Response to Queries raised in Module 1* of the N6 Galway City Ring Road

Oral Hearing

by

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* *During the presentation of this document at the oral hearing the title was corrected to "Reponses to Queries raised in Module 2 of the N6 Galway City Rind Road Oral Hearing". This has been corrected in the header of this report also. A footnote has also been added to page 33 of this document to also deal with a typographical error on that page that was pointed out at the Oral Hearing.*

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1 Biodiversity

1.1 Department of Culture, Heritage and the Gaeltacht – Barn Owl Foraging Habitat

The Department of Culture Heritage and the Gaeltacht (DCHG) queried whether the proposed road development would result in a net loss or a net gain in barn owl foraging habitat.

Optimal foraging habitat for barn owls includes edge habitats associated with treelines, hedgerow and woodland edge, rough grassland and wetland habitat, and heathland habitat. The foraging range of barn owl from the nest site can be up to 5km and this is the distance used to calculate the barn owl habitat losses and gains associated with the proposed road development. The only barn owl nest within 5km of the proposed road development is at Menlo Castle.

Within 5km of the nest site at Menlo Castle, approximately 40.6km of linear edge habitat is being lost and c.5.8ha of rough grassland/heathland habitat. Applying a 1m grass verge estimate to that 40.6km of linear edge habitat equates to an area of c.4.1ha of grassland margin. Therefore, the total estimate of barn owl habitat loss is approximately 9.9ha.

The commitment provided in the Schedule of Environmental Commitments (SoCs) with regard to grassland management for barn owl is as follows:

> "An unmanaged grass margin (at least 1m in width) will be retained along all field boundaries in the area of habitat to be retained that lies to the north-west of the proposed road carriageway at Menlo Castle."

In the area surrounding Menlo Castle, which is to be retained and enhanced, that proposal would result in the creation of c.6.1km linear length of edge habitat which equates to c.0.61ha of unmanaged grassland habitat for barn owl.

Following the NPWS's query on Tuesday 25 February 2020 at the oral hearing, an enhanced alternative approach was discussed with John Lusby (BirdWatch Ireland) to manage the entirety of the c.8ha of grasslands at Menlo Castle, currently proposed for bat habitat enhancement, for barn owl habitat (Plate 1 of Aebhin Cawley's Biodiversity EIA Statement of Evidence). This would involve grazing the area for a three-month period between July and October by cattle at a stocking rate of 0.35 livestock units/ha (i.e. using c.11 cattle). This revised approach to barn owl habitat creation would result in c.8ha of low intensity managed farmland habitat which would offer a greater benefit to the local barn owl population than the current proposal. It is now proposed to adopt this enhanced approach, and this will result in a gain of c.8ha of barn owl habitat at this location.

The strategy, and prescribed stocking density, follows that used by the Barn Owl Conservation Trust at their Nature Reserve in the UK, as detailed in the *Barn Owl Conservation Handbook* (Barn Owl Trust, 2012).

It is also important to note that this type of low-intensity grassland management is compatible with the lesser horseshoe bat mitigation strategy, which also requires low intensity grazing as part of the proposed habitat enhancement measures.

The Schedule of Environmental Commitments will be updated to replace the existing grassland management commitment with the following:

> "To establish and maintain rough grassland habitat for barn owl, lands to the west of the proposed road development at Menlo Castle (Plate 1 of Aebhin Cawley's Biodiversity EIA Statement of Evidence) will be grazed annually by cattle for a three month period between July and October at a stocking rate of 0.35 livestock units/ha.
>
> Annual monitoring of the grassland habitat will be undertaken for a period of 5 years post-implementation with the objective of recording the establishment of suitable rough grassland habitat and adjustment of the stocking density, if required."

In addition to the proposed grassland management regime to improve barn owl habitat in the vicinity of the nest site at Menlo Castle, c.1.81ha of Calcareous grassland [6210] habitat will be created as part of the mitigation strategy to address the losses of this Annex I habitat associated with the proposed road development. Calcareous grassland habitat will be created at receptor sites 6210.R1 and 6210.R2, as shown on Figure 7 of Appendix B to Aebhín Cawley's Biodiversity EIA Statement of Evidence. This will also improve the quality of barn owl habitat in the immediate vicinity of Menlo Castle as these fields are not currently managed as high-quality barn owl grassland habitat.

Furthermore, and also as part of the mitigation strategy to address the losses of Annex I habitat associated with the proposed road development, c.1.95 of Dry heath habitat will be created within 5km of Menlo Castle (i.e. within the foraging range of the nest site there). Dry heath habitat will be created at receptor sites 4030.R18, 4030.R19, 4030.R20 and 4030.R21, as shown on Figures 5 and 6 of Appendix B to Aebhín Cawley's Biodiversity EIA Statement of Evidence. This will result in a gain of c.1.95ha of barn owl habitat.

Thus the Schedule of Environmental Commitments will be updated as stated above.

In conclusion, whilst the proposed road development will result in an estimated loss of c.9.9ha of barn owl habitat within 5km of the Menlo Castle nest site, the creation of: (i) c.8ha of rough grassland habitat at Menlough (by applying the revised cattle grazing approach); (ii) c.1.81ha of Calcareous grassland habitat at Menlough; and (iii) c.1.95ha of Dry heath habitat west of the River Corrib will result in c.11.76ha of barn owl habitat being created/enhanced. This will provide an overall gain of c.1.86ha of barn owl habitat within the foraging range of the Menlo Castle nest site as a result of the proposed road development.

Finally, it is confirmed that this mitigation measure was discussed with the National Parks and Wildlife at a meeting on 27 February 2020 and the query raised regarding Barn owl habitat has been fully addressed as set out above.

1.2 DCHG – Peregrine Falcon

The DCHG queried whether remediation measures could be implemented to improve the condition of the existing Peregrine falcon nesting ledges post-construction.

Following the NPWS's presentation on Tuesday 25 February 2020 at the oral hearing, approaches to remediate the existing peregrine falcon nest ledges in Lackagh Quarry were discussed with John Lusby (BirdWatch Ireland), with a view to addressing, in particular, the issues of (a) existing water logging (from seepages from the rock face behind/above the nest ledge) and (b) disturbance. Mr. Lusby advised the Applicant that the optimal solution to maximise the long-term suitability and viability of the ledges for Peregrine falcon is to install an artificial nest box on each of the two ledges being retained in Lackagh Quarry at the locations of the existing nest sites.

Accordingly, in addition to the existing proposal to install a nest box on Galway City Council owned lands to the south-east of Lackagh Quarry as indicated on drawing GCRR-SK-PP-067 in Appendix A of Aebhín Cawley's statement of evidence, the Schedule of Environmental Commitments will be updated to include for the remediation of the nest ledges and installation of artificial nest boxes, as follows:

> "An artificial peregrine falcon nest box will be installed at each of the two former nest sites in Lackagh Quarry. Remediation works will be carried out at the two ledges to create a level and stable substrate for the nest boxes. The artificial nest boxes will be securely anchored to the cliff face at each location and will be provided in accordance with the design requirements set out in the report prepared by BirdWatch Ireland, the relevant extract from which is contained in Appendix A to this Schedule of Environmental Commitments."

In terms of post-construction monitoring of the artificial nest sites, the Schedule of Environmental Commitments has been updated, as follows, to refer to nest sites in the plural, to capture the three artificial nest boxes now proposed:

> "Use of the artificial nest sites will also be monitored during operation of the proposed road development for a period of three years."

This was discussed with the National Parks and Wildlife at a meeting on 27 February 2020 and the queries raised regarding Peregrine falcon have been fully addressed as set out above.

The DCHG queried whether both, or just one, of the peregrine falcon nesting ledges in Lackagh Quarry were being retained.

In the circumstances set out above, it is confirmed that both of the ledges in the quarry used by peregrine falcon will be retained.

The DCHG queried whether installation of the rock-bolts in a 'sensitive manner' is intended to maintain the nest ledge and/or minimise the potential for construction related disturbance.

The reference to installing rock-bolts in a sensitive manner relates both to (a) ensuring that the existing nesting ledges are retained and not damaged and (b) avoiding disturbance to the nest sites during construction. As per the Schedule of Environmental Commitments, monitoring of Peregrine falcon breeding activity at both Lackagh Quarry and the proposed alternative nest site is already committed to in the Schedule of Environmental Commitments.

The Schedule of Environmental Commitments will be updated to include a commitment that rock-bolts will not be installed in the immediate vicinity of an active peregrine falcon nest site (i.e. where eggs and/or unfledged young are present) during the breeding season, as follows:

> "Rock-bolts will not be installed in the immediate vicinity of an active peregrine falcon nest site during the breeding bird season (1st March to 31st August)."

This was discussed with the National Parks and Wildlife at a meeting on 27 February 2020 and the queries raised regarding Peregrine falcon have been fully addressed as set out above.

1.3 DCHG – Marsh Fritillary Butterfly

Section 8.6.8.2.1 of the EIAR has set out the mitigation for Marsh fritillary butterfly, which includes:

- a pre-construction larval web survey for all habitat suitable to support Marsh fritillary butterfly within the proposed development boundary, during the mid-August to the end of September window immediately preceding site clearance works
- translocation of larval webs to suitable habitat, either outside of the proposed development boundary, or within the proposed development boundary within areas which will be unaffected by construction works
- clearance of vegetation or cutting to ground level to render the area unsuitable for the species to recolonise once larval webs have been removed or if none were found present, and maintaining the vegetation in this unsuitable state until such time as the topsoil is removed

Section 4.7 of Aebhín Cawley's Biodiversity EIA Statement of Evidence, provides further detail on these mitigation measures.

The DCHG has requested additional clarifications as outlined below.

The DCHG requested clarification on the purpose of the marsh fritillary butterfly mitigation strategy.

The purpose of the mitigation measures proposed in relation to the marsh fritillary butterfly during the construction phase is to ensure that marsh fritillary eggs are not

destroyed, and that marsh fritillary caterpillars are not killed, during site clearance works. Whilst the mitigation strategy does not include the creation of habitat areas that will be managed over the long-term specifically for the marsh fritillary butterfly, it should be noted that (as set out below) there are two areas within the proposed development boundary that have been identified as 'suitable marsh fritillary habitat' during the surveys (Figures 8.6.3 and 8.6.5 of the EIAR) which will be retained and maintained for the operational lifetime of the proposed road development.

The DCHG requested more detail on the proposed translocation methodology for moving marsh fritillary larval webs, in particular the receptor sites and short-term management of same.

The larval webs will be moved by translocating vegetation turves which contain the host plant species (*Succisa pratensis*) with larval webs present.

The vegetation turves will be moved to the receptor site(s) immediately following excavation to ensure they do not dry out. The translocated turves will be set into existing vegetation immediately adjacent to the area of *Molinia* meadow and/or Wet heath habitat being retained (locations described below) and will be fenced off to prevent any accidental damage from construction works. Turves will be excavated, transported and handled as per the methodologies referred to in Section 1.4 below. Care will be taken to ensure that any specimens of *Succisa pratensis* with larval webs present will be at the centre of the turves. Turves will be fully bedded in at the receptor site(s) to ensure there are no exposed edges vulnerable to drying out.

There are two locations within the proposed development boundary that are suitable receptor sites for the translocated turves containing the marsh fritillary butterfly larvae.

The first is at Ch. 0+900, an area of wet grassland (GS4)/Annex I *Molinia* meadow [6410] habitat that is being retained within the proposed development boundary (Figure 8.23.1 of the EIAR). This location is a suitable receptor site because:

- It lies within a relatively large habitat patch of c.3ha identified as 'suitable marsh fritillary habitat' during the surveys (Figure 8.6.5 of the EIAR) where larval webs were recorded in 2014 and 2016 and which was recorded as being of 'good quality' marsh fritillary habitat, most of which falls outside of the proposed development boundary and therefore will not be removed.
- The habitat area has remained stable across the survey period (2014 – 2019) in terms of its description and classification, has consistently been recorded as 'good quality' marsh fritillary habitat and is, therefore, likely to have good long-term prospects in terms of habitat type and its condition.
- It lies adjacent to a *Molinia* meadow [6410] habitat creation area and *Succisa pratensis* is one of the species present in the 6410 donor site and is, therefore, a target species in the receptor site that would be expected to establish (6410.R1, see BoE Appendix B, Figure 2 of Aebhín Cawley's Biodiversity EIA Statement of Evidence).

The second is at Ch. 3+000, a mosaic of Annex I Wet heath [4010], wet grassland (GS4) and Annex I Dry heath [4030] habitat that is being retained within the

proposed development boundary (Figure 8.23.3 of the EIAR). This location is a suitable receptor site because:

- The retained habitat patch is above the 0.1ha threshold below which isolated habitat patches would become unusable by the species for breeding
- It was identified as 'suitable marsh fritillary habitat' during the surveys (Figure. 8.6.3 of the EIAR), larval webs were recorded in this area in 2014 and 2016 and it was recorded as being of 'good quality' marsh fritillary habitat
- The habitat area has remained stable across the survey period (2014 – 2019) in terms of its description and classification, was recorded as 'good quality' marsh fritillary habitat and is, therefore, likely to have good long-term prospects in terms of habitat type and its condition
- *Succisa pratensis,* the food plant of the marsh fritillary butterfly larvae, was recorded present in this habitat polygon (refer to three relevés taken in this habitat polygon EC09 R1, EC09 R2 and EC 09 R3 in Annex A.3.2 Relevé Dataset in Appendix A.3.1 of the RFI Response).

In the case of the Wet heath area at Ch. 3+000, this area is already classified as suitable marsh fritillary habitat and will be maintained for the operational lifetime of the proposed road development. The area of *Molinia* meadow [6410] habitat that is being retained at Ch. 0+900 is contiguous with the area of that same habitat being created at the habitat receptor site 6410.R1 which will be subject to the management measures described in Section 4.5 of Appendix A.8.26 of the EIAR. This includes preventing undesirable species establishing (e.g. *Pteridium aquilinum* and *Rubus fruticosus*) and a mowing regime. The condition of the retained area of *Molinia* meadow habitat will be maintained for the lifetime of the proposed road development. Equally, the management measures relating to the area of *Molinia* meadow habitat being created at this location (receptor site 6410.R1), will promote the development of a sward with the target species, including *Succisa pratensis* which is also present in the sward at the donor site, and these management measures will be implemented for the lifetime of the proposed road development.

Thus, as stated above, the Schedule of Environmental Commitments will be updated to substitute the following commitment for the existing translocation of larval webs commitment (page 1804 of Chapter 21 of the EIAR):

- The larval webs will be moved by translocating vegetation turves which contain the host plant species (*Succisa pratensis*) with larval webs present.
- The vegetation turves will be moved to the receptor site(s) immediately following excavation to ensure they do not dry out. The translocated turves will be set into existing vegetation immediately adjacent to the area of *Molinia* meadow and/or Wet heath habitat being retained (locations described below) and will be fenced off to prevent any accidental damage from construction works. Care will be taken to ensure that any specimens of *Succisa pratensis* with larval webs present will be at the centre of the turves. Turves will be fully bedded in at the receptor site(s) to ensure there are no exposed edges vulnerable to drying out.

- The first location is at Ch. 0+900, an area of wet grassland (GS4)/Annex I *Molinia* meadow [6410] habitat that is being retained within the proposed development boundary (Figure 8.23.1 of the EIAR). The second location is at is at Ch. 3+000, a mosaic of Annex I Wet heath [4010], wet grassland (GS4) and Annex I Dry heath [4030] habitat that is being retained within the proposed development boundary (Figure 8.23.3 of the EIAR).

This was discussed with the National Parks and Wildlife at a meeting on 27 February 2020 and the queries raised have been fully addressed as set out above.

1.4 DCHG – Habitat Creation

Following a meeting with the DCHG on 9 March 2020 feedback was received from the DCHG on what they considered to be an ambitious objective of recreating 7 hectares of dry heath given the fact that only 4 hectares of heath is available in the donor sites. In particular the DCHG expressed reservation about the fact that the receptor sites would not be completely covered in turves and portions of the receptor sites would be exposed as bare peat soil, which would have a greater risk of erosion. The DCHG emphasised that in creating receptor habitat the need to achieve habitat quality as opposed to quantity was of paramount importance. Following the feedback received, the receptor sites were re-examined in order to identify the 4 hectares most suited as translocation sites and which had the best prospects of achieving successful translocation. The attached maps in Appendix C4 identifies those translocation sites which were identified as the most suited. This updated proposal will ensure that these sites are completely covered with translocated turves, rather than a combination of peat turves and peat soil.

The Department of Culture Heritage and the Gaeltacht requested confirmation that Annex I Dry heath habitat [4030] can be successfully re-created using the donor and receptor sites as set out in the EIAR and supporting documentation, and requested more details on techniques and methodologies to be employed.

Evidence Supporting Dry Heath Creation/Translocation

The proposals set out in Appendix A.8.26 of the EIAR have been based on peer-reviewed scientific as well as grey literature, reporting on examples of successful dry heath habitat creation. Appendix A.8.26 of the EIAR contains a reference list of publications and it is acknowledged that this includes just two publications specifically referencing heathland. The bibliography confirming the sources consulted when the literature review was undertaken at the time of preparing the EIAR to inform the proposals for dry heath habitat creation, was not included within Appendix A.8.26. For the sake of completeness, this bibliography is provided in Appendix C1 and includes directly relevant examples, in the context of the proposed road development, of dry heath habitat creation and restoration.

The results of this literature review confirm that dry heath is a habitat that can and has been successfully translocated and recreated. The literature review confirmed that heathland restoration and creation has been researched and practiced for over 45 years. Heathland restoration or translocation has been undertaken for a range of development types including pipelines, roads, windfarms, forestry sites post-felling

and restoration post-burning damage. The approach to dry heath habitat creation and translocation for the proposed road development is evidence based and is founded on tried and tested known techniques and methodologies.

Particular examples which were drawn from and which are of direct relevance to the proposals for this proposed road development are listed below:

- Parker, D.M. (1995). *Habitat Creation – a Critical Guide.* English Nature Science No. 21. English Nature. This publication describes two case studies from Dorset; the Ferndown Bypass and the Gallows (Duck) Hill in Wareham. The Ferndown Bypass used heath soils to re-create heathland vegetation on roadside verges of the new bypass. The heathland soil was stripped following cutting of vegetation, stored for 18 months and then spread on roadside verges. A nurse mix was used to stabilise the soil. Monitoring for +3 years and +5 years indicated that a heathland sward had become established. In the Gallows (Duck) Hill, soils from a wet heath donor site were translocated to a site with nutrient-poor, waterlogged soil and heather brashings were used. The publication reports that some success was achieved at this site. The Ferndown Bypass in particular is directly comparable to what is being proposed for the proposed road development, being the same development type and having used the same primary method for habitat creation i.e. translocation of heath soils.
- Allison, M. and Ausden, M. (2004). *Successful use of topsoil removal and soil amelioration to create heathland vegetation.* Biological Conservation 120: 221–228. This study in Kent, compared the effectiveness of topsoil removal on improved agricultural grass fields in creating suitable soil conditions for establishment of heathland vegetation. The experiment examined topsoil removal combined with various treatments, including the addition of heathland clippings. The results demonstrated that it was possible to successfully create heathland vegetation on species-poor grassland using topsoil removal and addition of heathland clippings. The methods used have similarities with what is proposed for the proposed road development. The experiment found that the vegetation that established on areas involving topsoil removal and addition of heathland clippings comprised a species-rich mix of ericaceous dwarf-shrubs including *Calluna vulgaris* and *Erica cinerea;* two of the target dominant species for the dry heath receptor sites for this proposed road development.
- Pywell, R., Meek, W., Webb, N., Putwain, P. & Bullock, J. (2011). *Long-term heathland restoration on former grassland: The results of a 17-year experiment*. Biological Conservation 144, 1602-1609. This long-term large-scale experiment examined the effectiveness of five techniques for restoring heathland on improved agricultural grassland and found that the most successful methods were soil stripping followed by the incorporation of heathland topsoil and soil stripping followed by the translocation of large heathland turves. The results from this study supports the techniques being proposed for the proposed road development.
- The Corrib Onshore Pipeline case study. Ecologist Jenny Neff CEcol CEnv FCIEEM (consultant ecological adviser to Vermilion E&P Ireland Ltd - formerly to Shell E & P Ireland Ltd), provided details and experience of

peatland habitat translocation and restoration during the construction of the Corrib Gas Project, in particular the reinstatement of the Corrib Onshore Pipeline element of the project. For this project the peatland habitat in question was blanket bog rather than heath, however, directly relevant and applicable techniques used were drawn from to inform the proposals for the proposed road development. Photos supplied by Jenny Neff illustrating the techniques employed on the Corrib Onshore Project and which are also proposed for the proposed road development, are included in Appendix C2.

Mr. Arnold, assistant to the Inspector for the oral hearing for the N6 Galway City Ring Road, indicated that the M6 Toll Road in Birmingham may be an appropriate case study involving heathland creation/translocation and so we sought details on that project to draw on that case study also in preparing this response. The project sought consent c. 1993 and the road was opened to traffic in 2003. The environmental documentation associated with the planning stage is not digitally available and while the Department for Transport in the UK may hold hard copies of environmental or ecological monitoring reports relating to the project, none were obtainable from the Department at the time of writing.

The only publicly available information on the dry heath creation/translocation for that project is within a note prepared by the Bartlett School of Planning in the OMEGA Centre of the University College London which states "Approximately 1ha of dry heathland was created through a combination of techniques, including prior harvesting of seed from a Site of Special Scientific Interest (SSSI) through which the motorway was being constructed. Heather turves and peaty topsoil were also recycled separately from this SSSI and respread on the motorway verge prior to seeding with the harvested seed. Elsewhere, heather brash harvested during management operations from a nearby country park was used to create new heathland on screening bunds."

One of the ecologists engaged on that project, Dr. Stephanie Wray (CEcol CEnv FCIEEM), was involved in the heathland translocation and subsequent 10-year monitoring programme. Dr. Wray was contacted to inform this response. She confirmed that the heathland translocation was successful but was unable to supply copies of any of the reports or details of the work as all documents at the time were prepared in hard copy only.

It is noted that the Schedule of Environmental Commitments for the proposed road development will include as set out in more detail in Section 1.5 below the provision that "*will ensure that the results of monitoring will be used to inform the long-term ecological mitigation programme and any necessary timely corrective action. During construction, monitoring and any required corrective action, will be Galway County Council's responsibility as outlined in the Schedule of Environmental Commitments. During operation, GCC will engage the services of a suitable contractor to monitor the ecological mitigation measures for the lifetime of the project.*

Key Elements which Informed the Principal Methodology for Dry Heath Creation/Translocation as Informed by the Available Evidence from Scientific Literature and Case Studies

The proposed mitigation strategy for dry heath creation/translocation was informed by the literature review and case studies referenced above which demonstrates that

the best results for dry heath creation/translocation are achieved when soils and vegetation from existing heath or peatland sites are used in the process.

In accordance with the available evidence from scientific literature and case studies, it can be confirmed that the principal methodologies and techniques which will be followed are based on the following key elements which are fundamental to the success of the proposed mitigation strategy:

- The proposed road development will use soils and plant material from existing dry heath or related peatland habitats (i.e. wet heath and one small area of blanket bog). Details of all locations, sizes, and habitat classifications at the 72 donor sites were presented in Appendix B of Aebhín Cawley's Biodiversity EIA statement of evidence and are provided again in the interest of completeness in the attached updated maps in Appendix C4.
- There is sufficient suitable soil available from all donor sites for creation of habitat at the Dry heath receptor sites. An analysis of soil volumes available from donor sites within the proposed development boundary, and necessary for use at the receptor sites, informed the process. The soil analysis included an examination of soil/peat depth at donor sites (based on ground investigation works as well as data collected for relevés completed as part of habitat surveys). The analysis indicates that a depth of a minimum of 100mm of soil/peat at receptor sites can be generated from the volume of material available from donor sites.

Provision of More Details on Specific Techniques and Methodologies to be Employed

Many of the details regarding the methodologies and proposals for the dry heath habitat translocation and creation required to ensure its success, are already set out in Appendix A.8.26 of the EIAR, including:

- Section 2.5.1 which confirms how receptor sites were selected to ensure that they already have suitable conditions for supporting dry heath habitat (in particular soil type, existing habitats present and proximity to donor sites)
- Section 2.5.2 confirms important site preparation measures which will be undertaken to ensure that receptor sites are put in suitable condition for dry heath to become established on (e.g. vegetation and topsoil removal, and preparation and build-up of the Material Deposition Areas).
- Section 2.5.3 confirms a suite of techniques which will be implemented for the translocation and creation of dry heath habitat (i.e. translocation of turves and soils/peat at donor sites and harvesting and spreading of heather clippings).
- Sections 2.6 and 2.7 set out the necessary management and monitoring in both the short and long term.

Additional details requested by the DCHG regarding donor and receptor sites were included in Appendix B of Aebhín Cawley's Biodiversity EIA statement of evidence, including areas and habitat types present in each and locations of each indicated on figures.

In response to the queries from the DCHG during the oral hearing, further details on specific techniques and methodologies to be employed can be confirmed as set out below.

Details Regarding use of Material Deposition Areas (MDA) as Receptor Sites

Nine of the MDA sites will serve as receptor sites for dry heath habitat creation. Relevant details of these are summarised in Table 1 below.

Table 1: Details of the MDA sites on top of which dry heath habitat will be created

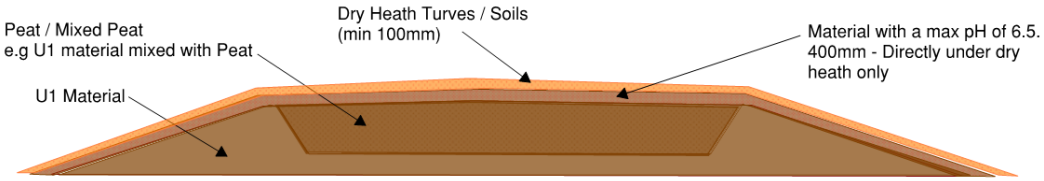
MDA Reference Number	Dry Heath Receptor Site Reference Code	Material Proposed for Build-up of the MDA
DA01	4030.R1	Peat with U1 bunds
DA03	4030.R3	Peat with U1 bunds
DA05	4030.nR8 and 4030.nR9	U1 only (i.e. no peat) As noted in the RFI Response (Table 4.4 of Annex 2 Material Deposition Areas - Baseline Report in Appendix A.1.11), there will be a restriction on the type of U1 material which may be placed in this MDA. This restriction is to prevent impact on local peatland habitat in this location by restricting the fill material to only that which is derived from native, or pH compatible, materials.
DA06	4030.R10	Peat with U1 bunds
DA08	4030.R11	Peat with U1 bunds
DA09	4030.R12	Peat with U1 bunds
DA11	4030.nR16	Peat with U1 bunds
DA12	4030.nR15	Peat with U1 bunds
DA15	4030.R19	Peat with U1 bunds

Section 2.5.2.4 of Appendix A.8.26 of the EIAR sets out the specific construction and operational requirements for MDA sites that overlap with dry heath receptor sites.

As outlined in the Appendix A.8.26 of the EIAR once the MDA area has been created, the dry heath habitat will be created on top of this layer by placing the translocated soils/turves from the dry heath donor sites on top.

[1] Materials classed as U1 includes a range of different soil types, all of which are unsuitable for use in road construction.

Plate 1: Typical Cross Section of Material Deposition Areas with Dry Heath



The root depth for some heathland plants may extend up to 500mm and therefore there may be interaction between the root zone of the dry heath habitat and the core of the MDA area. It can be confirmed that the pH of the top 400mm layer of the MDA material (where it directly underlies areas proposed for dry heath habitat creation) will be below 6.5. The habitat layer will include a minimum 100mm depth of translocated soil/peat depth and/or turves. Therefore, there will be a minimum of 500mm depth of material with a pH compatible with dry heath habitat.

The use of peat in MDAs and potential settlement is discussed further in Section 3 below.

Provision of More Details on Specific Techniques and Methodologies to be Employed in Dry Heath Translocation/Creation

As is detailed in Appendix A.8.26 of the EIAR, Ecology Site Management Plans will be prepared by the contractor prior to commencement. In response to the queries from the NPWS it can be confirmed that the measures below will be incorporated into the Ecology Site Management Plans to ensure compliance with the approaches and techniques set out below.

It was not expressly confirmed in Appendix A.8.26 of the EIAR that turves and soils/peat from all donor sites will be used. Rather turve and soils translocation were listed as an option that may be used. It is now confirmed that translocation of turves and soil/peat from all donor sites will be the principal method of habitat translocation for dry heath.

The preferred method is for direct translocation of turves and soil/peat from donor to receptor sites. However, the construction phasing may not facilitate this in every instance.

Where direct translocation of turves to receptor sites is not possible, they will be handled and stored based on documented best practice and proven case studies for peatland turve translocation which include:

- Ensuring turves are as large in size and depth as possible (e.g.3m x 1m and to a depth of 0.3m was successfully employed on the Corrib Onshore Pipeline project)
- If necessary use of specially designed digger buckets suitable for the purpose (as was successfully employed on the Corrib Onshore Pipeline project)
- Use of low ground pressure vehicles for turve removal, especially for wetter donor sites such as the 4010 and *7130 donor sites, and if necessary operating on bog mats

- Storage of turves for the minimum time possible and placement at receptor sites at the earliest possible opportunity
- Storage of turves in a single layer to avoid crushing and to maintain their integrity
- Storage of turves on a flat surface placed on top of either a geotextile membrane, on bog mats or similar
- Regular watering (with rainwater) and monitoring of the turves for the duration of the storage time
- Storing turves end to end (i.e. with no gaps) to avoid edges drying out and if necessary using silt fencing or geotextile membranes along any vertical exposed edges of turves
- In the case of some of the dry heath receptor sites the nature of the ericaceous vegetation, shallow soils and outcropping granite, may make intact turve removal difficult. In these situations trimming the ericaceous vegetation (and retaining this cut material for use as brash and a source of seed to assist in vegetation regeneration at the receptor sites) may assist in extracting intact turves. Where turves cannot be extracted intact in these areas then the scraw (mixture of soils, root stock, seed bank etc) will still be valuable for use as soils to be translocated to the receptor sites

The techniques outlined above are tried and tested on other habitat creation projects and the photos in Appendix C2 from the Corrib Onshore Pipeline project demonstrate some of them being successfully used on that project.

Similarly, where direct translocation of soil/peat to receptor sites is not possible, it will be handled and stored in the following manner to ensure it is protected:

- Use of low ground pressure vehicles for soil removal, especially for wetter donor sites such as the 4010 and *7130 donor sites, and if necessary operating on bog mats
- All wet peaty soils (e.g. this will be likely from the 4010 and *7130 donor sites) will be transported in sealed trucks to avoid loss of wet peat in transit
- Storage of soil/peat for the minimum time possible and placement at receptor sites at the earliest possible opportunity
- Storage of soils/peat from donor sites in dedicated area(s) within construction compounds for the proposed road development west of the River Corrib, on top of a geotextile layer, no higher than 1.5m to avoid compaction
- Turves from donor sites will be ‘thatched’ on top of the stored soil/peat areas to seal and protect it for the duration of the storage period

As has already been described above there is sufficient volume of soils from donor sites to achieve a minimum depth of 100mm translocated soils/ turves at the receptor sites. During the placement, turves will be placed end to end with no spaces between them.

Where necessary, receptor sites will be protected from erosion and vegetation regeneration encouraged through the following means:

- Use of geocoir (on flat surface) or geojute (on sloped areas) on areas of bare soil, pinned down with 0.5m long steel pegs or similar (details on this product are included in Appendix C3 and photos of its successful use on the Corrib Onshore Pipeline project are provided in Appendix C2).
- Spreading heather clippings which have been harvested from donor sites on bare soil
- Re-seeding, preferably with seeds collected from donor sites prior to turves/soil being removed, or if necessary with additional dry heath native seed material from a reputable supplier such as http://www.wildflowers.ie/. Where seeds are collected from donor sites prior to turves/soil being removed, they will be collected a minimum of one summer/autumn season prior to construction works commencing, during warm, dry conditions. Until such time as they are required to be planted at the receptor sites, seeds will be stored in suitable conditions to ensure their survival. These will be used for inclusion in the seed mix for planting later at the appropriate time of year at dry heath receptor sites.
- Minimising risks of erosion or escape of translocated soil/peat by:
    - Undertaking all translocation works and handling of turves and soils/peats during dry weather conditions
    - Undertaking these activities during dry conditions at the start of the vegetation growing season (i.e. spring) to encourage rapid establishment of plant growth prior to the winter season
    - Implement the measures set out in the Sediment, Erosion and Pollution Control Plan (SEPCP) which summarises the procedures and technical practices for implementing effective sediment, erosion and pollution control through a variety of delivery methods for the construction phase of the proposed road development is presented in Section 8 of the CEMP in Appendix A.7.5 of the EIAR and Appendix C of the NIS.
    - All wet peaty soils (e.g. this will be likely from the 4010 and *7130 donor sites) will be transported in sealed trucks to avoid loss of wet peat in transit

The Department of Culture Heritage and the Gaeltacht requested clarification regarding two heathland species *Arctostaphylos uva-ursi* and *Daboecia cantabrica*.

Neither *Arctostaphylos uva-ursi* or *Daboecia cantabrica* (St Dabeoc's Heath) is listed on the Flora (Protection) Order 2015, nor is either categorised as threatened on the Irish Red List for vascular plants (Ireland Red List No. 10: Vascular Plants, 2016), both being listed as being of 'least concern'. Both species are, however, typical of Connemara dry heath habitat and are therefore of local/regional value.

Arctostaphylos uva-ursi was recorded at two locations, both of which are outside the area of the proposed road development and, therefore, will not be removed. One is located to the north of the proposed road development at Aille and the other is located to the west of the proposed road development at Na Foraí Maola Thiar, as indicated on Plate 2 below.

Plate 2: Locations where *Arctostaphylos uva-ursi* was recorded

Daboecia cantabrica was recorded at 27 relevés recorded as part of the habitat surveys undertaken for the proposed road development. Six of these are outside of the proposed road development (and, therefore, will not be removed), with the remaining 21 being located within the proposed road development at locations which will be directly impacted by the proposed road development. 15 of these locations are within donor sites for dry heath habitat creation.

Plate 3: Locations where *Daboecia cantabrica* was recorded

In response to the query from the NPWS it can be confirmed that these species will not be lost locally as they occur within areas outside of the proposed road development.

Furthermore, it can be confirmed that the following measures will be implemented as part of the habitat translocation and creation measures to ensure that *Daboecia cantabrica* becomes established at the dry heath receptor sites:

- Seeds from mature plants of *Daboecia cantabrica* will be collected from the sites within the proposed development boundary where it has been recorded, from August/September onwards (in a year prior to construction works commencing), during warm, dry conditions. Seeds will be stored in suitable conditions to ensure their survival. These will be used for inclusion in the seed mix for planting later at the appropriate time of year at dry heath receptor sites
- Where it is possible to translocate turves from dry heath donor sites containing *Daboecia cantabrica*, all specimens *Daboecia cantabrica* will be located in the centre of turves to ensure their successful translocation
- All existing soils/peat at dry heath donor sites will be translocated for placement as the substrate at the dry heath receptor sites, thereby retaining the seedbank, including for *Daboecia cantabrica*, to allow natural regeneration of the species at the receptor site

- Heather clippings will be harvested at all dry heath donor sites and this material will include clippings from *Daboecia cantabrica* specimens

The Schedule of Environmental Commitments will be updated to reflect the measures required for the creation of Dry heath, as follows:

"Ecology Site Management Plans will be prepared by the contractor prior to the commencement of works, in accordance with the principles set out in Appendix A.8.26 of the EIAR. The specific measures below will be incorporated into the Ecology Site Management Plans:

- Soils and plant material (including turves) from all 4030 donor sites will be the primary method used for dry heath habitat translocation and creation. The locations of all 4030 donor and receptor sites are presented in the appendix to this Schedule of Environmental Commitments.
- Monitoring immediately after the turves are placed in the receptor sites will be undertaken every three weeks and after a heavy rainfall event until such time as the Dry heath is established, with an adaptive corrective plan put in place if evidence shows that it is not successful.
- A minimum 100m translocated soils/turve depth will be provided at each 4030 receptor site.
- The pH of the top 400mm layer of material in MDAs, where it directly underlies areas proposed for dry heath habitat creation, will be below 6.5.
- The preferred method of habitat translocation is for direct translocation of turves and soil/peat from donor to receptor sites. However, the construction phasing may not facilitate this in every instance. Where direct translocation of turves to receptor sites is not possible, they will be handled and stored based on documented best practice and proven case studies for peatland turve translocation which include:
    - Ensuring turves are as large in size and depth as possible
    - If necessary, use of specially designed digger buckets suitable for the purpose
    - Use of low ground pressure vehicles for turve removal, especially for wetter donor sites such as the 4010 and *7130 donor sites, and if necessary operating on bog mats
    - Storage of turves for the minimum time possible and placement at receptor sites at the earliest possible opportunity
    - Storage of turves in a single layer to avoid crushing and to maintain their integrity
    - Storage of turves on a flat surface placed on top of either a geotextile membrane, on bog mats or similar
    - Regular watering (with rainwater) and monitoring of the turves for the duration of the storage time

- Storing turves end to end (i.e. with no gaps) to avoid edges drying out and if necessary using silt fencing or geotextile membranes along any vertical exposed edges of turves
- In the case of some of the dry heath receptor sites the nature of the ericaceous vegetation, shallow soils and outcropping granite, may make intact turve removal difficult. In these situations, trimming the ericaceous vegetation (and retaining this cut material for use as brash and a source of seed to assist in vegetation regeneration at the receptor sites) may assist in extracting intact turves. Where turves cannot be extracted intact in these areas then the scraw (mixture of soils, root stock, seed bank etc) will still be valuable for use as soils to be translocated to the receptor sites

- Similarly, where direct translocation of soil/peat to receptor sites is not possible, it will be handled and stored in the following manner to ensure it is protected:
  - Use of low ground pressure vehicles for soil removal, especially for wetter donor sites such as the 4010 and *7130 donor sites, and if necessary operating on bog mats
  - All wet peaty soils (e.g. this will be likely from the 4010 and *7130 donor sites) will be transported in sealed trucks to avoid loss of wet peat in transit
  - Storage of soil/peat for the minimum time possible and placement at receptor sites at the earliest possible opportunity
  - Storage of soils/peat from donor sites in dedicated area(s) within construction compounds for the proposed road development west of the River Corrib, on top of a geotextile layer, no higher than 1.5m to avoid compaction
  - Turves from donor sites will be 'thatched' on top of the stored soil/peat areas to seal and protect it for the duration of the storage period
- Turves will be placed end to end with no gaps. Where necessary receptor sites will be protected from erosion, and vegetation regeneration will be encouraged through the following means:
  - Use of geocoir (on flat surface) or geojute (on sloped areas) on areas of bare soil, pinned down with 0.5m steel pegs or similar
  - Spreading heather clippings which have been harvested from donor sites on bare soil
  - Re-seeding, preferably with seeds collected from donor sites prior to turves/soil being removed, or if necessary with additional dry heath native seed material from a reputable supplier such as http://www.wildflowers.ie/. Where seeds are collected from donor sites prior to turves/soil being removed, they will be collected a minimum of one summer/autumn season prior to construction works commencing, during warm, dry conditions. Until such time as they

are required to be planted at the receptor sites, seeds will be stored in suitable conditions to ensure their survival. These will be used for inclusion in the seed mix for planting later at the appropriate time of year at dry heath receptor sites.

- Minimising risks of erosion or escape of translocated soil/peat by:
    - Undertaking all translocation works and handling of turves and soils/peats during dry weather conditions
    - Undertaking these activities during dry conditions at the start of the vegetation growing season (i.e. spring) to encourage rapid establishment of plant growth prior to the winter season
    - Implement the measures set out in the Sediment, Erosion and Pollution Control Plan (SEPCP) which summarises the procedures and technical practices for implementing effective sediment, erosion and pollution control through a variety of delivery methods for the construction phase of the proposed road development is presented in Section 8 of the CEMP in Appendix A.7.5 of the EIAR and Appendix C of the NIS
    - All wet peaty soils (e.g. this will be likely from the 4010 and *7130 donor sites) will be transported in sealed trucks to avoid loss of wet peat in transit
- The following measures will be implemented as part of the habitat translocation and creation measures to ensure that *Daboecia cantabrica* becomes established at the dry heath receptor sites:
    - Seeds from mature plants of *Daboecia cantabrica* will be collected from the sites within the proposed development boundary where it has been recorded, from August/September onwards (in a year prior to construction works commencing), during warm, dry conditions. Seeds will be stored in suitable conditions to ensure their survival. These will be used for inclusion in the seed mix for planting later at the appropriate time of year at dry heath receptor sites
    - Where it is possible to translocate turves from dry heath donor sites containing *Daboecia cantabrica*, all specimens *Daboecia cantabrica* will be located in the centre of turves to ensure their successful translocation
    - All existing soils/peat at dry heath donor sites will be translocated for placement as the substrate at the dry heath receptor sites, thereby retaining the seedbank, including for *Daboecia cantabrica*, to allow natural regeneration of the species at the receptor site
    - Heather clippings will be harvested at all dry heath donor sites and this material will include clippings from *Daboecia cantabrica* specimens"

1.5 DCHG – Mitigation Measures - General

The Department of Culture Heritage and the Gaeltacht requested clarification on the issue of confirmation by Galway County Council in relation to the long-term management of the mitigation measures (i.e. for the lifetime of the proposed road development.

The post-construction monitoring requirements, with specified time periods for various species and habitats, are set out in Appendix D of Aebhín Cawley's EIA Biodiversity Statement of Evidence. At the end of these specified monitoring periods, the mitigation will be reviewed by suitably qualified and experienced ecologist(s) to determine whether the monitoring periods need to be extended further, if for example it is viewed that the mitigation measures have not become fully established or is not functioning as intended by that time. Any extension to the monitoring period will need to consider whether on-going monitoring should be at annual or longer intervals e.g. +3 years post-creation, +6 years post-creation etc. All monitoring reports will be made available to the Planning Authority and will therefore be publicly available, including to the NPWS.

The Schedule of Environmental Commitments will be updated to include the following:

> "Galway County Council will ensure that the results of monitoring will be used to inform the long-term ecological mitigation programme and any necessary timely corrective action. During construction, monitoring and any required corrective action, will be Galway County Council's responsibility as outlined in the Schedule of Environmental Commitments. During operation, GCC will engage the services of a suitable contractor to monitor the ecological mitigation measures for the lifetime of the project. All the relevant requirements set out in the Schedule of Environmental Commitments, in relation to monitoring and maintenance of the ecological mitigation measures over the lifetime of the project, will be included as conditions in the contract(s) entered into with the appointed contractor. GCC shall ensure that provision is made, in the contract(s) entered into with the appointed contractor, for corrective action to be undertaken if any aspects of the implementation of the ecological mitigation measures and monitoring commitments proposals are not effective. These provisions shall include a requirement for a suitably qualified ecologist/biodiversity expert to review the efficacy of any corrective actions required."

1.6 Habitats at the Proposed Drainage Outfall from the N59 Link Road North

Mr. Arnold requested clarification on whether the habitat maps referred to in Section 4.6 of the RFI Response (Figures 2.8.01 and 2.8.02 in Annex II to Appendix A.3.1 of the RFI Response) were incomplete.

It is confirmed that Figures 2.8.01 and 2.8.02 in Annex II to Appendix A.3.1 of the RFI Response document are not incomplete. Rather, the figures demonstrate two distinct subsets of the overall habitat map in response to the specific question asked in the RFI, i.e. to "*Provide additional information on habitats/vegetation within the cSAC from the point of the outfall to the River Corrib, including for the drainage ditch and the vegetation located on either side (minimum 25m) along its full length.*"

Figure 2.8.01 in Annex 2 to Appendix A.3.1 of the RFI Response shows the Fossitt habitat classifications only for those areas along either side of the drainage ditch that lie downstream of the drainage outfall which is the pathway to the River Corrib.

Figure 2.8.02 in Annex 2 to Appendix A.3.1 of the RFI Response only shows those habitat areas along either side of the drainage ditch that lie downstream (i.e. along pathway to the River Corrib) of the drainage outfall that correspond with Annex I habitat types.

The full habitat map showing the Fossitt habitat classifications in that area, published in 2018, including both Annex I habitat types and non-Anne I habitat types is provided on Figure 8.14.12 of the EIAR and Figure 13.2 of the NIS. The amendments (by way of update) to the Fossitt habitat map in that area as a result of the 2019 surveys are shown on Figure 2.5.12 in Annex 2 to Appendix A.3.1 of the RFI Response – these amendments only cover habitat areas within the proposed development boundary.

The full habitat map showing the Annex I habitat classifications in that area, published in 2018, is provided on Figure 8.15.12 of the EIAR and Figure 14.2 of the NIS. The amendments to the Annex I habitat map in that area as a result of the 2019 surveys are shown on Figure 2.6.12 in Annex 2 to Appendix A.3.1 of the RFI Response – again, these amendments only cover habitat areas within the proposed development boundary.

Thus, in conclusion on this point, the habitat mapping is not incomplete. The habitat areas shading on Figure 2.8.02 in Annex II to Appendix A.3.1 of the RFI Response are areas of Annex I habitat. The non-shaded areas in that habitat map correspond with non-Annex I habitat type areas

For the avoidance of doubt, a composite map displaying all habitat survey results from 2018 and 2019 is provided in Plate 4 (Fossitt Code, i.e., non-Annex I habitat areas) and Plate 5 (Annex I Code) below.

Plate 4: Habitats at the Proposed Drainage Outfall from the N59 Link Road North (Fossitt Code)

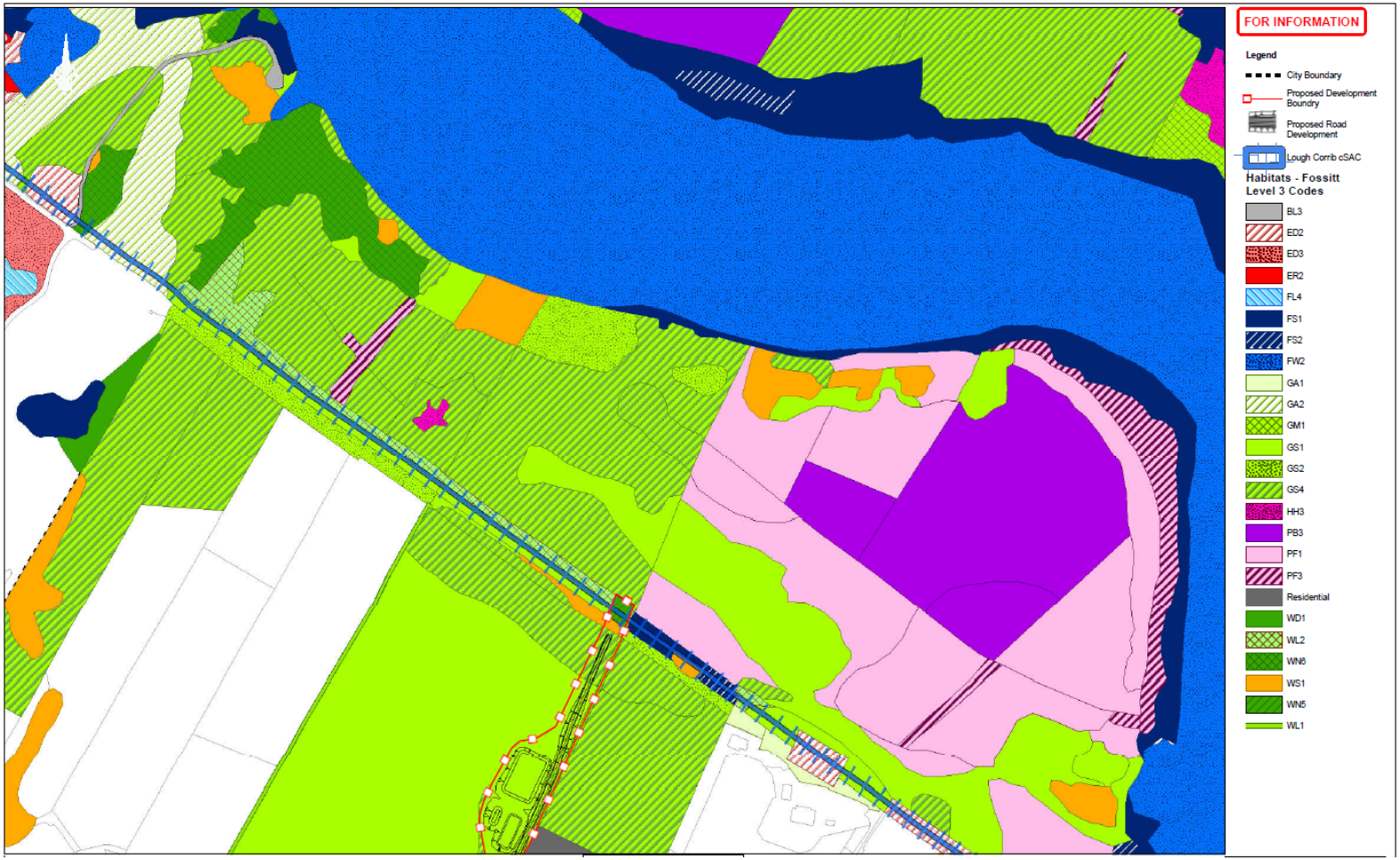
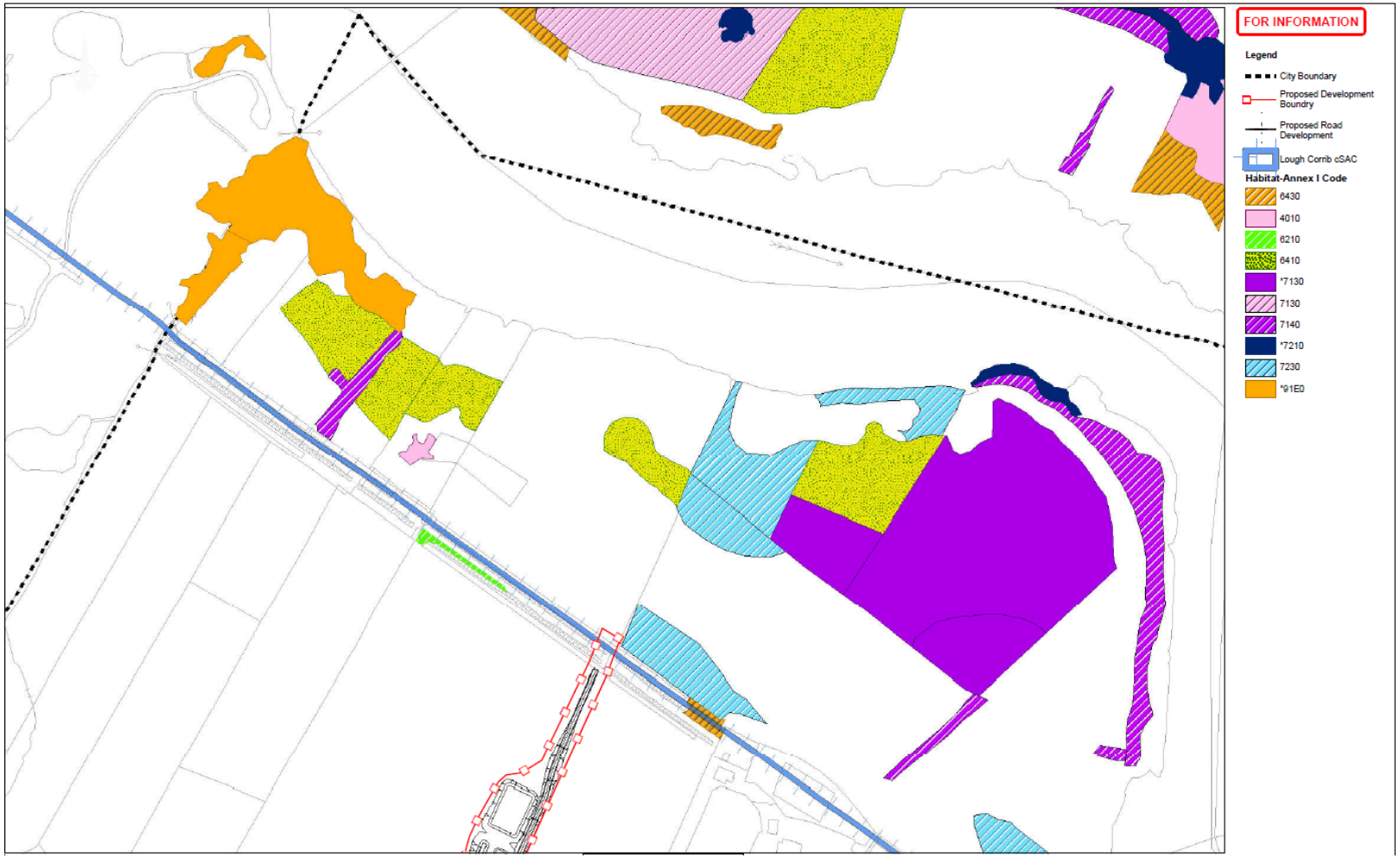


Plate 5: Habitats at the Proposed Drainage Outfall from the N59 Link Road North (Annex I Code)



1.7 Design of Mammal Underpasses

Mr. Arnold requested clarification on where design details of the mammal passage facilities were provided in the Applicant's documentation.

Table 8.36 of the EIAR sets out where dedicated mammal passage facilities will be provided in terms of: target species, location, type of structure and reference number, and dimensions. This table is reproduced below in Table 2 with reference included to the specific drawing for each mammal passage facility and a copy of each drawing included in Appendix A for ease of reference. Drawing GCOB—500-D-520 has been updated to the top water level and the otter ledge 200mm above the flood level.

Table 2: Mammal passage facilities

Ref. No.	Structure	Species and Description	Drawing Reference
C00/00	Pipe	Badger Dedicated 600mm concrete pipe will provide for mammal passage beneath the proposed road development	TII Publications CC-SCD-02504 & CC-SCD-02505
C00/01	Culvert	Bats A 2.5m wide by 1.35m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
C02/01b	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
C03/01	Culvert	Bats A 2.5m wide by 1.2m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
C03/03	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
C03/04	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
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~~	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011 & GCOB-500-D-520

Ref. No.	Structure	Species and Description	Drawing Reference
		~~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	TII Publications CC-SCD-02504 & CC-SCD-02505
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 A 3.1m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	TII Publications CC-SCD-02504 & CC-SCD-02505 Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011 & GCOB-500-D-520
C05/01	Pipe	Badger Dedicated 600mm concrete pipe will provide for mammal passage beneath the proposed road development	TII Publications CC-SCD-02504 & CC-SCD-02505
S06/01	Road Overbridge	Bats The unlit road underbridge will provide for bat passage across the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-001
C06/00	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
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	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
C07/00	Culvert	Bats A 2.5m wide by 2m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
C07/02A	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
C07/04	Pipe	Badger Dedicated 600mm concrete pipe will provide for mammal passage beneath the proposed road development	TII Publications CC-SCD-02504 & CC-SCD-02505

Ref. No.	Structure	Species and Description	Drawing Reference
C07/01(b)	Pipe	Badger Dedicated 600mm concrete pipe will provide for mammal passage beneath the proposed road development	TII Publications CC-SCD-02504 & CC-SCD-02505
C08/01(a)	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
C08/04	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
C08/05	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
C08/02	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
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	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-D-ST-C09-1-001 to GCOB-D-ST-C09-1-002
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	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-D-ST-C09-1-001 to GCOB-D-ST-C09-1-002
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	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-D-ST-C09-1-001 to GCOB-D-ST-C09-1-002
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	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-D-ST-C09-1-001 to GCOB-D-ST-C09-1-002
C09/05	Culvert	Bats and Badgers	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-

Ref. No.	Structure	Species and Description	Drawing Reference
		A 5m wide by 4m high culvert will provide for bat and badger passage beneath the proposed road development	D-ST-C09-1-001 to GCOB-D-ST-C09-1-002
S09/01	Road Overbridge	Bats and Badgers The road underbridge (10m wide by 5.3m high) will provide for bat and badger passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-001
C09/06	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
C09/07	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
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	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
S10/02	Road Overbridge	Bats The road underbridge (9.8m wide by 5.3m high) will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-C10-01-001
C10/02	Pipe	Bats and Badger Dedicated 1200mm concrete pipe will provide for mammal passage beneath the proposed road development	TII Publications CC-SCD-02504 & CC-SCD-02505
C12/01	Pipe	Badger Dedicated 600mm concrete pipe will provide for mammal passage beneath the proposed road development	TII Publications CC-SCD-02504 & CC-SCD-02505
C12/02	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
C12/03	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011

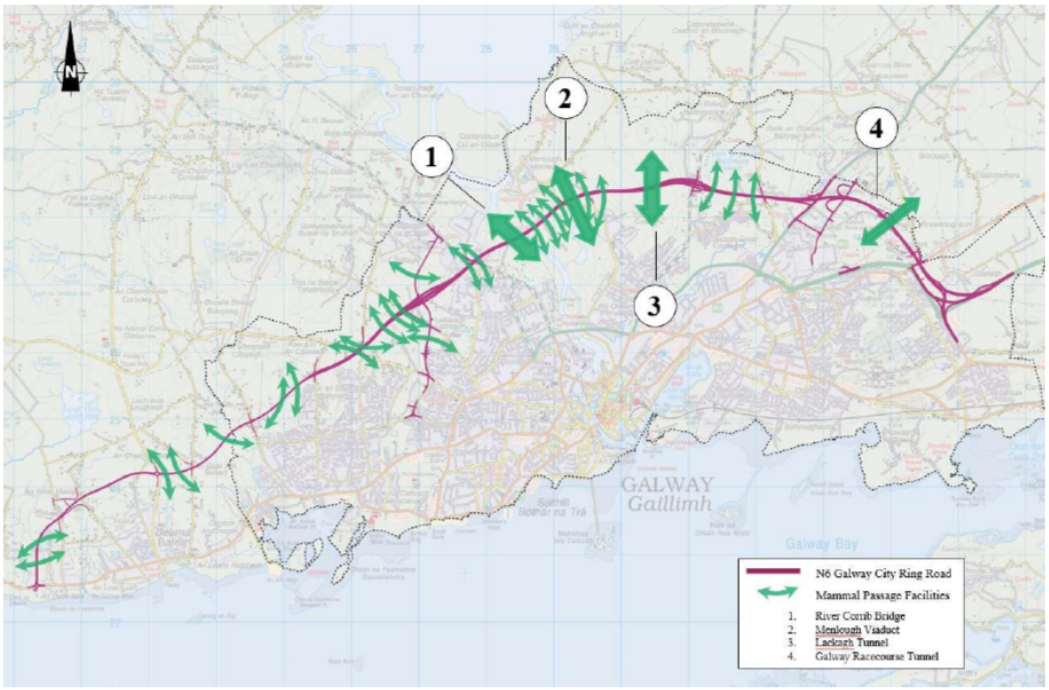
Ref. No.	Structure	Species and Description	Drawing Reference
C12/04	Culvert	Bats A 2.5m wide by 2.5m high culvert will provide for bat passage beneath the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011
S12/02	Green bridge	Bats and Badgers The Green Bridge (30m in width) will provide for bat and mammal passage over the proposed road development	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-S12-02-001
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	Appendix A.1.8 of the RFI Response Volume 3 - GCOB-1700-D-GEN-011

As stated in Section 8.6.7.3.2 of the EIAR, mammal underpasses intended for use by badgers will follow the design requirements set out in *Guidelines for the Treatment of Badgers during the Construction of National Road Schemes* (National Roads Authority, 2006) and those intended for use by otter will follow the *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes* (National Roads Authority, 2008). These guidance documents are provided in Appendix B.

In addition to the network of dedicated mammal passage facilities, 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 also provide for mammal passage across the route of the proposed road development.

Plate 4.11 in Section 7.1 of the RFI Response (reproduced below in Plate 6) illustrates the locations of all mammal passage facilities across the proposed road development.

Plate 6: Mammal Passage Facilities



1.8 Use of Underpasses by Common Lizard

Mr. Arnold queried whether there was any scientific evidence that the underpasses would provide habitat connectivity from one side of the road to the other for common lizard.

As stated in Section 7.1.2 of the RFI Response, the scientific literature relating to the use of road underpasses by reptile species is not focussed on common lizard specifically but the COST 341 publication transport infrastructure and habitat fragmentation *Wildlife and Traffic: A European Handbook for Identifying Conflicts and Designing Solutions* notes that overpasses, viaducts and larger underpasses are optimal solutions to minimise barrier and fragmentation effects on lizards.

There are studies that have recorded general reptile use of road underpass structures although these relate to species other than the common lizard and to other biogeographic zones.[2]

[2] Bond, A. & Jones, D. (2008) Temporal trends in use of fauna-friendly underpasses and overpasses. *Wildlife Research*, 2008, 35, 103–112.
Mata, C., Hervás, I., Herranz, J., Suárez,F. & Malo, J.E. (2005) Complementary use by vertebrates of crossing structures along a fenced Spanish motorway. *Biological Conservation 124* (2005), 397–405.
Jochimsen, D., Peterson, C., Andrews, K. & Whitfield Gibbons, J. (2004) *A Literature Review of the Effects of Roads on Amphibians and Reptiles and the Measures Used to Minimize Those Effects*. Idaho Fish and Game Department USDA Forest Service.
Ontario Ministry of Natural Resources and Forestry (2016) *Best Management Practices for Mitigating the Effects of Roads on Amphibians and Reptile Species at Risk in Ontario*.
Rodriguez, A., Crema, G., and Delibes, M. (1996). Use of non-wildlife passages across a high speed railway by terrestrial vertebrates. *Journal of Applied Ecology* 33, 1527–1540.
Tracey, J., Brehme, C., Rochester, C., Clarke, D. & Fisher, R. (2014) *A Field Study of Small Vertebrate Use of Wildlife Underpasses in San Diego County, 2014*.

An important point in considering the likely fragmentation effects of the proposed road development on common lizard habitat is that, with the exception of one area at Na Foraí Maola Thoir and another adjacent to the northern margins of Bearna Woods, the majority of local peatland and heathland habitats are located to the north and north-west of the proposed road development (refer to Figures 8.15.1 – 8.15.6 of the EIAR for the local distribution of peatland/heathland habitats). This limits to a large extent the degree of habitat fragmentation and severance likely to be experienced by the local common lizard population. The only large peatland/heathland habitat block severed by the proposed road development where common lizard were recorded is to the north of Bearna Woods (Figure 8.15.3) and wildlife passage facilities are provided in this area at structure C04/01 – a 5m wide by 2.5m high culvert incorporating a dedicated raised mammal ledge (refer to Table 2 above, in Section 1.7).

The series of culverts across the western part of the proposed road development (where common lizard were recorded) are of a size that are likely to be used by common lizard and will, therefore, maintain connectivity across the proposed road development and ensure that fragmentation does not result in any population level effects at any geographic scale.

1.9 Loss of Common Lizard Habitat

Mr. Arnold stated that there seems to be a reliance on existing habitats and lands outside the control of the Applicant to maintain the common lizard population and asked if the loss of common lizard habitat associated with the proposed road development could be calculated.

In Ireland, the common lizard is strongly associated with heath, bog and coastal sand dune habitats[3]. The locations and habitat complexes where common lizard were recorded during the field surveys are consistent with that and were associated with peatland and heathland mosaics in the western part of the study area. As assessed in Section 8.5.10.1 of the EIAR, the proposed road development will result in the permanent loss of an area of common lizard habitat within the proposed development boundary. In terms of habitat area, c.4.7ha of peatland and heathland habitat mosaic will be directly affected. To put the loss of c.4.7ha of peatland and heathland habitat mosaic into the wider context, this represents <2% of the peatland/heathland habitat recorded in the wider scheme study area in 2014 (refer to Figures 8.14.1 - 8.14.15 for the Fossitt habitat classifications and Figures 8.15.1 - 8.15.15 for Annex I habitat classifications). There are also extensive blocks of peatland/heathland habitat to the immediate north and north-west of the 2014 habitat map extent covering an area of approximately 40km^2. Despite the comparatively small extent of common lizard habitat that will be lost as a result of

[3] Marnell, F. (2002): The distribution and habitat of the common lizard, Lacerta vivipara Jacquin, in Ireland. Bull. Ir. *Biogeog. Soc.* 26: 75-82
Farren, A., Prodöhl, P., Laming, P. & Reid, N. (2010) Distribution of the common lizard (*Zootoca vivipara*) and landscape favourability for the species in Northern Ireland. *Amphibia-Reptilia* 31 (2010): 387-394.

the proposed road development, c.7ha[4] of heathland habitat will be created within lands in the Applicant's control as part of the mitigation strategy which will likely result in an overall gain in common lizard habitat locally associated with the proposed road development.

In general terms, the comparatively small area of common lizard habitat that will be lost within the proposed development boundary will not compromise the long-term viability of the local population as a result of (a) the area of heathland habitat being created, and (b) the vast areas of habitat locally that will remain unaffected by the proposed road development. Accordingly, it is not the case that there is a reliance on existing habitats and lands outside the control of the Applicant to maintain the common lizard population. Rather, the entirety of the receiving environment has been assessed, including areas within the boundary of the proposed road development and areas outside the control of the Applicant, and it has been concluded that there will not be a significant impact on the common lizard as a result of the project.

In addition to the fact that the area of common lizard habitat that will be lost is minor in comparison with the available habitat resource, the common lizard is a common and widespread species within areas of peatland and heathland habitat and is not listed as a threatened species on the Irish Red List for Amphibians, Reptiles & Freshwater Fish[5].

Therefore, and as per the assessment presented in Section 8.5.10.1 of the EIAR, "habitat loss is not likely to affect the species' conservation status or result in a likely significant negative effect, at any geographic scale".

1.10 Application of the 50% Criterion in Identifying Areas of Limestone Pavement

Mr. Arnold asked if the size of the polygon drawn could have influenced whether or not a particular area was deemed to be *8240 limestone pavement, given the application of the criterion of 50% surface bedrock at a polygon scale.

He also queried whether polygon refinement would be required in the area referred to as 1f in the NIS to avoid bias in the application of the 50% criteria.

Mr. Arnold asked for an explanation of why the habitat displayed in photo 3734_R1 does not conform to *8240, whereby the habitat displayed in photo 1883_R1_9 does conform to *8240.

The EIAR (Section 8.3.4.40 on page 423, and Appendix A.8.5 Section 2.6 on page 6) explains the definition of *8240 limestone pavement and the criteria that were

[4] During the presentation of this document at the oral hearing the reference to 7 hectares was corrected to read 4 hectares, consistent with Section 1.4 of this document.
[5] King, J.L., Marnell, F., Kingston, N., Rosell, R., Boylan, P., Caffrey, J.M., FitzPatrick, Ú., Gargan, P.G., Kelly, F.L., O'Grady, M.F., Poole, R., Roche, W.K. & Cassidy, D. (2011*) Ireland Red List No. 5: Amphibians, Reptiles & Freshwater Fish.* National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

applied to classify areas of the wooded variant of *8240 Limestone pavement, including application of the 50% criteria.

These criteria were developed by botanists from Botanic Environmental Consultants Ltd. who are highly experienced, having reputations as leading national experts, and being lead authors of the National Parks and Wildlife Service's national surveys of semi-natural grasslands and native woodlands.

In summary, the list of criteria applied by experienced botanists in the field when undertaking habitat surveys on Limestone pavement included:

- Presence of closed canopy of trees at least 3m tall
- At least 50% surface bedrock (including rock covered by mosses) at a polygon scale
- Evidence of limestone pavement structure e.g. evidence of clints, grikes or other features confirming rock was more likely to be pavement structure than random boulders or collections of rock
- Thin soils (<2 cm), although with places where it may have been deeper e.g. in old grikes
- Application of expert surveyor judgement considering all of the above factors to determine on balance whether the polygon would be mapped as either *8240, or in the case where small elements of the polygon included *8240, as a mosaic of *8240 along with the other relevant habitat types

Therefore, the percentage rock cover was not the only criterion used. In some cases, it was difficult to differentiate between wooded limestone pavement *8240 and non-Annex woodland which included some boulders or rocks. In many areas surveyed there was a high proportion of scattered boulder and rock and collapsed stone walls, which added to rock cover but with deeper soils or lack of any evidence of pavement structure. In these cases, application of expert judgement, by the botanist surveyors, considering all of the agreed criteria (including the 50% threshold at a polygon scale), was applied to determine whether the polygon would be mapped as *8240.

It should also be noted that the majority of the polygons mapped as wooded limestone pavement *8240 received the lowest Annex quality rating as they are considered to be poor examples of limestone pavement.

It should be noted that, consistent with the precautionary approach, a conservative approach was followed and many of the polygons classified as *8240 wooded limestone pavement were very marginal and were on the cusp of what may or may not be considered *8240. Having regard to the expertise and experience of the botanist surveyors, the robust methodology applied and the adoption of a conservative approach, Scott Cawley are entirely satisfied that all areas of limestone pavement have been identified.

Responses to Questions

Mr. Arnold asked if the size of the polygon drawn could have influenced whether or not a particular area was deemed to be *8240 limestone pavement, given the application of the criterion of 50% surface bedrock at a polygon scale.

The size of a polygon did not influence whether or not a particular area was deemed to be *8240 limestone pavement. As noted above a range of criteria were applied by experienced botanists, only one of which was the criterion of 50% surface bedrock. Other key criteria (as outlined above) included evidence of limestone pavement structure (e.g. evidence of clints, grikes or other features confirming evidence of pavement structure rather than random boulders or collections of rock) and presence of thin soils (<2 cm) with exceptions for places where it may have been deeper (e.g. in old grikes filled in with soil).

Mr. Arnold queried whether polygon refinement would be required in the area referred to as 1f in the NIS to avoid bias in the application of the 50% criteria.

Response

Area 1f was mapped as a single polygon. It is not necessary to break this polygon down into smaller sizes in order to apply the 50% criterion at a smaller polygon scale, as none of the key criteria for classification of *8240 limestone pavement as outlined above, were present in this polygon. In particular there is no evidence of limestone pavement structure (e.g. there are no clints or grikes) and the soils are deeper than 2cm. While there are some strewn boulders and rocks in the northern part of this polygon, which have been examined in the field, these are a random collection of rock and boulders most likely placed in the area following field clearance and/or due to collapsing stone walls within the polygon. Scott Cawley are satisified that this polygon does not conform to *8240.

Mr. Arnold asked for an explanation of why the habitat displayed in photo 3734_R1 does not conform to *8240, whereby the habitat displayed in photo 1883_R1_9 does conform to *8240.

Response

The criteria outlined above for defining *8240 limestone pavement are generally not discernible from an examination of photographs and are only properly measurable in the field and by applying expert judgement based on understanding of the habitat and applying the appropriate criteria. However, in order to provide an answer to the question raised, some of the criteria potentially decipherable from photographs of 3734_R1 and 1883_R1 are set out below.

Photo Number	Feature Indicating Positive/Negative Criteria for *8240
3734_R1	No evidence of pavement structure, random boulders/rock likely from historic field clearance and/or collapsed stone walls, rounded shape to rocks.

Photo Number	Feature Indicating Positive/Negative Criteria for *8240
1883_R1	Outcropping limestone bedrock visible, pavement structure evident in limestone slabs with striations, and slabs lying in parallel ridge formation.

Additional Comments and Conclusion

Polygon 1f was given particular attention and scrutiny, including field surveys, given its location within the Lough Corrib cSAC boundary. The area was visited by three botanists over three separate visits (19 August 2014, 10 June 2019 and 12 August 2019) with six relevés collected. All three botanists (Finnoula O'Neill, Simon Barron and Kate McNutt) are highly experienced with two having reputations as leading national experts, being lead authors of the National Parks and Wildlife Service's national surveys of semi-natural grasslands and native woodlands.

Polygon 1f is described in Section 9.1.2.1.1 of the NIS and Section 5.1.1.1 of Appendix A.3.1 of the RFI Response, and is shown on Figure 15.1 of the NIS. The six relevés taken within Polygon 1f are displayed on Figures 2.4.068, 2.4.069 and 2.4.072. These relevés are numbered BEC174, 3734_R1, 3734_R2, 3734_R3, 3734_R4 and 3734_R5 and are included in Annex A.3.2 Relevé Dataset in Appendix A.3.1 of the RFI Response.

The botanists that undertook the six relevés in Polygon 1f were consulted in response to Mr. Arnold's questions on Tuesday 25 February 2020 and they have confirmed that they are certain that the habitat in this area does not conform to *8240. Their judgement was made primarily on the basis of:

- The absence of any evidence of limestone pavement structure, including an absence of any clint or gryke features
- Presence of deep soils
- The setting and context of this area which is outside of an area of outcropping limestone bedrock with none of the immediately surrounding areas having any limestone bedrock or evidence of limestone pavement structure. This is in contrast to the area where Photo 1883_R1_9 was taken, which does have evidence of limestone pavement structure, including clint and gryke features (note reference to 58cm deep gryke measured at the relevé location), shallow soils, and is within a setting and context of expanses of *8240 limestone pavement.
- Evidence of historic beech woodland (felled some time ago and now regenerating) which would not have been supported if underlain by shallow soils on limestone pavement structure

In all the circumstances, the Board is enabled to conclude with certainty that that the habitat in the area of Polygon 1f does not conform to *8240.

1.11 Impact of Shading from the Menlo Viaduct on Limestone Pavement Habitat

Mr. Arnold requested clarification on the predicted impacts of shading from the Menlo Viaduct on the Limestone pavement underneath and whether any mitigation was proposed to address shading impacts.

EIAR Section 8.5.4.2 (page 502) and Section 8.5.4.3 (pages 509 and 510) and NIS Section 9.1.4.6 (page 154 and 155) state that the Menlough Viaduct will have some level of shading and that 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.

Appendix M of the NIS presents results of a specialist lighting study to investigate the predicted shading effects of the proposed road development on vegetation, including at the Menlough Viaduct. The results show that areas directly below the Menlough Viaduct, and at less than 10m from its projected edge, will experience a visually noticeable reduction in daylight. The area where the exposure reduction is detectable extends 20m from the edge of the Menlough Viaduct during summer months and up to 120m during winter months.

As detailed in the EIAR Section 8.5.4.3 (pages 509 and 510) "*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*."

Therefore, other than the c.0.05ha of *8240 limestone pavement which will be removed for the provision of the viaduct piers, there will be no loss of *8240 limestone pavement in this area. Due to the mitigation proposed for the construction of the viaduct (i.e. the limestone pavement protection system and/or a cantilever system or a precast beam superstructure) there will be no loss of *8240 limestone pavement beneath the spans of the Menlough Viaduct and the natural clint and grike structure of the pavement area will be retained. While there will be some change in terms of vegetation community and species composition, the structural integrity of the pavement will remain intact as a result of the methodology used. As a result, neither the area nor range of the habitat will be reduced at any geographic scale.

Vegetation beneath the viaduct is likely to recolonise with flora species typical of the surrounding local Limestone pavement habitat when the temporary protection system is removed (albeit, recolonisation will be constrained by shading effects and the existing species composition is not likely to fully re-establish itself, which will

result in a change in the character and quality of Limestone pavement habitat remaining) and will still provide valuable habitat. Furthermore, the area affected is relatively small in the context of the local habitat resource (i.e. c.202ha, of which the area beneath the viaduct represents c.0.03%). Retaining (albeit with reduction in quality) rather than losing this *8240 limestone pavement habitat, reduces the magnitude of the impact the proposed road development has on this habitat type.

The measures which have been included to minimise impacts on *8240 limestone pavement include significantly reducing the footprint of the viaduct piers (by reducing both the number of piers and their size) and locating those piers so as to avoid *8240 as far as possible, resulting in the minimum possible loss of habitat.

It is confirmed that the area which will be subject to shading, but not lost, as a result of the proposed road development, has not been included in the figure of 0.94ha of *8240 to be lost because that area which will be subject to shading will not be lost. However, the 500m^2 area which will be lost for the viaduct piers has been included in the figure of 0.94ha of *8240 which will be lost.

1.12 Interaction between Peat in MDAs and Calcareous Grassland habitat Creation

Mr. Arnold requested clarification on whether the use of peat in the MDAs in Lackagh Quarry would have any effect on the proposed Calcareous grassland habitat creation

As outlined in Section 4.5.19 of Aebhín Cawley's Biodiversity EIA Statement of Evidence, Section 4.12.4 of Juli Crowley's Statement of Evidence and Section 4.3.2 in Annex 2 of Appendix A.1.11 of the RFI Response, the mixed peat and U1 material used to construct the base of the Material Deposition Areas (MDAs) in Lackagh Quarry will be separated from the Calcareous grassland habitat layer on top by a 350mm depth, free draining material contained within a filter separator layer (e.g. geotextile), above and below to prevent the migration of fines sediment therefore ensuring the functionality of the layer. This drainage layer will prevent any interaction between the calcareous grassland substrate and the mixed peat layer and, therefore, the use of peat material will not have any effect on the creation of Calcareous grassland habitat on these MDAs.

As outlined in the Appendix A.8.26 of the EIAR (refer to Section 3.5.2.4, 3.5.2.5 and 3.5) once the MDA area has been created, including placement of the free draining material contained within a filter separator layer (e.g. geotextile), above and below to, the calcareous grassland habitat will be created on top of this layer.

As set out in Section 3.5.3 of Appendix A.8.26 of the EIAR, the methods to be used to ensure the successful creation of the habitat will include translocation of turves, translocation of suitable soils, seeding, haystrewing and natural colonization.

The habitat layer, in the case of turve translocation, would be a maximum depth of c. 250mm - 300mm in depth as dependent on conditions at donor site, and in the case of translocated soil substrates would be a maximum depth of c. 100mm-250mm. Below this will be the a 350mm depth free draining material layer contained within a filter separator layer (e.g. geotextile) above and below.

The root zone for calcareous grassland habitat typically does not extend further than 100 - 200mm and therefore the roots of colonising and established plants in the 6210 receptor sites will not extend through the calcareous grassland habitat substrate layer (max 100 - 300mm deep) and below that the 350mm free draining layer, into the mixed peat and U1 material layer within the MDA. There therefore will be complete separation between the calcareous grassland habitat and any peat.

The use of peat in MDAs and potential settlement is discussed further in Section 3 below.

1.13 Creation of Wet Heath Habitat

Mr. Arnold asked if there is potential to use peat elsewhere in the development for habitat creation, such as wet heath and referenced examples of wet heath creation for the M6 Toll Road in Birmingham and in Dorset.

There is potential to reuse peat within the proposed road development. All peat from peatland donor sites (which include wet heath, dry heath and a very small area of blanket bog) is proposed for reuse at dry heath receptor sites.

The bibliography attached in Appendix C1 confirms the sources consulted when the literature review was undertaken at the time of preparing the EIAR to inform the proposals for heath habitat creation. Although the results of the literature review confirmed that dry heath is a habitat that can and has been successfully translocated and recreated, it did not find the same evidence for wet heath habitat.

The only relevant example of wet heath translocation/creation that the literature review revealed was a published study by lead author John Box (Box *et al*, 2011). In this study an area of wet heath was translocated to an engineered receptor cell fed by combination of groundwater springs and direct precipitation. The unique circumstances of this study are different to the circumstances of the proposed road development in important ways. The receptor side was located on a clay seam and had groundwater springs which fed a supply of water to the translocated habitat. The receptor site was also engineered and actively managed to ensure the water levels were controlled to the required levels. Monitoring results indicated that the experimental translocation was successful for a period of 7 years when the hydrological regime of the receptor site was actively managed. However, when active management ceased, the receptor site became drier and species were lost.

Mr. Arnold, assistant to the Inspector for the oral hearing for the N6 Galway City Ring Road, indicated that the M6 Toll Road in Birmingham may be an appropriate case study involving heathland creation/translocation but as has been noted above in Section 1.4, none of the environmental or ecological monitoring reports relating to the project, were obtainable from the UK Department of Transport at the time of writing.

The only publicly available information on wet heath creation/translocation for that project is within a note prepared by the Bartlett School of Planning in the OMEGA Centre of the University College London which states “About 2ha of wet heathland was translocated to a carefully prepared receptor site - a double-lined lagoon, 1.5m deep, and backfilled with carefully stratified selected materials. This created a soil

profile to match the donor site. Specially designed machinery was introduced to allow giant 2.4m x 1.2m x 0.3m turves to be lifted and laid, accessing the site on temporary floating sleeper roads."

Given the complex hydrological conditions that support wet heath ecosystems, and the local context in which wet heath occurs (i.e. sunken pockets on shallow soils within granite bowls), it is not deemed feasible to successfully translocate or recreate wet heath habitat. Furthermore, ten of the heath receptor sites are located on MDA sites and at an elevated level it will not be possible to create appropriate hydrological conditions for wet heath habitat.

Any attempts to create wet heath habitat would require significant engineering interventions and long-term active management to maintain a viable area of wet heath habitat.

This viewpoint was discussed at the meeting with NPWS on 27 February 2020.

1.14 Reuse of Excavated Limestone Pavement for Wildlife Habitat Creation

Mr. Arnold asked whether there was scope to reuse excavated, weathered limestone pavement elsewhere within the proposed road development for general wildlife habitat creation.

There is indeed scope for reusing excavated blocks of limestone pavement for general wildlife and habitat creation within those lands along the east bank of the River Corrib in Menlough which are proposed for habitat retention, enhancement and creation. This will take the form of either placing slabs of pavement or mounds of excavated rock to provide refuges for fauna species such as the Irish stoat and pine marten.

The Schedule of Environmental Commitments will be updated to include the following:

> "Excavated blocks of limestone pavement will be retained for reuse for general wildlife and habitat creation within those lands along the east bank of the River Corrib in Menlough which are proposed for habitat retention, enhancement and creation."

1.15 Planning Policy in Relation to Biodiversity

Mr. Arnold raised a query in relation to the overall impact on biodiversity generally and compliance with planning policy on biodiversity, *e.g.* Policies 4.1 and 4.2 of Galway City Development Plan.

Response
Both the Galway City Development Plan 2017-2023 and Galway County Development Plan 2013-2020 include details on and protective policies / objectives for biodiversity of local, national and international importance. Specific provisions are set out in Chapter 4, and policies 4.1 and 4.2 of the City Plan and Section 9.8 and Policies NHB1 – NHB8 / Objectives NHB1-NHB14 of the County Plan.

It is acknowledged that the N6 GCRR will have an impact on biodiversity, however, it is considered that the proposed road development is consistent with and in accordance with planning policy on biodiversity as set out in both the City and County development plans. It is also noted in that that the Galway Transport Strategy (GTS), which includes the N6 GCRR, and both development plans, which incorporate the GTS were subject to Strategic Environmental Assessment and to Appropriate Assessment in accordance with the applicable European Directives and domestic legislation.

Chapter 8 of the EIAR provides a detailed survey and analysis of the existing biodiversity environment; a detailed assessment of impacts of the proposed road development on this baseline; and an extensive suite of mitigation measures for the avoidance, remediation and/or reduction of identified impacts. In particular, attention is drawn to Table 8.41 of Chapter 8 of the EIAR (pages 713-720), which presents an overall summary of the ecological receptors, their valuation and potential impacts. It sets out the proposed mitigation measures for these potential impacts, the residual impacts, and the residual impact significance. It is noted that as set out in the concluding paragraph of Chapter 8 of the EIAR (page 712), and notwithstanding the identified impacts on limestone pavement and wet heath, "*areas of related habitats will be created to provide an overall biodiversity gain for both peatland and limestone associated habitats locally."*

The assessment in Chapter 8 of the EIAR is further augmented and supported by the detailed information set out in the response to the request for further information provided to An Bord Pleanála in August 2019 and specific attention is drawn to the following statements contained therein.

> *"Table 8.27 of the EAAR sets out the areas of each of these habitats types that will be lost as a result of the proposed rad development. These areas are put in context, in terms of the local habitat resource of each, in Section 6.5.4.3 of the EIAR. The areas of each of these habitats types are relatively minor when compared against the residual habitat resource locally, which will be unaffected by the proposed road development. The relative portion of each habitat type becomes comparatively even less significant when compared against the diversity of habitats present in the wider area,[45] and the likely residual effect on biodiversity becomes negligible.*

Furthermore, none of the habitat areas directly affected by the proposed road development were noted as being unique in a local or regional scale – i.e. they do not support unique assemblages of plant species or communities."
(**Section 7.2.2, page 83 of the Response to the RFI**)

"...[A]s stated in Section 8.10 of the EIAR, there are significant residual effects on biodiversity (including to local biodiversity areas) predicted as a result of the presence of the proposed road development and the associated habitat loss.
However, as set out in this RFI Response, considering the relatively small proportion of the local habitat resource that will be permanently lost as result of the proposed road development, the relative abundance of these habitats types locally of comparable (and in many cases better) quality, the mitigation and compensation measures proposed, and the high level of landscape permeability that will be maintained, additional significant residual effects on biodiversity in general are not predicted to occur as a result of the proposed road development.
As regards the potential isolation of biodiversity to the south of the proposed development, it is concluded that, given the high level of permeability provided for wildlife across the length of the proposed road development, significant effects on biodiversity as a result of species isolation are not predicted to occur.
(**Section 7.2.2, page 84 of the Response to the RFI**)

In relation to potential impact on European Sites, it is noted that the proposed road development is subject to Appropriate Assessment and a Natura Impact Statement (NIS) accompanies the application to An Bord Pleanála. The conclusion to the NIS states:

"*It has been objectively concluded by Scott Cawley Ltd. following an examination, analysis and evaluation of the relevant information, including in particular the nature of the predicted impacts from the proposed road development and with the implementation of the mitigation measures proposed, that the proposed road development does not pose a risk of adversely affecting (either directly or indirectly) the integrity* [of] *any European site, either alone or in combination with other plans or projects, and there is no reasonable scientific doubt in relation to this conclusion*."
(**page 381 of the NIS**)

Chapter 4 of the City Plan sets out the key provisions in respect of Natural Heritage, Recreation and Amenity. Policy 4.1 Green Network and Policy 4.2 Protected Spaces: Sites of European, National and Local Ecological Importance , sets out the City Council's policy pertaining to biodiversity. The proposed road development complies with, and does not conflict with the majority of the provisions at policies 4.1 and 4.2. However potential conflict arises with two provisions in Policy 4.2 as per the extracts above from the NIS and the RFI, and as such some loss of local biodiversity has been identified.

Notwithstanding, it is noted that Section 5.3.4.5 of the County Plan states, inter alia, that the *N6GCRR project "is considered to be a critical part of the transport*

strategy for the county to deliver the necessary capacity and support the delivery of sustainable transport measures." Furthermore, Sections 3.10 and 11.2 of the City Plan state that "*priority will be given to the reservation of the N6 GCRR Preferred Route Corridor and the associated land requirements over other land use zonings and specific objectives*".

Therefore, despite the residual effects of the proposed road development on biodiversity, the N6 GCRR is in compliance with the policies and objectives of the City and County Plans as well as those of the City and County Biodiversity Plans.

2 Hydrogeology

Mr. Dodds' questions in relation to hydrogeology focused on two broad themes:

- Groundwater levels
- Hydraulic conductivity

The responses to those questions will be dealt with under these headings.

2.1 Groundwater levels

2.1.1 Why were certain boreholes selected for monitoring as opposed to others? What was the key criteria for selection?

To understand the groundwater regime, it was important to ensure a sufficient network of monitoring locations, including boreholes, was developed. A comprehensive approach towards the design of the monitoring network was developed from the start of the project. The key criteria for the selection of the locations was the need to gather the following information:

1. the maximum and minimum groundwater levels along the route
2. groundwater monitoring near to sensitive sites such as groundwater dependant habitat
3. groundwater monitoring away from the proposed road development (i.e. 'off-line') to provide regional context, particularly in the limestone aquifer

An early well survey and desk study identified that there were existing groundwater monitoring boreholes in the wider area which were installed as part of the ground investigation for the 2006 Galway City Outer Bypass (GCOB) and by the previous owners of Lackagh Quarry. These were reviewed to determine if they could be incorporated into the monitoring network for the project. As part of the monitoring location selection process, each of the existing boreholes considered underwent a condition survey to determine if it was in good working order. Some of those existing wells were not included in the updated monitoring network due to their poor condition, however, it was possible to remediate many existing wells and incorporate them into the network.

The wells remediated had their depth checked, new caps, lids, covers, and plinths installed, as well as being resurveyed for ground level and top of casing to ensure that they would be maintained in good working order for the duration of the monitoring period.

These existing boreholes provided monitoring locations close to sensitive groundwater receptors and gave good spatial coverage in the wider area (particularly in the karst limestone area) so that variations in regional connectivity (such as high permeability zones, barriers or perching) could be assessed.

Where there were insufficient existing monitoring boreholes to provide data to inform the assessment at sensitive receptors, additional groundwater boreholes were installed to provide enough data points.

These additional borehole locations all targeted the limestone area, specifically around the area of Coolagh Lakes (part of Lough Corrib cSAC) and Ballindooley Lough (area of habitat that supports wintering birds of the Lough Corrib SPA and Galway Bay SPA). These are known karst areas with surface water and groundwater interactions. These additional wells were installed with the aim of further understanding the local hydrogeology, with particular attention to shale horizons (or clay wayboards) which had been identified during walkover and desk study phases.

Following the installation of this network of monitoring wells, additional boreholes were installed along the alignment of the proposed road development as part of the project ground investigation.

During the roll out of the alignment ground investigation, a total of 28 no. selected boreholes were completed as monitoring wells to provide coverage along both the granite and limestone sections of the proposed road development. These ground investigations primarily targeted design elements, however, in certain locations, the depths and locations were adjusted to suit the groundwater monitoring network and provide wider coverage along the full extent of the proposed road development.

The full groundwater monitoring network comprises of 54 boreholes and 5 surface monitoring locations. The extensive groundwater monitoring network is summarised as follows:

- 19 pre-existing boreholes (comprising of 15 from the 2006 GCOB boreholes, 3 Lackagh Quarry monitoring boreholes and 1 existing pumping well) were selected as they were located at sensitive monitoring locations and provide regional context to the monitoring network so that hydraulic gradients can be determined. These monitoring boreholes are located away from the alignment at distances between 100m and 1.3km. The pre-existing borehole locations were condition surveyed and remediated before being incorporated into the network. Monitoring began between February and April 2015 and continued until November/December 2016. Selected monitoring wells had electronic data loggers. These 19 boreholes are presented as green stars in Appendix D - Figure 1 and highlighted as green in Appendix D – Table 1.

- 4 no. monitoring boreholes and 5 no. surface water stilling wells were added to the monitoring network to assess groundwater surface water interaction at sensitive locations in the limestone. These surface water stations were added in June 2015 and the monitoring boreholes in September 2015. All were monitored until November/December 2016, including using electronic data loggers. These 4 borehole locations are presented as red circles in Appendix D - Figure 1 and highlighted as red in Appendix D – Table 1. The 5 no. surface water stilling wells are presented as red stars on Figure 1 and are also highlighted in red in Appendix D – Table 1.

- 3 no. monitoring wells were installed at the location of Lackagh Tunnel in December 2015 and were monitored up to November 2016. These 3 boreholes are presented as yellow circles in Appendix D - Figure 1 and highlighted as yellow in Appendix D – Table 1.
- 28 no. monitoring wells were installed along the alignment of the proposed road development in February/ April 2016 and these were monitored until November/ December 2016/ January 2017. These wells provide data on seasonal changes in groundwater levels along the alignment. These wells were installed after the peak groundwater conditions of December 2015/January 2016 and as such they did not capture that event. Due to access issues at some locations, all wells could not be monitored every month. These 28 boreholes are presented as blue circles in Appendix D – Figure 1 and highlighted as blue in Appendix D – Table 1.

The monitoring wells are presented in Figure 1 of this document (originally included as NIS Plate 1). A summary of all groundwater monitoring data is tabulated in Appendix D – Table 1 of this document, which includes the number of records for each borehole and whether electronic logging was deployed.

2.1.2 Is there a map with all monitoring wells presented on it?

The map showing all monitoring wells was originally presented on Plate 1 in Appendix A to the NIS[6]. Figure 1 in Appendix D of this document is an updated version of this which breaks down the origin of the monitoring wells, as per the response to 2.1.1 above (this information is contained in Section 10.3.2 of the EIAR). Surface water monitoring points are also clearly identified.

[6] This figure was corrected in the Corrigendum presented to ABP as part of the Hydrogeology statement of evidence at Oral Hearing

2.1.3 Questions regarding hydraulic gradients

2.1.3.1 How were the regional hydraulic gradients developed (considering the linear nature of the proposed development), particularly in the limestone?

The regional hydraulic gradient was developed for the limestone area using groundwater levels recorded in monitoring boreholes both upgradient and downgradient of the proposed road development, as well as groundwater levels measured along the proposed road development and the receiving water level at the River Corrib, Terryland River and Galway Bay.

In the limestone, 7 no. boreholes are located in the wider area. These include monitoring boreholes from 2006 GCOB (RC and MW) and the 4 monitoring boreholes designed to monitor surface water groundwater interaction (RP-02 series). In addition, the 3 no. Lackagh Quarry monitoring wells (LQMW series) and 3 no. surface water monitoring locations (SW-02 series) were also used to develop the gradients. The River Corrib (including the OPW gauge for the River Corrib at Dangan) and the Terryland River were used as receiving water for groundwater and where appropriate used to triangulate groundwater flow directions and gradients. It is noted that the OPW gauge for the River Corrib at Dangan (Station 30098) is reported to Poolbeg datum rather than the modern Malin head datum. All elevations from the N6 GCRR monitoring network are reported to Malin head datum.

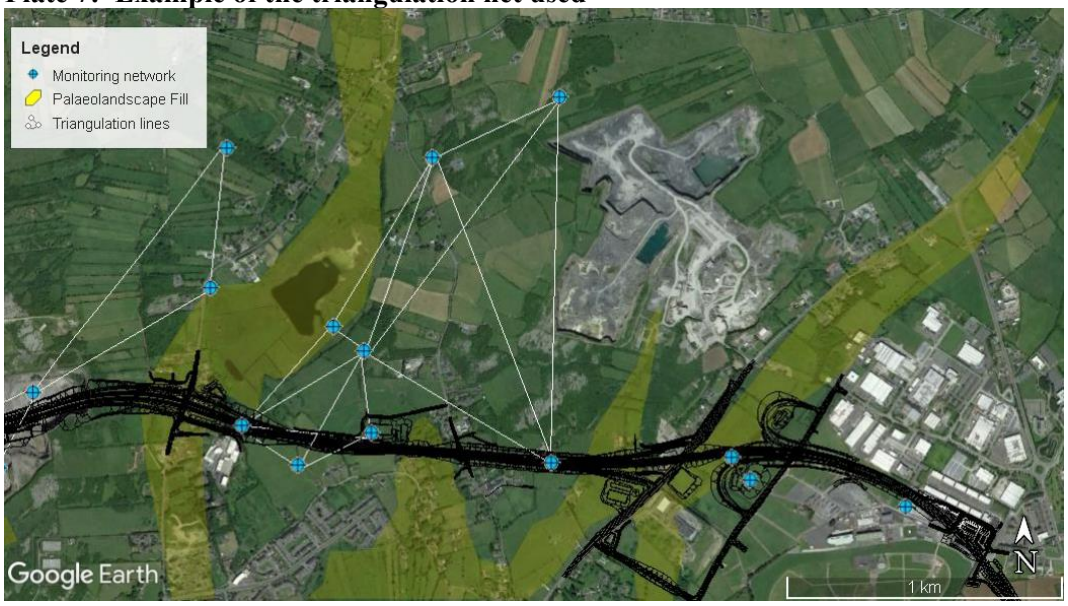
All wells are presented on Plate 1 in Appendix A to the NIS[7] and, for ease of reference, in Figure 1 in Appendix D to this document.

2.1.3.2 How were the hydraulic heads away from the centreline triangulated?

Hydraulic heads away from the centreline were used to triangulate the regional groundwater gradient and flow direction. A triangulation net was constructed across limestone groundwater bodies to provide a comprehensive assessment of gradient and flow direction. This allowed hydraulic gradients between monitoring points to be calculated and used to plot groundwater contours beyond the centreline and in the wider extent of the aquifer. The groundwater monitoring network allows groundwater flow directions to be calculated. An example of the triangulation net used is presented below in Plate 7.

[7] It was noted that this figure was corrected in the Corrigendum presented to ABP during the Oral Hearing

Plate 7: Example of the triangulation net used



Based upon the gradient calculations and generation of groundwater contours (Refer to Appendix D - Figure 2 and Figure 3) the predominant groundwater flow direction is towards the surface water features (the River Corrib and Terryland River).

In addition to using on-line and off-line monitoring borehole levels for triangulation, water levels in the River Corrib were also used, these were based upon the OPW stage level recorded at Dangan.

Those off-line boreholes north of the proposed road development showed that they were hydraulically upgradient. Those off-line boreholes south of the proposed road development showed that they were hydraulically downgradient.

In addition, as the groundwater flow is towards surface water features (the River Corrib, Terryland River and Galway Bay) – these can be considered the discharge points for groundwater. By using the river levels in combination with the boreholes along the proposed road development and off-line boreholes, heads can be triangulated as a three-point problem for the wider area. This allows the groundwater gradient to be calculated.

2.1.3.3 What is the groundwater gradient based on?

Groundwater gradient is based on the on-line and off-line borehole groundwater levels as well as the receiving waters at the River Corrib (including the OPW gauging station at Dangan) and the Terryland River. This data is used to determine the groundwater gradient along the alignment of the proposed road development.

In the Ballindooley area of the limestone aquifer, the off-line groundwater monitoring locations are located north, (and hydraulically upgradient, of the proposed road development. Whilst in the Coolagh Lakes area, the off-line monitoring wells are located north and south of the proposed road development and provide both up-gradient and down-gradient monitoring points.

The above refers to the hydraulic gradient of the regional groundwater table. However, there is also local perching of the groundwater table at specific stratigraphic horizons. One horizon in particular, an argillaceous limestone observed in Lackagh Quarry, perches recharge in the Menlough/Lackagh Quarry area. The geometry of the 'shale' bed dips at 2 degrees with a strike of 288 degrees. The location of boreholes in Lackagh Quarry is presented in Appendix D – Figures 2 & 3. The seasonal variation of groundwater levels in Lackagh Quarry are presented in Appendix E Hydrograph (i), which is derived from Plate 10.5 in Chapter 10 of the EIAR and Appendix A.10.3 of the EIAR.

This geological geometry forms a control on the perched water level that is intersected by 4 no. boreholes: BH05, LQMW05, LQMW06 and RP-5-S. The location of these boreholes is presented in Appendix D – Figures 2 & 3. The hydrographs for these boreholes are presented in Appendix E Hydrograph (ii), which is derived using data from Plate 10.5 in Chapter 10 of the EIAR and Appendix A.10.3 of the EIAR.

The ground investigations along the 2006 GCOB route and proposed road development identify four locations where the geology is interrupted by deep buried valleys (River Corrib, Coolagh Lakes/Lackagh Quarry, N84 Headford Road and N83 Tuam Road). These buried valleys locally interrupt the regional groundwater gradient and either impound and/or deviate the regional trend.

2.1.4 Was there a thought process around the depth of the boreholes and where they sat stratigraphically?

The methodology developed in respect of the target depth and stratigraphy of the boreholes installed as part of the project was based on the initial site walkover and desk study. In the limestone area, those locations identified for groundwater monitoring had target depths designed to exceed the minimum regional groundwater table and also encounter the presence of shale horizons and possible multi perched water tables. This was particularly the case in Lackagh Quarry where the exposed rock faces showed the presence of a shale bed that had the potential to influence groundwater flows to Coolagh Lakes.

Drilling borehole RP-02-01 at Ballindooley Lough was located to determine if a shale bed also had control of groundwater east of Lackagh Quarry, however, at that location, no shale horizons were encountered. Shale was encountered at borehole RP-02-05D and a second well, RP-02-05S, was installed to determine recharge correlations above and below the shale horizon, hydrographs of which are presented in Appendix E - Hydrograph ii.

2.1.5 Groundwater monitoring in Lackagh Quarry

2.1.5.1 Regarding the geology in LQMW 1-6

The Lackagh Quarry monitoring wells (LQMW 1-6) were originally installed when the quarry was operational, and no geological logs are available.

LQMW01, 02, 03 and 04 are in the quarry void. LQMW05 and LQMW06 are to the south-west, in the quarry yard area and quarry access road respectively. These locations are shown on Figure 2 and Figure 3 of Appendix D.

The geology of these wells was determined based the condition survey (which determined their depth), the geological mapping of the quarry and from boreholes drilled for the project.

From mapping the geology at the wells, LQMW01, 02, 03 and 04 are in the limestone aquifer below the shale horizon. As outlined above, the argillaceous limestone (also referred to as shale bed) observed in Lackagh Quarry, perches recharge in the Menlough/Lackagh Quarry area. The geometry of this 'shale' bed dips at 2 degrees with a strike of 288 degrees. LQMW05 is installed through the shale horizon into the lower aquifer and as such picks up both deeper and shallower groundwater. LQMW06 (by extrapolation of the geology geometry) is also installed through the shale horizon but on the opposite side of a buried valley to LQMW05.

The geological logging of the five boreholes installed as part of the proposed road development along the alignment of Lackagh Tunnel was used to cross check this. These are shown in Plate 8 (also refer below to Figure 5 in Appendix A of the Lackagh Tunnel Geotechnical and Hydrogeological Appraisal in Appendix A.7.3 of the EIAR and Appendix F of the NIS for completeness).

2.1.5.2 Regarding the location and geology of BH04 and BH05

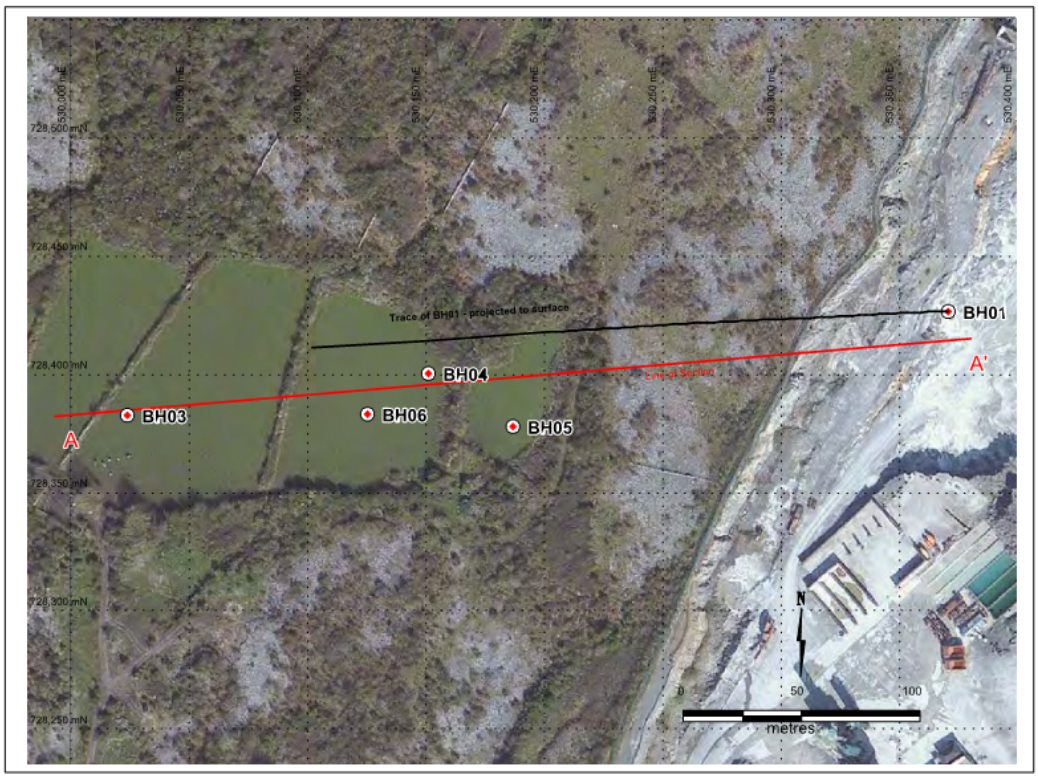
BH04 and BH05 are located to the west of the quarry as shown in Plate 8 below, outside of the quarry floor and on the same side of the palaeochannel. They are located in the limestone aquifer and both encountered the shale horizon.

In borehole BH04, the shale was reported as mudstone with clay above and below it in a unit from 13.77mOD to 12.62mOD. In borehole BH05, a zone of core loss and clay occurred at 13.94mOD to 13.69mOD.

Both BH04 and BH05 had piezometers installed below the shale horizon. However, based on the geology encountered, whilst borehole BH04 has a significant thickness of shale that would perch recharge, the shale horizon in borehole BH05 was weathered and would not perch recharge (i.e. recharge could leak faster through it).

As such, borehole BH05 represents a breach in the shale horizon where recharge may drain to the regional groundwater table and interpretation of the BH05 hydrograph needs to be mindful of this.

Plate 8: Locations of boreholes BH03, BH04, BH05 and BH06 (Source: Lackagh Tunnel Geotechnical and Hydrogeological appraisal Appendix A Figure 5)



2.1.5.3 Regarding peak groundwater levels reported in Lackagh Quarry

Peak flood levels were surveyed on the floor of Lackagh Quarry on 5 January 2016 at 15.69mOD. This peak flooding level represents the peak groundwater level.

In reference to the 2015/ 2016 peak event, a cumulative rainfall chart (updated to include data for February 2020) is provided in Appendix E. This confirms that 2015/ 2016 has greater cumulative rainfall than 2020 to date.

The following levels were measured :

- LQMW04 was manually measured on 11 January 2016 as 15.41mOD
- BH04 was manually measured on 5 January 2016 at 14.29mOD and on 11 January 2016 at 15.74mOD. The delayed peak response in BH04 represents equalisation in the unsaturated zone in the days after heavy rain.
- BH05 was manually measured on 5 January 2016 at 19.46mOD and on 11 January 2016 at 16.66mOD. The equalisation from the recharge peak in BH05 would have caused the subsequent delayed peak response in nearby BH04.

As stated in Section 2.1.5.1 above, whilst the shale horizon forms a natural barrier in BH04, that barrier is weathered in BH05. As such, the higher groundwater levels in BH05 are a reflection of recharge from above the shale horizon entering the well. The high groundwater levels in BH05 are a recharge response and not representative

of the regional groundwater table. Following rainfall, recharge will flow via multiple pathways through the thick unsaturated zone down to the regional water table. Where natural weathered gaps in the shale horizon occur then these will focus the recharge to the regional groundwater table.

2.1.6 Does the monitoring data recorded capture the peaks and allow interpretation of the karst system? (considering its dynamic nature)

The monitoring data does indeed capture the peaks and allow for the interpretation of the karst system (considering its dynamic nature) for the following reasons:

- The monitoring network was designed to ensure that electronic loggers would be used in boreholes that had flashy responses to recharge whilst those boreholes with a more gradual response were relied on manual monthly measurements only
- The first stage was to identify those wells with flashy recharge responses. Flashy wells are those whose water levels change rapidly, typically in response to events like rainfall. The purpose of this was to see how they responded to individual recharge events
- A data logger was installed longterm on MW01, LQMW06, RP-2-01 and RP-2-5S because the data showed that those particular wells were quite flashy (i.e. the levels rose and fell quickly during and after rainfall events)
- A logger was initially installed in LQMW04, RC133, MW02 and MW03. However, the data showed that the water level changes at these wells were more gradual (i.e. not flashy). For this reason, these wells were deemed suitable for monthly monitoring and the logger was removed and installed elsewhere. This bespoke monitoring regime was specifically undertaken because of the karst hydrogeology of the aquifer in this location.

Appendix E – Hydrograph (i), (ii) and (iii) clearly show the wells that have a flashy nature and those that have a more gradual response.

All electronic loggers were installed in the limestone area, with the exception of RC451A, which was installed at Moycullen Bogs NHA (Tonabrocky) to determine the groundwater relationship at sensitive peatland habitat.

By undertaking this early characterisation of the wells, using data loggers to confirm whether they had a flashy or gradual response, the most appropriate wells could be chosen for the installation of data loggers. This allowed a robust interpretation of the groundwater regime of the karst system. Therefore, it is the case that the monitoring data captures the peaks and allows the interpretation of the karst system (considering its dynamic nature).

2.2 Permeability

2.2.1 How are the water quality impact areas identified?

The methodology used to determine the water quality zones differed between granite and limestone.

For the karst limestone, the full extent of the groundwater body downgradient of the proposed road development was used for the construction scenario as a conservative screening assessment. This is because there is a potential risk of encountering karst pathways between the proposed road development and receiving waters during construction. This methodology is based on Geological Survey of Ireland groundwater protection schemes (GSI, 1999) which includes guidance for karst limestones. Based on this conservative assessment, the construction water quality impact areas extend along the full extent of the groundwater body downgradient of the proposed road development.

The proposed road development has been conservatively designed such that there is a fully sealed drainage system along all limestone sections of the development. Thus, the water quality of the limestone aquifer is not at risk during operation. Therefore, the operational water quality impact areas only extend as far as the area of the infiltration basins.

For granite, the 100-day travel time was determined using a Darcy flow-based calculation using a permeability of $4.6x10^{-6}$m/s, effective porosity of 1% and the local gradient (for construction and operation). The 100-day travel time is a standard way of determining source protection zones for abstraction wells and is used in this instance to determine the velocity of groundwater flow from the site.

$$v = K.i/n_e$$

It should be noted that the water quality zone queried by Mr. Dodds in the water quality impact area shown on Figure 10.8.107 of the EIAR incorrectly shows the construction phase water quality area instead of the operational phase water quality area. The appropriate correction has been made to Figure 10.8.107 and the corrected figure is included in Appendix F. As already stated above, the drainage system is fully sealed on the limestone areas and therefore the operational water quality impact areas only extend as far as the area of the infiltration basins.

2.2.2 Are the permeability values used in the drawdown calculation for limestone reasonable considering that it is a karst aquifer?

Permeability in karst limestone is highly variable with ranges extending from more than 100m per day down to $1x10^{-9}$m/s. In order to accommodate the possible permeability variation, two assessments were undertaken for all limestone cuttings. The first type of assessment was undertaken in the scenario where karst was encountered and the second type of assessment in the scenario where karst was not encountered. The Sichardt calculation was only used for the second assessment, i.e. limestone aquifers without karst.

The Sichardt calculation is presented in Chapter 10 of Appendix A.10.6, of the EIAR and for clarity also presented below:

$R_o = 3000\ h\sqrt{K}$ (Sichart equation)

Where,

R_o = Radius of influence (m)

h = Drawdown (m)

k = Hydraulic conductivity (m/sec)

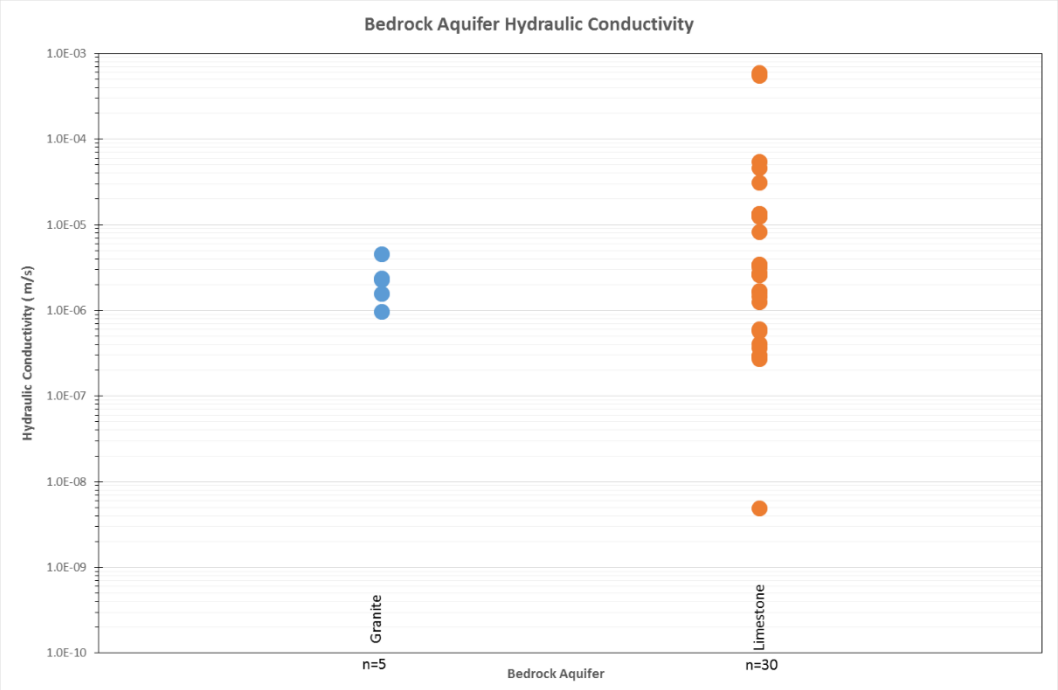
Karst assessment

In the scenario where karst was encountered, the potential for head drawdown is very high due to potentially very high connectivity and groundwater could be lowered within the upgradient karst network. To conservatively address the risk for each cutting in limestone, an assessment was made based upon a conduit network with a gradient of 2m/km and the direction of groundwater flow. Based on these factors, it is possible to determine the drawdown in a karst scenario for the full saturated limestone area upgradient and downgradient of the cutting. Thus, the permeability values used in the drawdown calculation for limestone in a karst aquifer are robust.

Non karst assessment (Sichardt calculation)

The second (non-karst) scenario was assessed on a conservative basis by applying the Sichardt formula and using a conservative non-karst high permeability value of 1.5x10-4 m/s. This permeability value was chosen based on field testing and the number of tests in the limestone and the range of permeabilities demonstrated is presented below to illustrate that the value chosen is high. Plate 9 below is taken from Plate 10.1 in Chapter 10 of EIAR (Page 847), the supporting narrative on aquifer properties is provided in Section 10.3.3 in Chapter 10 of EIAR (Page 845-847).

Plate 9: Bedrock Aquifer Hydraulic Conductivity



In the case of the Castlegar cutting (EW27), which was queried by Mr. Dodds, due to existing lowering of groundwater levels from a nearby quarry at Twomile Ditch, the potential extent of drawdown in the karst and non-karst scenario is similar. A cross section has been prepared for the Castlegar cutting (EW27) which is included as Appendix G – Castlegar Cross Section A-A).

As part of design stage, a hydrogeological assessment was undertaken to identify where cuttings had the potential to cause water level impacts to groundwater receptors and in particular, karst. The assessment was based on the karst survey and water level data from the monitoring network. Based on this data and assessment thereof, a minimum elevation was set for those sections of the proposed road development (and associated drainage) to ensure that cuttings would not lead to drawdown that could have potential impacts to receptors.

Reference was also made to a cutting in limestone west of the River Corrib. It is confirmed that there are no cuttings in limestone west of the River Corrib. The area of drawdown shown on Figure 10.7.106 and 10.7.107 and Figure 10.8.106 and 10.8.107 of the EIAR is an error as there is no cutting at that location. Figures 10.7.106, 10.7.107, 10.8.106 and 10.8.107 of the EIAR have been corrected and included in Appendix F.

2.2.3 Can a reference be provided for the 100-day travel time calculation used on the granite?

The 100-day time of travel calculation used for granite is a Darcy flow calculation that uses permeability and the local gradient to determine how far water would move in 100 days. The calculation is based on Darcy flow and is a standardised methodology for estimating velocity in groundwater.

$$v = K.i/n_e$$

These calculations are used to determine the extent that contaminants may migrate in the case of an accidental spill. This calculation is appropriate for granite and non-karst limestone but not for karst limestone. For calculations in karst limestone, the full groundwater body downgradient of the proposed road development and the receiving surface water is identified as being at risk (as is shown in Figure 10.7 of the EIAR).

Mitigation measures are proposed for the construction phase to reduce the likelihood of contamination occurring and these are comprehensively detailed in the CEMP in Appendix A.7.5 of the EIAR and Appendix C of the NIS. Of particular importance is managing routine operations so that routine operations, such as refuelling and vehicle maintenance, only occurs in designated protected areas. The CEMP includes extensive measure for the control of suspended solids in runoff, with particular measures in limestone areas when karst may be encountered.

The proposed road development has been conservatively designed such that there is a fully sealed drainage system with treatment by separator, wetland, emergency storage and settlement/infiltration along all limestone sections of the road. Thus, the limestone aquifer is not at risk during operation.

Again, it should be noted that the water quality zone in Figures 10.8.107 - 10.8.109 of the EIAR have been corrected to remove the construction impacts from the operation drawings and are included in Appendix F. In the limestone area, the proposed road development drainage system is fully lined and there are no operation water quality risks areas other than the area of the infiltration basins.

2.2.4 Detail of Karst Survey undertaken

A surface karst survey was undertaken as part of the project with support from the Geological Survey of Ireland. The survey is presented in Appendix 10.2 of the EIAR.

The karst survey included analysis of Lidar data to identify all surface karst landforms (enclosed or open depressions) in the project area. All features were then ground truthed, described and characterised. This assessment was used to identify potential point inputs and indications of underground pathways. The results of the karst survey assisted in designing the ground investigation and in particular the design and location of monitoring boreholes and geophysics.

3 Soils and Geology

3.1 Peat in Material Deposition Areas with Calcareous Grassland

Dr Arnold raised a query in relation to settlement control of peat and long-term performance of the free draining material in Material Deposition Areas underneath Calcareous grassland.

The following is a description of the overview of the construction process, which is outlined in Section 4.1 of Annex 2 of Appendix A.1.11 of the RFI Response with respect to Material Deposition Areas containing peat:

1. Excavation of Peat
2. Temporary Stockpiling and Assessment at Source; determine material properties and propose mix for transportation and end-use
3. Material Mixing; co-mingling with drier material
4. Material Transportation to Deposition Location
5. Material Mixing; further mixing at deposition location is permitted in order to meet long term performance requirements
6. Placement of material in Deposition Location

3.1.1 Peat Sources

Peat will be obtained from areas of cuts and under the footprint of the proposed road development. The identification of areas containing peat were primarily obtained through assessment of intrusive investigation and consultation of the EPA Subsoil mapping. According to the Teagasc subsoil mapping for the county, less than 1% of the peatland areas in County Galway fall within the study area. Areas containing peat are displayed in Figure 9.7.001 to Figure 9.7.002 and Figure 9.7.101 to Figure 9.7.114 of the EIAR and the conceptual site model as presented in Figure 9.8.001 to Figure 9.8.012 of the EIAR.

Peat is found to be widespread on the west of the River Corrib but reduces toward the river (Extract from EIAR Section 9.3.2.1 page 743) and some isolated areas of peat also exist on the eastern side of the River Corrib.

From the intrusive investigation undertaken, the top of the peat strata was encountered at ground level and depths up to 0.8m below ground level (EIAR Table 9.8 in Chapter 9). Typically, the depths observed for the peat were less than 1.0m, however, a number of locations were identified where the peat extended up to thicknesses of 2.0m (EIAR Section 9.3.7 of Chapter 9, page 754). The areas of cut and fill associated with the proposed road development are presented in Table 9.16 of Chapter 9 of the EIAR (page 764 to 769) and Appendix A.5.2 of the Design Report in Appendix A.10.1 of the RFI Response, which identify the areas where peat will be generated.

The peat encountered along the proposed road development during the ground investigation ranged in natural moisture content from 90 to 970% (averaging <400%). Peat typically can have moisture content in excess of 1000%.

3.1.2 Peat retrieval and placement activity

3.1.2.1 Excavation

A Sediment, Erosion and Pollution Control Plan (SEPCP) which summarises the procedures and technical practices for implementing effective sediment, erosion and pollution control through a variety of delivery methods for the construction phase of the proposed road development is presented in Section 8 of the CEMP in Appendix A.7.5 of the EIAR and Appendix C of the NIS.

Peat will be stripped and excavated in a controlled manner from its source location, excluding the material required from the seventy two dry heath donor sites as discussed in Section 1.4 above. Excess water will be allowed to dissipate reducing the moisture content in the peat.

The agitation process will significantly reduce the water content and void ratio in addition to disturbing the peat structure. This will improve the peat workability and reduce settlement.

While at source, the peat will be mixed with other material, typically classified as U1 unacceptable. This will further improve the workability of the material. The classification of U1 material is in accordance with TII Series 600 Earthworks Specification Clause 601.2 (https://www.tiipublications.ie/library/CC-SPW-00600-03.pdf). In general, U1 material will consist of natural cohesive till material which is wet of optimum, or in some cases, only marginally wet of optimum. As such, U1 will have a significantly lower water content than the peat.

The mixing of the materials together will significantly change the virgin peat properties by:

- Breaking down the virgin structure of the peat
- Significant reduction in the water content of the peat
- Reduction in the void ratio of the material in comparison with typical values within the peat. This will significantly decrease settlement in comparison with virgin peat. The mixed peat will permit a controlled approach to achieving the settlement performance criteria

The mixed peat will then be loaded into vehicles for transportation to the material deposition area.

3.1.2.2 Placement

At the point of deposition, further mixing is permitted in order to meet long term performance requirements. The mixed material will be spread in layers up to full thickness. The thickness of the individual layers will be determined based on the workability of the material. Each layer will be spread with appropriate plant (e.g. dozer), resulting in some compaction of the material.

3.1.3 Material Deposition Area Geometry

Peat is proposed to be deposited in 19 material deposition areas (out of a total of 32).

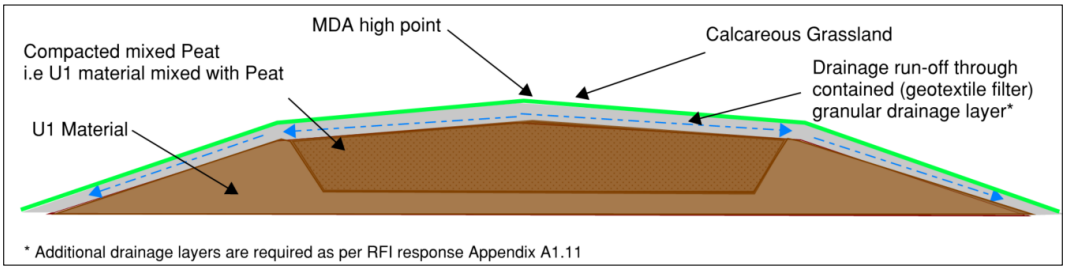
The mixed peat layer will be placed in the upper area of material deposition areas (see Section 4.1.1.2 of Annex 2 of Appendix A.1.11 of the RFI Response), with the final surface shaped to drain towards and shed surface water runoff to the perimeter swale and shallow surface drains which will be installed to accommodate surface drainage, as per the requirements in Section 8.3.3.2 of the CEMP in Appendix A.7.5 of the EIAR and Appendix C of the NIS.

Where a drainage layer is necessary to maintain surface drainage in accordance with the Habitat Compensation Management Plan (in Appendix A.8.26 of the EIAR), in particular for the creation and maintenance of Calcareous grassland (6210) this layer will be placed on top of the final shaped mixed peat surface as shown in Plate 10A below.

The free drainage material will be contained within a filter separator layer (e.g. geotextile), above and below to prevent the migration of fines sediment therefore ensuring the functionality of the layer. This drainage layer of 350mm depth will also provide a separation between the calcareous grassland and the mixed peat zone.

The combination of the drainage layer and the sloped mixed peaty surface will facilitate free surface drainage, as demonstrated in Plate 10B.

Plate 10A: Typical Cross Section of Material Deposition Areas with Calcareous Grasslands



3.1.4 Peat Performance

Settlement is considered over three stages for all material, namely immediate, primary (consolidation) and secondary (creep).

The reduction in water content and organic content due to the soil mixing will significantly reduce the compressibility characteristics of material in comparison to

virgin peat and as such will reduce the magnitude of primary and secondary consolidation (settlement).

Given the relatively small increase in effective stress exhibited by the free draining material and calcareous grassland, and the small variable load exhibited by the maintenance of the grassland (e.g. ride-on mower), the magnitude of primary consolidation is considered insignificant in terms of the working requirement of the free draining material.

As peat is an organic material, secondary consolidation (i.e. creep) must be considered. However, given the alteration of the material characteristics due to the preceding steps (mixing at source with U1 material), the magnitude of creep settlement is significantly less than for virgin peat.

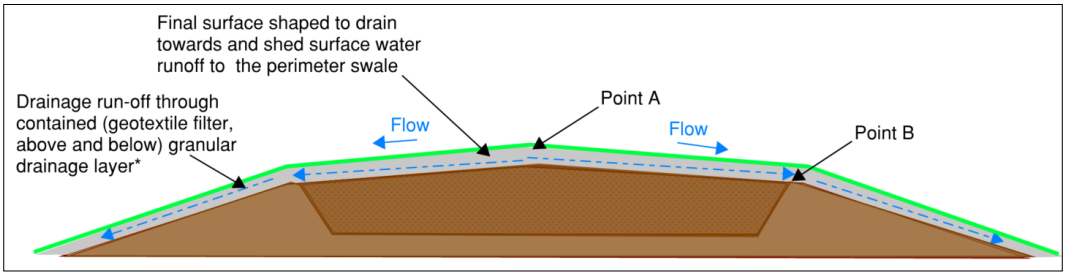
Given the mixed nature of the material there is potential for differential settlement. However, as settlement is considered minimal, differential settlement will not impact the final performance of the surface drainage.

3.1.5 Commitments

In addition to the commitments outlined in Section 1.4 of this document and Appendix A.1.11 of the RFI Response, the Schedule of Environmental Commitments will be updated to include the following:

- **Settlement:** The composition of the mixed peat will ensure that the magnitude of immediate, primary and secondary consolidation will not exceed 250mm.
- **Drainage:** A drainage layer with a minimum depth of 350mm depth will be provided to ensure free drainage of surface water from Calcareous grassland.

Plate 10B: Plate 10A as above, Together With Free Drainage Detail



With the implementation of the additional commitments set out above, effective free drainage of surface water from Calcareous grassland shall occur. This will be facilitated by Point A draining to Point B and away from the deposition area.

3.1.6 Conclusion

The depth and thickness of peat encountered across the proposed road development is shallow. This makes the peat easy to excavate, manage and handle. The moisture content of the peat within the proposed road development is on average less than 400%, again making the material easier to manage.

Peat will be stripped and excavated in a controlled manner from its source location and excess water will be allowed to dissipate from the peat. This agitation process will significantly reduce the water content and void ratio and will improve the peat workability and reduce settlement. Peat will then be mixed with other material, typically classified as U1 unacceptable, which will further improve the workability of the material.

Given the mixed nature of the material, the steps from excavation to placement in the MDA and the commitments set out in Section 3.1.5, total settlement and differential settlement is considered minimal, resulting in a negligible impact of the prescribed end performance of the overlying free draining material.

4 Engineering

4.1 Why was the eastern section of the N6 Galway City Outer Bypass (2006) not selected as the preferred route?

A suggestion which has repeatedly been made during the hearing is that the previous route option, known as the 2006 Galway City Outer Bypass (GCOB), should have been the preferred option even though the western section did not receive planning approval under the earlier application due to potential environmental impacts in the area of Moycullen Bog Complex NHA and the eastern section was ultimately found to adversely affect the integrity of the Lough Corrib cSAC.

At the commencement of the assessment work on the N6 Galway City Ring Road, in line with the 2016 Common Appraisal Framework, it was necessary to undertake an appraisal on whether investing public money in solving the transportation problem in Galway represented value. At this point, it was necessary to clearly define the problem to be solved and clearly identify the objectives that need to be achieved. This required the design team to start with a blank canvas – which it did – with the benefit of more informed population data sets and modelling tools than were available at the time of the 2006 GCOB.

The traffic analysis which was undertaken to inform the 2006 GCOB utilised manual origin and destination surveys using roadside surveys undertaken by An Gardaí Siochana of every tenth vehicle. By comparison, the design team on the N6 GCRR had the 2011 Census data available which gave detail on place of work and place of education (POWSCAR) for every single home in the study area. In addition, the transport model which was available to test scenarios in 2014 is the West Regional Model, which is a strategic transport multi-modal model for the counties Galway, Mayo, Roscommon, Sligo, Leitrim and Donegal, with a focus on the city of Galway, and is capable of modelling walking, cycling and public transport in addition to private vehicle trips.

This level of data together with the more sophisticated modelling techniques identified that the congestion problems experienced in Galway were not primarily attributed to by-passable traffic. This raised the further question as to whether a bypass would solve the problem. Therefore, in line with the requirements of CAF, project objectives together with specific performance targets were defined in conjunction with Galway City Council and Galway County Council so that it was very clear going forward what the scope was. It should be noted that these objectives included the preservation of existing well-established communities as well as seeking to minimise impacts on the ecological designated sites. These were presented in the Phase 1 Project Brief, which was then submitted to Transport Infrastructure Ireland, to seek approval to proceed to the next stage, i.e. the stage which involves the identification of potential options to resolve the problem. At all stages during the project, potential options were assessed against these agreed project objectives to establish whether they would progress further.

During the optioneering phase, various options were tested, including the N6 GCOB. However, the 2006 GCOB did not progress to the final options for the following reasons:

- It does not provide connectivity with the city to the degree required to alleviate congestion sufficiently.
- It does not have any connection with the N83 Tuam Road, a national road, thereby providing a lesser level of connectivity with the national network.
- It has longer journey times and less relevant journey possibilities between east and west.
- It did not provide any connection to the key employment centres at Parkmore and Ballybrit and, therefore, offered minimal relief to the existing congestion in these eastern city areas.
- It would not facilitate the delivery of the optimum intermodal transport solution.
- It has an adverse impact on the site integrity of the Lough Corrib cSAC per the European Court decision in *Sweetman v An Bord Pleanala.*
- It has potential to impact on Lough Inch River which is known to contain Freshwater pearl mussels downstream.
- It has a significant impact on the Moycullen Bog Complex NHA from a hydrogeological and hydrological perspective both at Tonabrocky and in the vicinity of Lough Inch.
- It has a profound impact on the curtilage of Menlo Castle from a cultural heritage perspective and on the amenity value from Human Beings perspective.
- Because it was the longest route and would result in longer journeys with the highest carbon emissions during the operational phase, it was the least sustainable of the options studied.

While it was recognised that the 2006 GCOB option would have less impacts on homeowners, communities and amenities with a lower number of demolitions and an overall improvement in the level of severance experienced, it did not meet the project objectives and had a number of significant shortcomings as set out above. Accordingly, it was not advanced further.

A further query which has been raised during the hearing is whether a tunnel was considered to avoid the Limestone pavement habitat at the surface level within Lough Corrib cSAC along the line of the N6 GCOB between the N84 Headford Road and the River Corrib. Consideration was given to this option, but it was immediately apparent that it was not viable.

The tunnel length would be in excess of 2km in length, with significant cuttings of the order of 50m diameter to construct the launch pit at either side. There are significant issues to consider with a tunnel of this length under the headings of sustainability and economy both in the construction and operational phase. In particular, in connection with longer tunnels, fire safety and ventilation

requirements increase operational cost and resource consumption significantly. Therefore, a tunnel on the 2006 GCOB alignment under the extent of the Limestone pavement within the Lough Corrib cSAC was not advanced because of the following reasons:

- Tunnel length exceeding 2km in length and large construction footprint at either portal with significantly increased construction period
- Significant tunnel length in a karst area with uncertain hydrogeological conditions which in turn could have an impact on Lough Corrib cSAC
- A tunnel of this length is not a sustainable solution and would result in very significant additional carbon emissions both during construction and during operation
- Very significant operational costs due to fire safety and ventilation requirements of a tunnel of this length
- Resilience would require duplication of tunnel maintenance building

In contrast, Lackagh Quarry offered the opportunity of using the existing quarry face to launch the tunnel construction resulting in a much shorter tunnel length of only 230m. Indeed, this tunnel is so short that it is not classified as a tunnel under EU Standards and therefore, has much lower fire safety and ventilation requirements. A tunnel of this length is a much more sustainable option.

The N6 GCRR route, in contrast to the 2006 GCOB route, afforded the opportunity for a short tunnel. The N6 GCRR route was then capable of being developed into a solution which proved to most effectively meet the project objectives.