltered pockets at ceiling level. An earth floor will maintain humidity and some of the guttering be piped inside to create an optional water-filled trough along one wall so that humidity levels can be adjusted if needed.
- No water or electricity services are required.
- Access for surveyors will be via a door on the southern side. Bats will be allowed to fly around the ground floor via an open hatch in the attic floor near the entry point.
- The proposed location within the proposed development boundary is close to vegetation which is important cover for bats entering and leaving. Additional planting is proposed to link the roost to the perimeter and to connecting features in the wider landscape.

Plate 8.6: Proposed location of Menlo Castle artificial roost structure

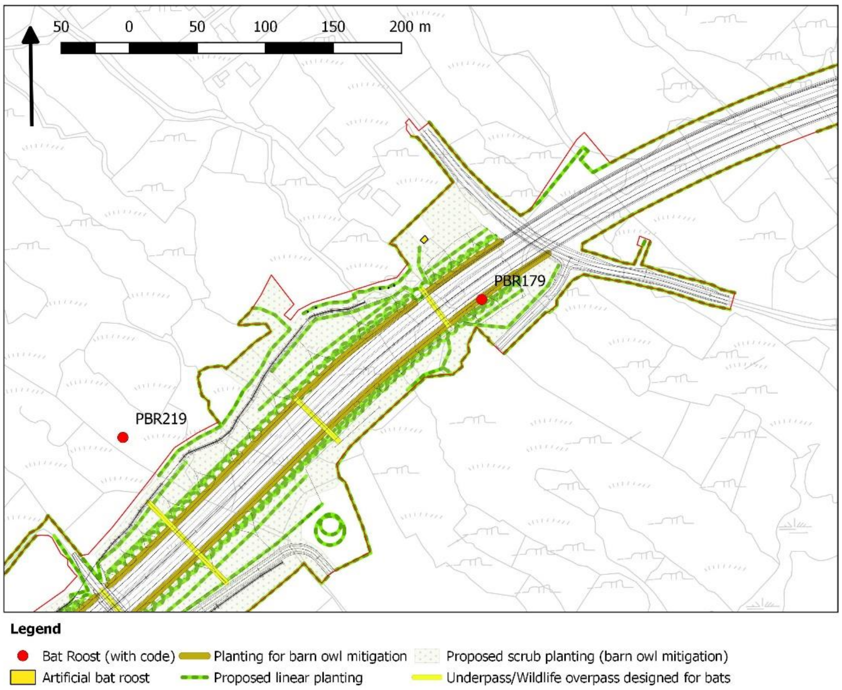


Menlough Woods Replacement Night roost for Lesser horseshoe bats and Soprano pipistrelle and Brown long-eared bats roosts

This is to replace a night roost for Lesser horseshoe bats (PBR219) and also replace roosts for Soprano pipistrelle bats (PBR179) and Brown long-eared bats (PBR179). It will be located near the edge of the proposed development boundary west of An Bóthar Nua and will be a simple wooden shed type structure (1m wide, 2.5m high, 2m deep). The footprint will be much smaller than the area indicated below on **Plate 8.7**. The design parameters include:

- Steep pitched slate roof facing southeast
- Plywood "ceiling" with access open hatch 300mm x 300mm for bats
- Access for bats via gap over access door 500mm x 500mm
- Access for birds prevented by installing plywood baffle 1m behind access gap
- Roof lined with BS747 bituminous felt

Plate 8.7: Proposed location of Menlough Woods artificial night roost structure



Ballindooley Night/Day roost for Brown long-eared and Pipistrelle bat and night/day/hibernation roost for Lesser horseshoe bats

This roost is to replace a Lesser horseshoe day/night roost on the N84 Headford Road (PBR and to replace roosts for Pipistrelle and Brown long-eared bats (PBR204, PBR182, PBR196). The structure will be a small block building (e.g. 6m x 8m footprint) with natural slate roof and some external features e.g. Kent bat boxes for use by other bats species.

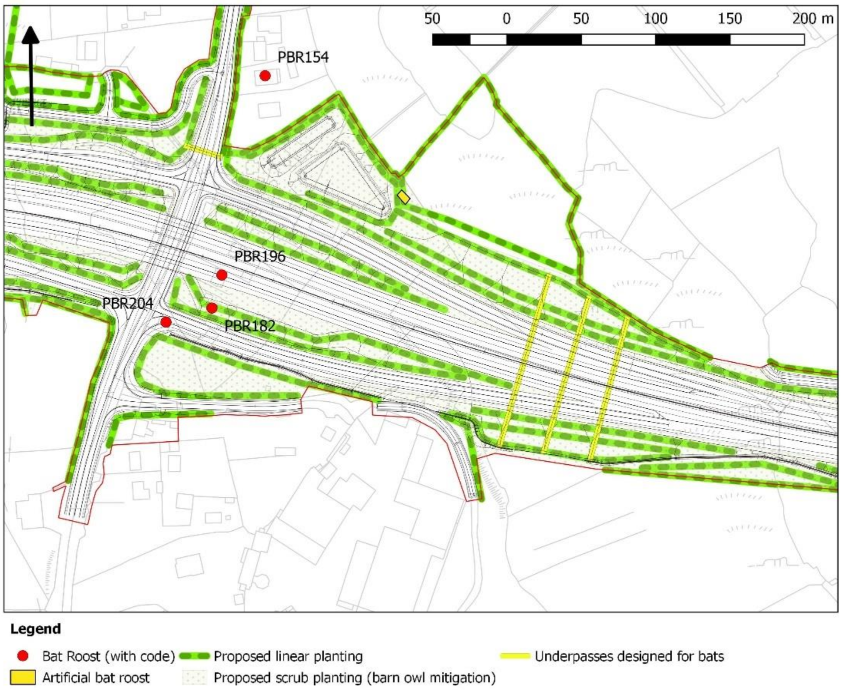
The design parameters include:

- Single storey structure with southwest orientation for maximum solar gain
- Location as set out in **Plate 8.8** below abutting the vegetation for good connections to foraging and shelter
- Rendered block wall structure with natural slate roof and can be clad and designed so as to have no adverse visual impact
- The building would have a footprint in the region of 6m x 8m with a steep pitched slate roof, partition wall in the ground floor and roof space and an attic floor laid down with an open hatch for access for bats[106]
- Plywood partitions may be installed within the roof voids to create bat “hotboxes” and separate roosting spaces for different species
- The interior of the roof should be lined with BS747 bituminous felt

[106] Vincent Wildlife Trust (2015) *Lesser Horseshoe Bat: Conservation Handbook.*

- Entry points for bats shall be on the east facing sides away from the proposed road development and close to the vegetation to the north which will be retained and enhanced
- The northern corner will include a hibernation room at ground level which will be lined with concrete blocks and insulated to provide suitable conditions for hibernation. Plywood partitions will hang down from the ceiling to provide sheltered pockets at ceiling level. An earth floor will maintain humidity and some of the guttering be piped inside to create an optional water-filled trough along one wall so that humidity levels can be adjusted if needed
- No water or electricity services are required
- Access for surveyors will be via a door on the southern side

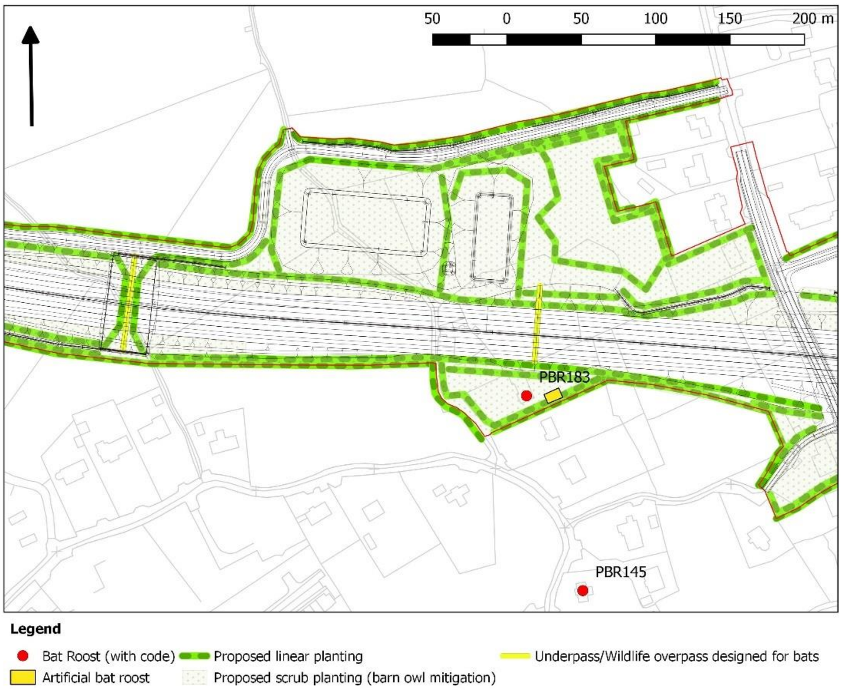
Plate 8.8: Proposed location of Ballindooley artificial night roost structure options



Retrofitting of Existing Structure

At Ch. 12+960 the detached converted garage (next to PBR183) to the south of the proposed road development to be retained and converted for use by several species including Brown long-eared bats and Lesser horseshoe bats. This building is in a strategically-important location as it will connect to the linear planting on the south side of the proposed road development and is just c.250m from the proposed Castlegar Wildlife Overpass in and within a local ecological corridor leading to Cooper's Cave, a proven hibernation and mating site for Lesser horseshoe bats. This structure will undergo minor interior and exterior modifications to create warm areas in the roof space for summer roosting and breeding and also cold conditions for hibernation. **Plate 8.9** shows this location below:

Plate 8.9: Retrofitted roost near PBR183, Castlegar



Bat Boxes

Bat boxes will preferably be located near the roosts to be lost but not immediately adjacent to the proposed road development where risk of collision with vehicles is highest.

Bat boxes will be erected by, or under the supervision of, a bat specialist.

These bat boxes will target Common and Soprano pipistrelle bats and Brown long-eared bats and will consist of Schwegler Type 1FF and 2FN bat boxes (or equivalent) as these have been demonstrated as being successful for these species in Ireland[107]. Mounting boxes on poles close to the edge of tree canopies will also allow the long-term retention of the boxes, as opposed to mounting boxes on small trees which have limited longevity.

A rocket box (as shown in **Appendix A.8.25** - see Drawing GCOB-3000-D-002 in Annex F of the bat derogation licence application) will be installed at Ch. 3+320 near the roost at PBR241, rather than a bat box fixed to the building itself, so as not to detract from its cultural heritage value.

Box locations, as shown on **Figure 8.24.1** to **8.24.15**, will include the following:

- Ch. 3+320: Rocket box to be erected to west of the building PBR241

[107] McAney K. and Hanniffy, R. (2015) *The Vincent Wildlife Trust's Irish Bat Box Schemes* http://www.mammals-in-ireland.ie/wp-content/uploads/2015/11/Ireland-Bat-Box-Project-Report-WEB.pdf

- Ch. 10+050: 5 boxes to be erected along the edge of the tree canopy near the underpass
- Ch. 11+400: 5 boxes to be erected on the entrance road into Lackagh Quarry
- Ch. 15+100: 5 bat boxes to be erected south of Galway Racecourse

In the case of bat boxes provided as replacements for bat tree roosts to be felled, boxes will be Schwegler Type 1F bat boxes (or equivalent) erected on suitable trees or structures retained within the proposed development boundary in the vicinity of the tree to be lost where possible. The type and siting of any bat boxes required will be determined by the bat specialist at that time but preliminary areas for bat boxes have been identified in the areas of woodland around Menlough, Coolough, on retained structures and the quarry walls at Lackagh Quarry and in areas near attenuation and infiltration ponds.

All new roosts, retrofitted structures and bat boxes will be erected in advance of the commencement of site clearance so that replacement roosts are available to bats and that there is reasonable chance that they will have discovered them prior to loss of the existing roost. Boxes can be erected at any time of year and preferably as soon as the necessary consents are in place for the proposed road development.

Protection of proposed artificial roosts during construction works

- Newly-created roosts and bat boxes within the proposed development boundary will be protected from the adverse effects of noise and lighting during the construction phase as it is an essential element of the mitigation strategy that they are accessible and usable by bats during this time
- All existing and proposed artificial roosts retained within the proposed development boundary will be surrounded with wooden panels to a height that allows shading and shelter of key roost access features
- Planting around the existing and proposed artificial roosts retained within the proposed road development will include fast growing shrub species, or fast-growing willow if the ground conditions permit. Planting will aim to guide bats away from the open construction zone toward linear features. Use of non-native species may be appropriate in some locations where it is important to get vegetation established
- All structures will be locked and not used for other purposes such as storage of materials or shelter
- The maintenance of the existing and proposed artificial roosts retained within the proposed development boundary, in a state that they are accessible and usable by bats, will be carried out by the Contractor until the completion of the proposed road development whereby it will be taken in charge by the local authority. Maintenance will include standard building repairs over time and responding to the results of the roost monitoring (e.g. increasing or reducing humidity)

8.9.2.2 Compensation for loss of foraging habitat

Approximately 7ha of woodland-pasture-hedgerow-scrub habitat will be removed from the area between the River Corrib and An Bóthar Nua in Menlough. This habitat is used by the Lesser horseshoe bat population and therefore there is a risk that there may be reduced breeding success if replacement planting is not made available.

An area of land has been identified which is within the known core foraging area of the Menlo Castle roost (PBR06) but is not optimal feeding habitat. It is composed of open fields of varying size used for low density cattle grazing. Hedgerows in this area will be augmented and thickets of hazel, hawthorn, holly and oak will be provided in several of the fields to create pockets of wood and grassland habitat. Grazing will continue on the lands as it has been shown that foraging over grazed land is preferred to ungrazed lands (Downes et al, 2016). Connectivity to foraging areas will also be secured through tying the proposed planting strips to hedgerows and woodland edges.

Planting of new hedgerows in fields between the proposed road development and Menlo Castle will improve the foraging resources of this core foraging area. Such planting will include an additional native hedgerows planted across the existing fields to increase the lengths of hedgerows close to the proposed new roost for Lesser horseshoe bats (refer to **Section 8.6.7.2**). The fields will still be grazed and the hedgerows can be fitted with field gates as required providing gaps are kept to a minimum.

The area of habitat enhancement for the purposes of offsetting the loss of suitable bat habitat due to the proposed road development amounts to approximately 8ha (refer to **Figure 8.24.7**).

8.9.2.3 Proposed Monitoring Programme

The monitoring programme described in **Section 8.6.7.2.3** above also relates to the compensation measures for bats described in this section.

8.9.3 Peregrine falcon

While artificial nest sites for Peregrine falcon can, and have been proven to, be successful, they require suitable cliff face or building of sufficient height at the proposed nest site. However, providing such nest sites does not guarantee that they will be taken up by either the Peregrine pair being displaced or occupied by another breeding pair in the future; particularly when they would likely be remote from the existing site, by at least a few kilometres, due to the topography of the surrounding land and the type and height of building structures nearby. Therefore, the potential loss of a Peregrine falcon nest site associated with the proposed road development cannot be compensated.

8.10 Summary

The proposed road development, despite the implementation of the mitigation and compensation measures proposed, will have the following likely significant residual effects on biodiversity:

- A likely significant residual effect, at the international geographic scale, for the permanent loss of c.0.54ha of the priority Annex I habitat Limestone pavement [*8240]
- A likely significant residual effect, at the national geographic scale, for the permanent loss of c.2.93ha of the Annex I habitat Wet heath [4010][108]
- A likely significant residual effect, at the county geographic scale, for the permanent loss of a Petrifying spring [*7220] feature at Lackagh Quarry
- A likely significant residual effect, at the county geographic scale, for the potential permanent loss of a Peregrine falcon nest site at Lackagh Quarry
- A likely significant residual effect, at the local geographic scale, on all bat species due to the presence of the proposed road development within their foraging areas
- A likely significant residual effect, at the local geographic scale, for the permanent loss of 15 calcareous springs (FP1) at Lackagh Quarry, c.7.81ha of Dry-humid acid grassland (GS3) and c.0.13ha of Poor fen and flush habitat (PF2)

These significant residual impacts will also affect the following local biodiversity areas:

- Coast Road (R336) to the N59 Moycullen Road local biodiversity area

  Residual impact at the national geographic scale for the loss of Wet heath [4010] habitat

  Residual impact at the local geographic scale for the loss of Dry-humid acid grassland (GS3) and Poor fen and flush habitat (PF2) along with impacts on bat species present here

- River Corrib and the Coolagh Lakes local biodiversity area

  Residual impact at the local geographic scale due to impacts on bat species present here

- Menlough to Coolough Hill local biodiversity area

  Residual impact at the international geographic scale for the loss of Limestone pavement [*8240] habitat

  Residual impact at the county geographic scale for the loss of Petrifying springs [*7220] and impact on the Peregrine falcon

[108] As noted in **Table 8.40**, this comprises c.2.13ha of Wet heath dominated habitat and an additional c.0.87ha of habitat mosaic which contains Wet heath.

Residual impact at the local geographic scale from the loss of Calcareous springs (FP1) and along with impacts on bat species present here

- Ballindooley – Castlegar local biodiversity area

  Residual impact at the local geographic scale due to impacts on bat species present here

- Doughiska local biodiversity area

  Residual impact at the international geographic scale for the loss of Limestone pavement [*8240] habitat

  Residual impact at the local geographic scale due to impacts on bat species present here

Although the significant residual effects associated with the losses of Limestone pavement and Wet heath habitat cannot be directly compensated for, areas of related habitats will be created to provide an overall biodiversity gain for both peatland and limestone associated habitats locally. The area of Dry heath habitat being provided is c.7.06ha which is greater than the combined losses of all peatland habitats combined (c.4.78ha). The area of Calcareous grassland habitat being provided is c.7.14ha which is greater than the combined losses of Limestone pavement and Calcareous grassland habitat combined (c.1.24ha).

Table 8.41 presents an overall summary of the ecological receptors, their valuation and potential impacts. It presents the proposed mitigation measures for these potential impacts, the residual impacts, proposed compensation measures where applicable and the overall residual impact significance post-compensation.

Table 8.41: Summary of the Likely Significant Residual Effects of the Proposed Road Development on Biodiversity (post-compensation)

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance	Compensation	Residual Impact Significance Post-compensation
Designated Areas for Nature Conservation							
Lough Corrib cSAC (including Lough Corrib pNHA)	International (National)	**Construction** Habitat loss Habitat degradation – tunnelling/excavation Habitat degradation – hydrogeology Habitat degradation – hydrology Habitat degradation – air quality Habitat degradation – non-native invasive plant species Mortality risk **Operation** Habitat degradation – hydrogeology Habitat degradation – non-native invasive plant species Mortality risk	Likely significant effect at the international geographic scale	see Section 10 of the NIS	No likely significant residual effect		
Galway Bay Complex cSAC (including Galway bay Complex pNHA)	International (National)	**Construction** Habitat degradation – hydrology Habitat degradation – non-native invasive plant species Barrier effect Mortality risk	Likely significant effect at the international geographic scale	see Section 10 of the NIS	No likely significant residual effect		
Lough Corrib SPA (including Lough Corrib pNHA)	International (National)	**Construction** Habitat degradation – hydrogeology Habitat degradation – hydrology Disturbance/displacement **Operation** Habitat degradation – hydrogeology	Likely significant effect at the international geographic scale	see Section 10 of the NIS	No likely significant residual effect		
Inner Galway Bay SPA including Galway bay Complex pNHA)	International (National)	**Construction** Habitat degradation – hydrogeology Habitat degradation – hydrology Disturbance/displacement **Operation** Habitat degradation – hydrogeology	Likely significant effect at the international geographic scale	see Section 10 of the NIS	No likely significant residual effect		
Moycullen Bogs NHA	National	**Construction** Habitat degradation – air quality Habitat degradation – non-native invasive plant species Habitat degradation – hydrology **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the national geographic scale	Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5** Water quality during construction – **Section 8.6.4**	No likely significant residual effect		

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance	Compensation	Residual Impact Significance Post-compensation
Habitats (outside of designated areas for nature conservation)							
Limestone pavement [*8240]	International Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the international geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	Likely significant residual effect at the international geographic scale	No	Likely significant residual effect at the international geographic scale
Petrifying springs [*7220]	International Importance	**Construction** Habitat loss	Likely significant effect at the county geographic scale (see **Section 8.5.4.3** under petrifying springs)	To reduce the scale of habitat loss – see **Section 8.6.2.1**	Likely significant residual effect at the county geographic scale (see **Section 8.7.2**)	No	Likely significant residual effect at the county geographic scale
Calcareous grassland [*6210/6210]	International/National Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the national geographic scale (No *6210 affected – see **Section 8.5.4.3** under Calcareous grassland))	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	Likely significant residual effect at the national geographic scale (see **Section 8.7.2**)	Yes, see **Section 8.9** and **Appendix A.8.26**	No likely significant residual effect
Dry heath [4030]	National Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the national geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	Likely significant residual effect at the national geographic scale (see **Section 8.7.2**)	Yes, see **Section 8.9** and **Appendix A.8.26**	No likely significant residual effect
Wet heath [4010][109]	National Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – groundwater **Operation** Habitat degradation – groundwater	Likely significant effect at the national geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction - **Section 8.6.3** Groundwater during construction and operation – **Section 8.6.5**	Likely significant residual effect at the national geographic scale (see **Section 8.7.2**)	No	Likely significant residual effect at the national geographic scale
Molinia meadow [6410]	National Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation**	Likely significant effect at the national geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction - **Section 8.6.3**	Likely significant residual effect at the national geographic scale (see **Section 8.7.2**)	Yes, see **Section 8.9** and **Appendix A.8.26**	No likely significant residual effect

[109] Including areas of Wet heath/Dry heath/*Molinia* meadow [4010/4030/6410] mosaic

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance	Compensation	Residual Impact Significance Post-compensation
		Habitat degradation – non-native invasive plant species		Groundwater during construction and operation – **Section 8.6.5**			
Residual alluvial forest [*91E0]	International Importance	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the international geographic scale	Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	Likely significant residual effect at the international geographic scale (see **Section 8.7.2**)	Yes, see **Section 8.9** and **Appendix A.8.26**	No likely significant residual effect
Turloughs [*3180]	International Importance	**Construction** Habitat loss Habitat degradation – surface water quality Habitat degradation – groundwater Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – groundwater Habitat degradation – non-native invasive plant species	Likely significant effect at the international geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction - **Section 8.6.3** Water quality during construction – **Section 8.6.4** Groundwater during construction and operation – **Section 8.6.5** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	No likely significant residual effect		
Hard water lakes [3140]	National Importance	**Construction** Habitat degradation – surface water quality (Ballindooley Lough)	Likely significant effect at the national geographic scale	Water quality during construction – **Section 8.6.4**	No likely significant residual effect		
Mesotrophic lakes (FL4) *Part of Ballindooley complex*	County Importance[110]	**Construction** Habitat degradation – surface water quality	Likely significant effect at the county geographic scale	Water quality during construction – **Section 8.6.4**	No likely significant residual effect		
Eutrophic lakes (FL5) *Part of Ballindooley complex*	County Importance[111]	**Construction** Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the county geographic scale	Water quality during construction – **Section 8.6.4** Groundwater during construction – **Section 8.6.5**	No likely significant residual effect		
Calcareous springs (FP1) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat loss	Likely significant effect at the local geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1**	Likely significant residual effect at the local geographic scale	No	Likely significant residual effect at the local geographic scale
Cladium fen [*7210]	International Importance	**Construction** Habitat degradation – surface water quality (Ballindooley Lough)	Likely significant effect at the international geographic scale	Water quality during construction – **Section 8.6.4**	No likely significant residual effect		

[110] On the basis that it forms part of the wetland complex at Ballindooley Lough
[111] On the basis that it forms part of the wetland complex at Ballindooley Lough

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance	Compensation	Residual Impact Significance Post-compensation
Hydrophilous tall herb [6430]	International Importance	(see Lough Corrib cSAC above) **Construction** Habitat degradation – hydrogeology Habitat degradation – hydrology **Operation** Habitat degradation – hydrogeology	Likely significant effect at the international geographic scale	see Section 10 of the NIS	No likely significant residual effect		
Alkaline fens [7230]	National Importance	**Construction** Habitat degradation – surface water quality (Ballindooley Lough)	Likely significant effect at the national geographic scale	Water quality during construction – **Section 8.6.4**	No likely significant residual effect		
Reed and large sedge swamps (FS1) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality	Likely significant effect at the local geographic scale	Water quality during construction – S**ection 8.6.4**	No likely significant residual effect		
Tall-herb swamps (FS2) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect		
Eroding/upland rivers (FW1)	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality	Likely significant effect at the local geographic scale	Water quality during construction – **Section 8.6.4**	No likely significant residual effect		
Depositing/lowland rivers (FW2) River Corrib	International Importance	The River Corrib forms part of see Lough Corrib cSAC (see above and NIS)	Likely significant effect at the international geographic scale	see Section 10 of the NIS	No likely significant residual effect		
Terryland River	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect		
Drainage ditches (FW4)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect		
Marsh (GM1)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect		
Dry calcareous and neutral grassland (GS1) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect		
Dry meadows and grassy verges (GS2) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect		
Dry-humid acid grassland (GS3) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale	Air quality during construction **- Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	Likely significant residual effect at the local geographic scale	No	Likely significant residual effect at the local geographic scale

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance	Compensation	Residual Impact Significance Post-compensation
Wet grassland (GS4) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect		
Rich fen and flush (PF1) Non-Annex I habitat type	County Importance	**Construction** Habitat degradation – surface water quality Habitat degradation – air quality	Likely significant effect at the county geographic scale	Water quality during construction – **Section 8.6.4** Air quality during construction - **Section 8.6.3**	No likely significant residual effect		
Poor fen and flush (PF2) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality **Operation** Habitat degradation – groundwater	Likely significant effect at the local geographic scale	Air quality during construction - **Section 8.6.3**	Likely significant residual effect at the local geographic scale	No	Likely significant residual effect at the local geographic scale
(Mixed) broadleaved woodland (WD1)	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	Likely significant residual effect at the local geographic scale	Yes, see **Section 8.9**	No likely significant residual effect
Mixed broadleaved/conifer woodland (WD2)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect		
(Mixed) conifer woodland (WD3)	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect		
Hedgerows (WL1)	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	Likely significant effect at the local geographic scale	Yes, see **Section 8.9**	No likely significant residual effect
Treelines (WL2)	Local Importance (Higher Value)	**Construction** Habitat loss Habitat degradation – air quality Habitat degradation – non-native invasive plant species **Operation** Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale	To reduce the scale of habitat loss – see **Section 8.6.2.1** Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	Likely significant effect at the local geographic scale	Yes, see **Section 8.9**	No likely significant residual effect

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance	Compensation	Residual Impact Significance Post-compensation
Oak-ash-hazel woodland (WN2) Non-Annex I habitat type	Local Importance (Higher Value)	**Construction** Habitat degradation – air quality Habitat degradation – non-native invasive plant species	Likely significant effect at the local geographic scale	Air quality during construction - **Section 8.6.3** Non-native invasive plant species during construction and operation – **Section 8.6.6** and **Appendix A.7.5**	No likely significant residual effect		
Scrub (WS1) Non-Annex I habitat type	Local Importance (Higher Value)	None	No likely significant effect at any geographic scale	None	No likely significant residual effect		
Fauna Species							
Badger	Local Importance (Higher Value)	**Construction** Loss of breeding/resting sites Disturbance/displacement **Operation** Habitat severance/barrier effect Mortality risk	Likely significant effect at the local geographic scale	Measures to protect Badger during construction – **Section 8.6.7.2.1** Measures to protect Badger during operation – **Section 8.6.7.2.2**	No likely significant residual effect		
Otter	International Importance	**Construction** Habitat degradation - water quality **Operation** Habitat severance/barrier effect Mortality risk	Likely significant effect at the local geographic scale	Measures to protect Otter during construction – **Section 8.6.7.1.1** Measures to protect Otter during operation – **Section 8.6.7.1.2**	No likely significant residual effect		
Other mammal species protected under the Wildlife Acts	Local Importance (Higher Value)	**Construction** Habitat degradation - water quality **Operation** Habitat severance/barrier effect Mortality risk	Likely significant effect at the local geographic scale	Measures to protect other mammal species (excl. bats) during construction – **Section 8.6.7.4.1** Measures to protect other mammal species (excl. bats) during operation – **Section 8.6.7.4.2**	No likely significant residual effect		
Lesser horseshoe bat	National Importance	**Construction** Roost loss Habitat loss Habitat fragmentation Disturbance/displacement **Operation** Mortality Barrier/severance effects Disturbance/displacement	Likely significant effect at the national geographic scale	Measures to protect bats during construction – **Section 8.6.7.2.1** Measures to protect bats during operation – **Section 8.6.7.2.2**	Likely significant effect at the national geographic scale	Yes, see **Section 8.9**	Likely significant residual effect at the local geographic scale
All other bat species	Local Importance (Higher Value)		Likely significant effect at the local geographic scale	Measures to protect bats during construction – **Section 8.6.7.2.1** Measures to protect bats during operation – **Section 8.6.7.2.2**	Likely significant effect at the local geographic scale	Yes, see **Section 8.9**	Likely significant residual effect at the local geographic scale
Marsh whorl snail	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality	Likely significant effect at the local geographic scale	Measures to protect the Marsh whorl snail during	No likely significant residual effect		

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance	Compensation	Residual Impact Significance Post-compensation
		Habitat degradation – groundwater **Operation** Habitat degradation – groundwater		construction – **Section 8.6.8.1.1** Measures to protect the Marsh whorl snail during operation – **Section 8.6.8.1.2**			
Marsh fritillary butterfly	County Importance	**Construction** Mortality risk	Likely significant effect at the local geographic scale	Measures to protect the Marsh fritillary butterfly during construction – **Section 8.6.8.2.1**	No likely significant residual effect		
SCI bird species	International	*see Lough Corrib SPA and Inner Galway Bay SPA above*	Likely significant effect at the international geographic scale	see Section 10 of the NIS	No likely significant residual effect		
Barn owl	County Importance	**Operation** Mortality risk	Likely significant effect at the county geographic scale	Measures to protect breeding birds during operation – **Section 8.6.9.1.2**	No likely significant residual effect		
Peregrine falcon	County Importance	**Construction** Loss of nest site Disturbance/displacement **Operation** Disturbance/displacement	Likely significant effect at the county geographic scale	Measures to protect breeding birds during construction – **Section 8.6.9.1.1** Measures to protect breeding birds during operation – **Section 8.6.9.1.2**	Likely significant residual effect at the county geographic scale	No	Likely significant residual effect at the county geographic scale
All other breeding bird species (non SCI)	Local Importance (Higher Value)	**Construction** Mortality risk Disturbance/displacement **Operation** Mortality risk Disturbance/displacement	Likely significant effect at the local geographic scale	Measures to protect breeding birds during construction – **Section 8.6.9.1.1** Measures to protect breeding birds during operation – **Section 8.6.9.1.2**	No likely significant residual effect		
All other wintering bird species (non-SCI)	Local Importance (Higher Value)	**Construction** Disturbance/displacement (Ballindooley Lough) Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the local geographic scale	Measures to protect wintering birds during construction – **Section 8.6.9.2.1** Measures to protect wintering birds during operation – **Section 8.6.9.2.2**	No likely significant residual effect		
Smooth newt Common frog	Local Importance (Higher Value)	**Construction** Habitat loss Disturbance & mortality risk Habitat degradation – surface water quality **Operation** Habitat severance/barrier effect	Likely significant effect at the local geographic scale	Measures to protect amphibians during construction – **Section 8.6.10.1** Measures to protect amphibians during operation – **Section 8.6.10.2**	No likely significant residual effect		
Common lizard	Local Importance (Higher Value)	**Construction** Habitat loss Disturbance & mortality risk **Operation**	Likely significant effect at the local geographic scale	Measures to protect reptiles during construction – **Section 8.6.11.1**	No likely significant residual effect		

Ecological Receptor	Ecological Valuation (after National Roads Authority, 2009)	Impacts with the Potential to result in Likely Significant Effects	Potential Impact Significance	Mitigation Measures	Residual Impact Significance	Compensation	Residual Impact Significance Post-compensation
		Habitat severance/barrier effect		Measures to protect reptiles during operation – **Section 8.6.11.2**			
Atlantic salmon European eel	International Importance	**Construction** Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the local geographic scale	Measures to protect fish species during construction – **Section 8.6.12.1**	No likely significant residual effect		
All other fish species recorded	Local Importance (Higher Value)	**Construction** Habitat degradation – surface water quality Habitat degradation – groundwater	Likely significant effect at the local geographic scale	Measures to protect fish species during construction – **Section 8.6.12.1**	No likely significant residual effect		
Local Biodiversity Areas							
Local biodiversity areas	The value of the biodiversity receptors recorded in the vicinity of the proposed road development, across the local biodiversity areas, range from Local Importance (Lower Value) to Internationally Important	Combinations of all of the potential impacts noted above The specific impacts are related to and dependent upon the potential impacts of the proposed road development on each of the individual ecological receptors that make up the biodiversity resource within a given local biodiversity area	Likely significant effects from local up to the international geographic scale	All of the mitigation measures included within **Section 8.6** The specific mitigation measures are related to and dependent upon the potential impacts of the proposed road development on each of the individual ecological receptors that make up the biodiversity resource within a given local biodiversity area	Likely significant effects from local up to the international geographic scale Refer to **Section 8.7.10** for breakdown by local biodiversity area	Yes, see **Section 8.9.1** for habitats and **Section 8.9.2** for bats	Yes, see **Section 8.10** for details

8.11 References

Abbott I.M., Butler F. and Harrison S. (2012a) *When flyways meet highways - The relative permeability of different motorway crossing sites to functionally diverse bat species*. Landscape and Urban Planning 106, 293-302.

Abbott I.M., Harrison S. and Butler F. (2012b). *Clutter-adaptation of bat species predicts their use of under-motorway passageways of contrasting sizes – a natural experiment.* Journal of Zoology 287, 124-132.

Abbott, I. M. (2012c) *Assessment of the effectiveness of mitigation measures employed on Irish national road schemes for the conservation of bats***.** PhD thesis, University College Cork, Ireland.

Anderson, R. (2005) An annotated list of the non-marine mollusca of Britain and Ireland. *Journal of Conchology 38,* 607-638.

A.P. McCarthy Planning Consultants. (2007a) *Environmental Impact Statement – Park & Ride Facility NUI Galway.*

A.P. McCarthy Planning Consultants. (2007b) *Environmental Impact Statement – Proposed New Engineering Building at The National University of Ireland, Galway*.

Arup. (2016) *N6 Galway City Transport Project: Route Selection Report*.

Bailey, M. and Rochford J. (2006) Otter Survey of Ireland 2004/2005. *Irish Wildlife Manuals, No. 23*. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Barron, S.J., Daly, O.H., Seale, E.G. & Brophy, J.T. (2013) *Galway City Outer Bypass Marsh Fritillary Survey Report*. Unpublished Report by BEC Consultants Ltd.

Bat Conservation Trust. (2016) *Core Sustenance Zones: Determining zone size.* http://www.bats.org.uk/data/files/Core_Sustenance_Zones_Explained_-_04.02.16.pdf

Benítez-López, A., Alkemade, R. & Verweij, P. (2010) The impacts of roads and other infrastructure on mammal and bird populations: A meta-analysis. *Biological Conservation 143* (2010) 1307–1316.

Berthinussen, A. & Altringham, J. (2012a) Do bat gantries and underpasses help bats cross roads safely? PLoS ONE, 7.

Berthinussen, A. & Altringham, J. (2012b) The effect of a major road on bat activity and diversity. Journal of Applied Ecology, 49: 82–89.

Berthinussen, A. & Altringham, J. (2015) *WC1060 Development of a Cost-Effective Method for Monitoring the Effectiveness of Mitigations for Bats crossing linear transport infrastructure. Final report 2015*. School of Biology, University of Leeds, Leeds.

Betzholtz, P.E., Ehrig, A., Lindeborg, M. & Dinnétz, P. (2007) Food plant density, patch isolation and vegetation height determine occurrence in a Swedish metapopulation of the marsh fritillary *Euphydryas aurinia* (Rottemburg, 1775) (Lepidoptera, Nymphalidae). *Journal of Insect Conservation* 11:343–350.

Bignal, K., Ashmore, M. & Power, S. (2004) *The Ecological Effects of Diffuse Air Pollution from Road Transport*. English Nature.

Billington G. (2001-2006) *A487 Llanwnda to South Llanllyfni Improvement. Bat Surveys*. Greena Ecological Consultancy, Devon UK.

Bontadina, F., Schofield H. and Naef-Daenzer B. (2002) Radio-tracking reveals that lesser horseshoe bats (Rhinolophus hipposideros) forage in woodland. J. Zool., Lond. 258, 281-290

Britschgi A., Theiler A. and Bontadina F. (2004) *Wirkungskontrolle von Verbindungsstrukturen. Teilbericht innerhalb der Sonderuntersuchung zur Wochenstube der Kleinen Hufeisennase* in Friedrichswalde-Ottendorf /Sachsen.

Browne, A., Connolly, K., McDonnell, R, Peppiatt, C., Springer, S, Williams, C. & Fuller, J. (2009) *The Barna Woods Project, Biodiversity Report*. Galway City Council.

Browne, A. & Fuller, J. (2009) *Merlin Park Woodland Habitat Survey and Management Plan*. Galway City Council.

Bulman, C. R. (2001) *Conservation biology of the marsh fritillary butterfly*, Euphydryas aurinia. PhD, University of Leeds, U.K.

Butchkowski, C. M., and J. M. Hassinger. (2002). *Ecology of a maternity colony roosting in a building.* Pp. 130–142, in The Indiana bat: biology and management of an endangered species (A. Kurta and J. Kennedy, eds.). Bat Conservation International, Austin, Texas, 253 pp.

Byrne, A., Moorkens, E.A., Anderson, R., Killeen, I.J. & Regan, E.C. (2009) *Ireland Red List No. 2 – Non-Marine Molluscs*. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

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

The Central and Regional Fisheries Board. (2009) *Corrib Estuary: Sampling Fish for the Water Framework Directive – Transitional Waters 2008.*

CIEEM. (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition. Chartered Institute of Ecology and Environmental Management, Winchester.

Capo G.J. J. Chaut and A. Laurent. (2006). *Quatre ans d'etude de mortalite des Chiropteres sur deux kilometres routiers proches d'un site d'hibernation. [Four years of bat mortality study along two kilometres of road near to a hibernation site]*. Symbioses 15:45–46.

Carr LW, Fahrig L. (2001) *Impact of road traffic on two amphibian species of different vagility*. Conservation Biology 15, 1071-1078.

Choquene, G. L. (2006) *Mortalité de chauves-souris suite à des collisions avec des véhicules routiers en Bretagne.* [Mortality of bats due to collisions with road vehicles in Brittany]. *Symbioses*, 15: 43–44.

Colhoun, K. & Cummins, S. (2013) Birds of Conservation Concern in Ireland 2014-2019. *Irish Birds 9*:523-544.

Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London. ISBN-13 978-1-872745-96-1

Crushell, P. & Foss, P. (2014a) Coolagh Lakes, Lough Corrib SAC, Co. Galway: Wetland Survey and Conservation Assessment. Report prepared on behalf of Wetland Surveys Ireland Ltd. for BEC Consultants Ltd. Unpublished Report.

Crushell, P. & Foss, P. (2014b) Coolanillaun Bog, Lough Corrib SAC, Co. Galway: Wetland Survey and Conservation Assessment. Report prepared on behalf of Wetland Surveys Ireland Ltd. for BEC Consultants Ltd.

Cutts, N. Phelps, A. & Burdon, D. (2009) *Construction and Waterfowl: Defining Sensitivity, Response, Impacts and Guidance*. Report prepared by the Institute of Estuarine and Coastal Studies University of Hull for Humber INCA.

Department of the Environment, Heritage and the Gaeltacht. (2011) *Threat Response Plan Otter* Lutra lutra *2009-2011*.

Dodd, C. K., Jr., W. J. Barichivich, and L. L. Smith. 2004. *Effectiveness of a barrier wall and culverts in reducing wildlife mortality on a heavily traveled highway in Florida.* Biological Conservation, 118: 619–631.

Dolan L. (2006) Monitoring of wildlife crossing structures on Irish national road schemes. IN: *Proceedings of the 2005 International Conference on Ecology and Transportation*, Eds. Irwin CL, Garrett P, McDermott KP. Centre for Transportation and the Environment, North Carolina State University, Raleigh, NC: p. 608. (Abstract).

Downes, N.C., Cresswell, W., Reason P., Sutton, G. Wells, D., and Wray, S. (2016). *Sex-Specific Habitat Preferences of Foraging and Commuting Lesser Horseshoe Bats Rhinolophus hipposideros (Borkhausen, 1797) in Lowland England.* Acta Chiropterologica 18, 451-465.

Eldridge, B. & Wynn, J. (2011) Use of badger tunnels by mammals on Highways Agency schemes in England. *Conservation Evidence 8*. Pages 53-57.

Elmeros M. and Dekker J. (2016) SafeBatPaths. Fumbling in the dark - effectiveness of bat mitigation measures on roads: Final report.

Elmeros M., Dekker, J., Garin, I. Christensen, M. Fjederholt E.T., Moller J., Baagoe, J. (2016) *Bat mitigation measures on roads – a guideline: Fumbling in the dark – effectiveness of bat mitigation measures on roads.* CEDR Transnational Road Research Programme. Conference of European Directors of Roads.

Environmental Protection Agency. (2002) *Guidelines on the Information to be contained in Environmental Impact Statements*.

Environmental Protection Agency. (2003) *Advice Notes on Current Practice in the Preparation of Environmental Impact Statements*.

Environmental Protection Agency. (2015) *Advice notes for Preparing Environmental Impact Statements* (Environmental Protection Agency. Draft, September 2015.

Environmental Protection Agency. (2017) *Guidelines on the information to be contained in Environmental Impact Assessment Reports*. Draft, August 2017.

European Commission. (2017) *Environmental Impact Assessment of Projects, Guidance on the preparation of the Environmental Impact Assessment Report*.

European Union. (2013) *Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment*.

Fowles, A. & Smith, R. (2006) Mapping the habitat quality of patch networks for the marsh fritillary Euphydryas aurinia (Rottemburg, 1775) (Lepidoptera, Nymphalidae) in Wales. *Journal of Insect Conservation 10*:161–177.

Fossitt, J.A. (2000) *A guide to habitats in Ireland*. Heritage Council, Kilkenny, Ireland.

Galway County Council. (2007) *Coastal Habitat Study for Bearna*.

Galway County Council/Roscommon National Roads Design Office. (2011) *N59 Maigh Cuilinn (Moycullen) Bypass Road Project Environmental Impact Statement*.

Galway Harbour Company. (2014) *Galway Harbour Extension Environmental Impact Statement*.

Goodwillie, R. (1992) *Turloughs over 10 ha: vegetation survey and evaluation.* A report for the National Parks and Wildlife Service.

Glista, D. J., and T. L. DeVault. (2008) Road mortality of terrestrial vertebrates in Indiana. *Proceedings of the Indiana Academy of Science*, 117: 55–62.

Haigh, A. (2012) Annual patterns of mammalian mortality on Irish roads. *Hystrix, the Italian Journal of Mammalogy*. Volume 23 (2): 58–66, 2012.

Hardy, J, Crick, H., Wernham, C., Ruiley, H., Etheridge, B. & Thompson, D. (2009) Raptors: A Field Guide for Surveying and Monitoring (2nd Edition).

Hein, C. D., S. B. Castleberry, and K. V. Miller. (2009) *Site-occupancy of bats in relation to forested corridors.* Forest Ecology and Management, 257: 1200–1207.

Highways Agency. (2001a) *Design Manual for Roads and Bridges: Volume 10: Environmental Design and Management. Section 4: Nature Conservation: Part 3, HA 80/99; Nature Conservation Advice in Relation to Bats*. The Highways Agency.

Highways Agency. (2001b) *Design Manual for Roads and Bridges: Volume 10: Environmental Design and Management. Section 4: Nature Conservation: Part 4,* *HA 81/99; Nature Conservation Advice in Relation to Otters.* The Highways Agency.

Highways Agency. (2005) *Design Manual for Roads and Bridges: Volume 10: Environmental Design and Management. Section 4: Nature Conservation: Part 7, HA 116/05; Nature Conservation Advice in Relation to Reptiles and Roads*. The Highways Agency.

Hula, V., Konvicka, M., Pavlicko, A. & Fric, Z. (2004) Marsh Fritillary (*Euphydryas aurinia*) in the Czech Republic: monitoring, metapopulation structure, and conservation of an endangered butterfly. *Entomologica Fennica* Volume 15:231-241.

IFI. (2010) IFI's Biosecurity Protocol for Field Survey Work.

IFI. (2016) Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters.

Irish Wildlife Trust. (2012) *Cork City Urban Otter Survey 2011-2012*. Irish Wildlife Trust.

Kelleher C. and Marnell F. (2006) *Bat Mitigation Guidelines for Ireland*. National Parks and Wildlife Service.

Lande R. (1987) *Extinction thresholds in demographic models of territorial populations*. American Naturalist 130, 624-635.

Lesiński G. (2007) *Bat road casualties and factors determining their number.* Mammalia 20, 138-142.

Luo, J., Siemers, I. M., and Kosel, K. (2015) *How anthropogenic noise affects foraging.* Global Change Biology 21: 3278-3289.

McAney, K. (2010) *A pilot study to test the use of hair tubes to detect the Irish stoat along hedgerows in County Galway.* The Vincent Wildlife Trust.

McCarthy, Keville and O'Sullivan. (2009a) *Environmental Impact Statement - Translational Research Facility/Clinical Research Facility, University Hospital Galway Campus, Lower Newcastle Road, Galway*.

McCarthy, Keville and O'Sullivan. (2009b) *Environmental Impact Statement – Science Research Building*.

McCarthy, Keville and O'Sullivan. (2011) *Natura Impact Statement - Proposed Development at Liam Mellows GAA. Ballyloughmane, Renmore, Co. Galway*.

McCarthy, Keville and O'Sullivan. (2014a) *Ecological Impact Assessment & Natura Impact Statement, Proposed 3G All Weather Pitches NUI Galway, Dangan, Galway*.

McCarthy, Keville and O'Sullivan. (2014b) *Bat Survey of the NUIG Sports Facilities at Dangan, Co. Galway*.

Mitchell-Jones A. J., and McLeish A. P. (1999) *The Bat Workers' Manual, 2nd Edition*. Joint Nature Conservation Committee.

Mooney, E. & O'Connell, M. (1990) The phytosociology and ecology of the aquatic and the wetland plant communities of the Lower Corrib Basin, Co. Galway. *Proceedings of the Royal Irish Academy 90B* (5).

Moore Group Environmental Services. (2011) *Ecological Impact Assessment & Natura Impact Statement NUI Galway Life Course Studies Building, Corrib Village, Upper Newcastle, Galway*.

Moorkens, E. (2014a) *A Survey of Selected Rivers for the Galway City Transport Project with Potential for* Margaritifera.

Moorkens, E. (2014b) *A Molluscan Survey of Selected Wetland Sites for the Galway City Transport Project*.

Murnane, E., Heap, A. & Swain, A. (2006) *CIRIA C648: Control of water pollution from linear construction projects: Site guide*.

National Parks & Wildlife Service. (2007a) Circular Letter NPWS 2/07 Guidance on compliance with Regulation 23 of the Habitats Regulations 1997 – strict protection of certain species/applications for derogation licences.

National Roads Authority. (2005) *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes*.

National Roads Authority. (2006a) *Guidelines for the Treatment of Badgers during the Construction of National Road Schemes*.

National Roads Authority. (2006b) *Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes*. National Roads Authority.

National Roads Authority. (2008a) *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes*. National Roads Authority.

National Roads Authority. (2008b) *Environmental Impact Assessment of National Road Schemes – A Practical Guide*. National Roads Authority.

National Roads Authority. (2008c) *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes*.

National Roads Authority. (2009) *Guidelines for Assessment of Ecological Impacts of National Roads Schemes: Revision 2*. National Roads Authority.

National Roads Authority. (2010) *Guidelines on the Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads*.

National Roads Authority. (2014) *Good Practice Guideline for the Treatment of Noise during the planning of National Road Schemes*.

Natura Environmental Consultants. (2005) *Galway City Habitat Inventory*. Galway City Council.

Natura Environmental Consultants. (2012) *Galway City Council Ardaun Local Area Plan Habitat Assessment*.

NPWS. (2007b) Circular Letter PD 2/07 and NPWS 1/07 Compliance Conditions in respect of Developments requiring (1) Environmental Impact Assessment (EIA); or (2) having potential impacts on Natura 2000 sites.

NPWS. (2010) Circular NPW 1/10 & PSSP 2/10 Appropriate Assessment under Article 6 of the Habitats Directive: Guidance for Planning Authorities.

NPWS. (2013a). *The Status of EU Protected Habitats and Species in Ireland. Overview Volume 1*. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland. Editor: Deirdre Lynn.

NPWS. (2013b) *The Status of EU Protected Habitats and Species in Ireland. Habitat Assessments Volume 2. Version 1.1.* Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

NPWS. (2013c) The Status of EU Protected Habitats and Species in Ireland. Species Assessments Volume 3. Version 1.0. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

NPWS. (2013d) *Inner Galway Bay Special Protection Area (Site Code 4031), Conservation Objectives Supporting Document, Version 1*.

O'Grady, M. F. (2006) *Channels & Challenges. Enhancing Salmonid Rivers*. Irish Freshwater Fisheries Ecology & Management Series: Number 4. Central Fisheries Board, Dublin, Ireland.

O'Neill, F.H. & Barron, S.J. (2013) Results of monitoring survey of old sessile oak woods and alluvial forests. Irish Wildlife Manuals, No. 71. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

O'Neill, F.H. & Barron, S.J. (2015) Galway City Transport Project: *Report on the presence of Annex I habitat *7220 Petrifying springs with tufa formation*. Unpublished report by BEC Consultants Ltd.

O'Neill, F.H. & Martin, J.R. (2015). *Summary of findings from the Survey of Potential Turloughs 2015*. Unpublished Report for National Parks & Wildlife Service. Volume I: Main Report.

O'Neill, F.H., Martin, J.R., Devaney, F.M. & Perrin, P.M. (2013) The Irish semi-natural grasslands survey 2007-2012. *Irish Wildlife Manuals*, No. 78. National Parks and Wildlife Service, Dublin.

Perrin, P.M., Barron, S.J., Roche, J.R. & O'Hanrahan, B. (2014). Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland. Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Perrin, P.M. (2014) *Galway City Transport Plan – Assessment of Annex I habitats in the Ballygarraun survey area*. Unpublished Report by BEC Consultants Ltd.

Ramsden, D. (2003) *Barn Owls and major roads: results and recommendations from a 15-year research project*. Ashburton, Devon: The Barn Owl Trust.

Rees, E., Bruce, J. & White, G. (2005) Factors Affecting the Behavioural Responses of Whooper Swans (*Cygnus c. cygnus*) to Various Human Activities. *Biological Conservation 121* (2005) 369–382.

Regan, E.C., Nelson, B., Aldwell, B., Bertrand, C., Bond, K., Harding, J., Nash, D., Nixon, D., & Wilson, C.J. (2010) *Ireland Red List No. 4 – Butterflies*. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Ireland.

Reijnen, R. & Foppen, R. (2006) John Davenport and Julia L. Davenport, (eds.,) *The Ecology of Transportation: Managing Mobility for the Environment*, 255–274.

Reiter, G., Polzer, E., Mixanig, H., Bontadina, F., and Huttmeir, U. (2012) *Impact of landscape fragmentation on a specialised woodland bat, Rhinolophus hipposideros.* Mammalian Biology - Zeitschrift fur Saugetierkunde · December 2012.

Rich, C. & Longcore, T. (eds.) (2005) *Ecological Consequences of Artificial Night Lighting*. Island Press.

Roche, N., Aughney T. and Langton S. (2015) Lesser horseshoe bat: population trends and status of its roosting resource. Irish Wildlife Manuals, No. 85. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Ireland.

Roden, C. (2005) *Pseudorchis albida at Doughiska, Galway City – Report of a search in May-June 2005*.

RPS. (2006) *N6 Galway City Outer Bypass. Environmental Impact Statement.* Galway County Council and Galway City Council.

RPS. (2012a) *Flora and Habitat Survey Proposed R336 to N59 Road Scheme, Co. Galway*. Unpublished Report by RPS Planning & Environment Ltd.

RPS. (2012b) *R336 to N59 Road Scheme, Co. Galway Marsh Fritillary Survey Report*. Unpublished Report by RPS Planning & Environment Ltd.

RPS. (2013a) *R336 to N59 Road Scheme, Co. Galway Bat Survey Report*. Unpublished Report by RPS Planning & Environment Ltd.

RPS. (2013b) *R336 to N59 Road Scheme, Co. Galway Mammal Survey Report*. Unpublished Report by RPS Planning & Environment Ltd.

RPS. (2013c) *R336 to N59 Road Scheme, Co. Galway Wintering Bird Survey Report*. Unpublished Report by RPS Planning & Environment Ltd.

Russell A.L., Butchkoski C.M., Saidak L., McCracken G.F. (2009) *Road-killed bats, highway design, and the commuting ecology of bats.* Endangered Species Research 8, 49-60.

Shiel, C.B., Shiel, R.E., & Fairley, J.S. (1999) Seasonal changes in the foraging behaviour of Leisler's bats (*Nyctalus leisleri*) as revealed by radio-telemetry. Journal of Zoology: 249: 347-358.

Sparks, D.W., & Choate J.R. (2000) *Distribution, natural history, conservation status, and biogeography of bats in Kansas*. Pages 173–228 in J.R. Choate, editor, Reflections of a naturalist: papers honoring Professor Eugene D. Fleharty. Fort Hays Studies, Special Issue 1, Hays, Kansas.

Summers, P., Cunnington, G. & Fahrig, L. (2011) Are the negative effects of roads on breeding birds caused by traffic noise? *Journal of Applied Ecology* 2011, 48, 1527–15.

The Environment Agency. (2010) *Fifth Otter Survey of England 2009-2012*. Full Technical Report. The Environment Agency, U.K.

Toner, P., Bowman, J., Clabby, K., Lucey, J., McGarrigle, M., Concannon, C., Cleneghan, C., Cunningham, P., Delaney, J., O' Boyle, S., McCarthaigh, M., Craig, M. & Quinn, R. (2005) Water Quality in Ireland, 2001–2003. Environmental Protection Agency, Co. Wexford, Ireland.

Waldren, S. (Ed.) (2015) Turlough Hydrology, Ecology and Conservation. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Warren, M.S. (1994) The UK status and suspected metapopulation structure of a threatened European butterfly, the marsh fritillary *Eurodryas aurinia*. *Biological Conservation 67*:239–249.

West E.W.W. (2016) *Technical Guidance for the Assessment and Mitigation of the Effects of Traffic Noise and Road Construction Noise on Bats.* CALTRANS.

Whitaker, J. O., Jr., and R. E. Mumford. (2009) *Mammals of Indiana.* Indiana University Press, Bloomington, Indiana, 661 pp.

Wilson, S. and Fernández, F. (2013) National survey of limestone pavement and associated habitats in Ireland. *Irish Wildlife Manuals*, No. 73. National Parks & Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

With K.A., King A.W. (1999) *Extinction thresholds for species in fractal landscapes*. Conservation Biology 13, 314-326.

Wright, M., Goodman, P & Cameron, T. (2010) Exploring Behavioural Responses of Shorebirds to Impulsive Noise. *Wildfowl* (2010) 60: 150–167.

Zimmermann, K., Fric, Z., Jiskra, P., Kopeckova, M., Vlasanek, P., Zapletal, M. & Konvicka, M. (2011) Mark–recapture on large spatial scale reveals long distance dispersal in the Marsh Fritillary, *Euphydryas aurinia*. *Ecological Entomology*, 36, 499–510.

Zurcher A.A., Sparks D.W., Bennett V.J. (2010) *Why the bat did not cross the road?* Acta Chiropterologica, 12, 337-340